R E P O R T R E S U M E S

ED 013 339 VT 004 438

MICROFICHE COLLECTION OF DOCUMENTS REPORTED IN ABSTRACTS OF INSTRUCTIONAL MATERIALS IN VOCATIONAL AND TECHNICAL EDUCATION, FALL 1967.

OHIO STATE UNIV., COLUMBUS, CENTER FOR VOC. EDUC.

PUB DATE 67

EDRS PRICE MF-$22.25 HC NOT AVAILABLE FROM EDRS 5,517P.

DESCRIPTORS- *INSTRUCTIONAL MATERIALS, *VOCATIONAL EDUCATION, *TECHNICAL EDUCATION, BUSINESS EDUCATION, AGRICULTURAL EDUCATION, DISTRIBUTIVE EDUCATION, HEALTH OCCUPATIONS EDUCATION, HOME ECONOMICS EDUCATION, INDUSTRIAL ARTS, TRADE AND INDUSTRIAL EDUCATION, INDEXES (LOCATERS), CLEARINGHOUSES,

DOCUMENTS ANNOUNCED IN THE FALL 1967 ISSUE (VT 003 884) OF "ABSTRACTS OF INSTRUCTIONAL MATERIALS IN VOCATIONAL AND TECHNICAL EDUCATION" (AIM), WITH MINOR EXCEPTIONS, ARE INCLUDED IN THIS MICROFICHE SET. THE MICROFICHE SET IS ARRANGED IN THE FOLLOWING SEQUENCE -- (1) A VOCATIONAL TECHNICAL (VT) NUMBER INDEX TO DOCUMENTS IN THE MICROFICHE COLLECTION, (2) A VT LIST OF DOCUMENTS WHICH WERE LISTED IN AIM BUT ARE NOT IN THE MICROFICHE COLLECTION, (3) THE AUTHOR AND SUBJECT INDEX FROM AIM, AND (4) THE FULL TEXT OF DOCUMENTS LISTED IN THE VT NUMBER INDEX. THE TEXTS ARE FILMED CONTINUOUSLY IN VT NUMBER SEQUENCE. (BS)

ED013339

Microfiche Collection of Documents

Reported in Abstracts of Instructional Materials in Vocational and Technical Education

(AIM)

Compiled and Indexed by The ERIC Clearinghouse
on Vocational and Technical Education

Fall 1967

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ERIC Clearinghouse
The Center for Vocational and Technical Education
The Ohio State University
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VT004438

INTRODUCTION

This collection of microfiche includes the documents announced in the Fall, 1967 issue of Abstracts of Instructional Materials in Vocational and Technical Education (AIM) with minor exceptions. The microfiche set is arranged in the following sequence:

1. Vocational Technical (VT) Number Index to Microfiche Collection of Documents Reported in AIM, Fall 1967.

2. VT Number List of Documents not in Microfiche Collection. Copies of these documents may be obtained from the source indicated in the citation on page 6.

3. Source List of addresses for documents cited on pages 2-5.

4. Selected indexes from AIM, Fall 1967.

   a. Author Index

   b. Subject Index

   The page numbers shown in these indexes refer to the location of the abstracts in AIM, Fall 1967.

5. The full text of documents listed in the VT Number Index on page 1.
   The documents are arranged in numerical order according to VT numbers. The texts of materials in this microfiche set have been filmed continuously in VT number sequence thereby facilitating the purchase of the texts of all documents on microfiche with one order and lowering the cost of the entire set as contrasted to the purchase of microfiche of individual titles.

The documents identified in this collection of microfiche with an ERIC Document (ED) number are also available as separate documents from ERIC Document Reproduction Service (EDRS) by using the ED number. Items with the ED symbol but without the six numerical digits will be available as separate documents from EDRS when they have been fully processed into the ERIC system. Research in Education will announce those documents as they become available from EDRS.

The documents identified in this collection of microfiche without an ED number are titles in the local clearinghouse collection. Microfiche for these items is obtainable only through purchase of this set or from agencies who have this set, and who have the capability of reproducing microfiche.

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[1]Also available from EDRS as individual documents.

VT Number List of Documents[1] Not in

Microfiche Collection

Address Code[2]

C VT 000 145
Mathematics of Distribution. Texas University, Austin. Department of Distributive Education. July, 1965. Price: $5.00.

C VT 000 157
Basic Selling. Robert R. Luter. Texas University, Austin. Department of Distributive Education. June, 1965. Price: $2.50.

C VT 000 164
Merchandising. Texas University, Austin. Department of Distributive Education. March, 1965. Price: $4.00.

C VT 000 168
Marketing in Our Economy. Robert R. Luter. Texas University, Austin. Department of Distributive Education. September, 1964. Price: $3.50.

C VT 000 211
Home Furnishings Sales Training Kit. Texas University, Austin. Department of Distributive Education. September, 1960. Price: $19.95 (complete kit of 19 parts).

C VT 000 216
Auto Parts Counterman. Texas University, Austin. Instructional Materials Laboratory. June, 1965. Price: $12.50 (complete kit of 5 parts).

B VT 000 220
Supervised Study Guide in Auto Upholstery and Trim. Ernest F. West. Texas University, Austin. Department of Industrial Education. Texas Education Agency, Austin. Industrial Education Division. September, 1965. Price: $4.00 (includes study guide and unit tests publications).

B VT 000 241
Supervised Study Guide, Dental Assistant. Texas University, Austin. Department of Industrial Education. January, 1965. Price: $3.75 (includes study guide and unit tests publications).

B VT 000 244
Supervised Study Guide, Nurse Aide. O. O. Williams. Texas University, Austin. Department of Industrial Education. October, 1965. Price: $4.35 (includes study guide and unit tests publications).

Address Code[2]

B VT 000 262
Supervised Study Guide in Medical Laboratory Techniques. Bill E. Lovelace. Texas University, Austin. Department of Industrial Education. Texas Education Agency, Austin. Industrial Education Division. December, 1963. Price: $3.75 (includes study guide and test booklet publications).

C VT 000 437
Your attitude is Showing. Elwood N. Chapman. Science Research Associates, Inc., Chicago, Illinois. 1964. Price: $5.65 (includes student guide and answer booklet).

A VT 000 589
Training for Students in the Food Industry. John A. Beaumont. Office of Education, Washington, D. C. 1961. GPO Number FS5.282:82004. Price: 15¢.

A VT 000 674
Seafood Merchandising, A Guide for Training Programs. Office of Education, Washington, D. C. 1964. GPO Number FS5.282:82014. Price: 30¢.

A VT 000 909
Distributive Education for Adults, Guide for Part-Time Instructors. Natalie Kneeland. Office of Education, Washington, D. C. 1960. GPO Number FS5.282:82003. Price: 15¢.

B VT 001 464
Supervised Study Guide for Television Cameraman (Video-Camera Engineer). Leo Schreiner and Russell Brown. Texas University, Austin. Department of Industrial Education. Texas Education Agency, Austin. Industrial Education Division. January, 1967. Price: $5.05 (includes publication of answers to assignments and unit tests, and publication of unit tests).

B VT 001 469
Supervised Study Guide for Auto Body And Fender Repairman. Angel Navarro. Texas University, Austin. Department of Industrial Education. Texas Education Agency, Austin. Industrial Education Division. January, 1967. Price: $4.50 (includes publication of answers to assignments and tests and publication of tests).

A VT 001 791
Automotive Service Specialist, A Suggested Guide for a Training Course. Arthur J. Oettmeier. Office of Education, Washington, D. C. 1965. GPO Number FS5.287:87015. Price: 45¢.

A VT 001 817
Planning and Organizing an Export Trade Education Program. Willem Winkel. Office of Education, Washington, D. C. 1963. GPO Number FS5.282:82012. Price: 20¢

A VT 001 826
The Visiting Homemaker, A Suggested Training Program. Office of Education, Washington, D. C. 1964. GPO Number FS5.287:87002. Price: 20¢.

Address Code[2]

A VT 001 856
Mechanical Technology, Design and Production, A Suggested 2-Year Post High School Curriculum. Office of Education. Washington, D. C. 1964. GPO Number FS5.280:80019. Price: 70¢.

B VT 001 895
Supervised Study Guide in Electric Motor Repair. Oscar A. Self. Texas University, Austin. Department of Industrial Education. January, 1967. Price: $5.00 (includes study guide and unit tests publications).

A VT 001 980
Civil and Highway Technology, Suggested Techniques for Determining Courses of Study in Vocational-Technical Education Programs. Clarence E. Peterson. Office of Education, Washington, D. C. Technical Education Branch. 1964. GPO Number FS5.280:80018. Price: 25¢.

A VT 002 133
Instruction in Farm Mechanics, Suggestions for Developing Training Programs in Farm Mechanics in Vocational Agriculture. A. H. Hollenberg and E. J. Johnson. Office of Education, Washington, D. C. 1964. GPO Number FS5.281:81009. Price: 50¢.

A VT 002 134
Farm Business Analysis, Guidelines for a Suggested Program in Farm Management. Harold F. Duis and others. Office of Education, Washington, D. C. 1964. GPO Number FS5.281:81010. Price: 20¢.

A VT 002 201
The Landscape Aide, A Suggested Training Program. Office of Education, Washington, D. C. 1964. GPO Number FS5.287:87010. Price: 25¢.

A VT 002 270
The Homemaker's Assistant, A Suggested Training Program. Office of Education, Washington, D. C. 1964. GPO Number FS5.287:87008 Price: 20¢.

A VT 002 271
The Forestry Aide, A Suggested Training Program. Office of Education, Washington, D. C. Division of Vocational and Technical Education. 1964. GPO Number FS5.287:87011. Price: 25¢.

A VT 002 272
Highway Engineering Aide, A Suggested Training Program. Office of Education, Washington, D. C. 1964. GPO Number FS5.287:87009. Price: 35¢.

B VT 002 280
Supervised Study Guide for Optician, Dispensing Optician, and Optical Mechanic. Jim Cockrum. Texas University, Austin. Department of Industrial Education. February, 1967. Price: $7.50 (includes study guide and unit tests publications).

Address Code[2]

A VT 002 281
Medical Laboratory Assistant, A Suggested Guide for a Training Program. Office of Education, Washington, D. C. 1966. GPO Number FS5.287:87017. Price: 60¢.

A VT 002 361
Electronic Data Processing I, A Suggested 2-Year Post High School Curriculum for Computer Programers and Business Applications Analysts. Maurice W. Roney. Office of Education, Washington, D. C. January, 1966. GPO Number FS5.280:80024. Price: 40¢.

A VT 002 419
The Preparation of Occupational Instructors, A Suggested Course Guide. James L. Cockrum. Office of Education, Washington, D. C. Division of Vocational and Technical Education. 1966. GPO Number FS5.280:80042. Price: $1.25.

A VT 002 422
Instrumentation and Automatic Control, Suggested Techniques for Determining Courses of Study in Vocational and Technical Education Programs. Office of Education, Washington, D. C. GPO Number FS5.280:80043. Price: 25¢

A VT 002 483
Three-Dimensional Teaching Aids for Trade and Industrial Instruction. Harold J. Rosengren. Office of Education, Washington, D. C. 1965. GPO Number FS5.284:84024. Price: 35¢.

A VT 002 515
Chemical Technology, A Suggested 2-Year Post High School Curriculum. Robert M. Knoebel. Office of Education, Washington, D. C. 1964. GPO Number FS5.280:80031. Price: 75¢.

A VT 002 516
Instrumentation Technology, A Suggested 2-Year Post High School Curriculum. Office of Education, Washington, D. C. 1964. GPO Number FS5.280:80033. Price: 75¢.

A VT 002 635
Civil Technology, Highway and Structural Options, A Suggested 2-Year Post High School Curriculum. Walter J. Brooking. Office of Education, Washington, D. C. 1966. GPO Number FS5.280:80041. Price: 60¢.

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[1]Copies of these documents may be obtained from the source indicated in the citation.

[2]Correct address to obtain cited item is given in the source list, page 6.

Source List for Documents

Not in Microfiche Collection

Address Code

A	Superintendent of Documents U. S. Government Printing Office Washington, D. C. 20402
B	Industrial Education Department Division of Extension The University of Texas Austin, Texas 78712
C	Instructional Materials Laboratory Distributive Education Department Division of Extension The University of Texas Austin, Texas 78712

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AGRICULTURAL EDUCATION TEACHING MATERIALS CENTER, COLLEGE STATION, TEX.
VT 002 178 125
Vocational Agriculture Services Publication List.

ALABAMA UNIV., UNIVERSITY. DEPT. OF TRADE AND INDUSTRIAL EDUCATION
VT 003 132 114
Furniture Upholstery and Repair, A Study Guide and Progression Record for Furniture Upholstery and Repair Students in a Cooperative Training Program.

ARIZONA UNIV., TUSCON. DEPT. OF AGRICULTURAL EDUCATION
VT 000 350 3
Selected Reference Books for Departments of Vocational Agriculture.

BEARD, LOUISE AND OTHERS
VT 000 116 70
Psychiatric Aide.

BEAUMONT, JOHN A.
VT 000 589 57
Training for Students in the Food Industry.

BROOKING, WALTER J.
VT 002 635 ED 108
Civil Technology, Highway and Structural Options, A Suggested 2-Year Post High School Curriculum.

BROWN, RUSSELL
VT 001 464 93
Supervised Study Guide for Television Cameraman.

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CALIFORNIA STATE DEPT. OF INDUSTRIAL EDUCATION. SACRAMENTO. BUREAU OF INDUSTRIAL EDUCATION
VT 002 180 ED 127
Instructional Materials.

CHAPMAN, ELWOOD N.
VT 000 437 55
Your Attitude is Showing.

COCKRUM, JAMES L.
VT 002 280 100
Supervised Study Guide for Optician, Dispensing Optician, and Optical Mechanic.

VT 002 419 ED 117
The Preparation of Occupational Instructors, A Suggested Course Guide.

COLICCHIO, ANTOINETTE J.
VT 002 924 ED 110
Needle Trades Mathematics I.

COLLIE, IDA
VT 000 111 67
Hospital Wark Clerk.

COUNCIL FOR DISTRIBUTIVE TEACHER EDUCATION
VT 000 507 ED 56
Distributive Education Library Lists.

DORNFIELD, BLANCHE E.
VT 002 780 ED 118
Commercial Foods, Mathematics I.

DUIS, HAROLD F. AND OTHERS
VT 002 134 ED 29
Farm Business Analysis, Guidelines for a Suggested Program in Farm Management.

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VT 000 507 ED 56
Distributive Education Library Lists.

FITTS, JAMES
VT 001 132 ED 25
Parks and Landscape Employee.

FLORIDA STATE DEPT. OF EDUCATION, TALLAHASSEE
VT 000 356 4
Selected Reference Books for Departments of Vocational Agriculture.

HILL, DURWIN
VT 001 140 ED 26
Agricultural Machinery - Power.

HILL, JOY
VT 002 792 75
Surgical Technician Unit, Surgical Aseptic Technique.

HOLLENBERG, A. H.
VT 002 133 ED 28
Instruction in Farm Mechanics, Suggestions for Developing Training Programs in Farm Mechanics in Vocational Agriculture.

IDAHO STATE BOARD FOR VOCATIONAL EDUCATION, BOISE. DISTRIBUTIVE EDUCATION DIVISION
VT 000 507 ED 56
Distributive Education Library Lists.

ILLINOIS UNIV., URBANA. VOCATIONAL AGRICULTURE SERVICE
VT 002 175 ED 122
Catalog of Teaching Materials, 1967-68.

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Producing High Corn Yields.

VT 002 258 ED 33
Transplanting Shade Trees.

VT 002 259 ED 34
Setting Up Farm Records to Provide for Analysis.

VT 002 260 ED 35
The Planter -- Selection, Adjustment, Maintenance, and Use.

VT 002 262 ED 36
Selecting, Feeding, and Caring for Light Horses.

INDIANA STATE UNIV., TERRE HAUTE, INSTRUCTIONAL MATERIALS
VT 002 176 ED 123
Available Instructional Materials.

JANES, MARTHA W.
VT 000 115 69
Personal Care and Family Aide.

JOHNSON, E. J.
VT 002 133 ED 28
Instruction in Farm Mechanics, Suggestions for Developing Training Programs in Farm Mechanics in Vocational Agriculture.

JOHNSON, JOHNNY
VT 001 132 ED 25
Parks and Landscape Employee.

JURIST, RODNEY G.
VT 003 124 ED 46
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KENTUCKY UNIV., LEXINGTON. INSTRUCTIONAL MATERIALS LABORATORY
VT 002 786 ED 43
General Business Unit, The Influence of Automation on Business and Personal Life.

VT 002 792 75
Surgical Technician Unit, Surgical Aseptic Technique.

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VT 000 909 ED 59
Distributive Education for Adults, Guide for Part-Time Instructors.

KNOEBEL, ROBERT M.
VT 002 515 ED 106
Chemical Technology, A Suggested 2-Year Post High School Curriculum.

LOUISIANA STATE DEPT. OF EDUCATION, BATON ROUGE, DISTRIBUTIVE EDUCATION SECTION
VT 002 251 63
Advanced Sales Techniques, Instructor's Guide.

VT 002 254 64
Tour Guide Training, Conference Leader's Guide, Adult Series.

LOUISIANA VOCATIONAL CURRICULUM DEVELOPMENT AND RESEARCH CENTER, NATCHITOCHES
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VT 003 022 111
Economics for Industrial Supervisors.

VT 003 024 ED 112
Introduction to Management for Industrial Supervisors.

LOVELACE, BILL E.
VT 000 262 73
Supervised Study Guide in Medical Laboratory Techniques.

LUTER, ROBERT R.
VT 000 157 50
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VT 000 168 52
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LYNCH, MILDRED
VT 003 017 78
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MISSISSIPPI STATE DEPT. OF VOCATIONAL EDUCATION, JACKSON
VT 001 277 92
A Guide for Use in Developing Training Programs in Mechanical Technology.

VT 002 782 ED 109
A Basic Plan for the Organization and Management of Instruction in Vocational Radio and Television.

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VT 002 924 ED 110
Needle Trades Mathematics I.

VT 003 124 ED 46
The Curriculum for a Model Business Education Program.

VT 003 129 113
Baking, Related Science and Trade Information. Part I - Ingredients.

NORTH CAROLINA STATE BOARD OF EDUCATION, RALEIGH
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VT 002 158 30
Rate of Planting Corn, A Laboratory Exercise.

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VT 000 488 ED 6
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VT 000 499 ED 17
Adjustment, Maintenance, and Repair of Small Gasoline Engines.

VT 000 500 ED 18
Tractor Tune-Up and Maintenance.

VT 000 501 ED 19
Gasoline Tractor Engine Systems.

VT 000 502 ED 20
Diesel Engine Systems.

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VT 000 504 ED 22
Course Outline for Agricultural Machinery - Service Occupations.

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VT 002 174 ED 121
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OFFICE MACHINES
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U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

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PML 1002

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COURSE OUTLINE

HOSPITAL WARD CLERK

January, 1965

VT000111

CURRICULUM LABORATORY
DEPARTMENT OF COMMUNITY COLLEGES
STATE BOARD OF EDUCATION
RALEIGH, NORTH CAROLINA

MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) Roger G. Worthington (Agency) Vocational-Technical Division Department of Community Colleges

(Address) Education Building, Raleigh, North Carolina 27602

DATE: June 14, 1967

RE: (Author, Title, Publisher, Date) Ida Collie, R. N.; "Hospital Ward Clerk"; Curriculum Laboratory, N. C. Dept. of Community Colleges; January, 1965.

Supplementary Information on Instructional Material

Provide information below which is not included in the publication. Mark N/A in each blank for which information is not available or not applicable. Mark P when information is included in the publication. See reverse side for further instructions.

(1) Source of Available Copies:
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(2) Means Used to Develop Material:
Development Group Author, under direction of staff consultant for health occupation
Level of Group Author-local teacher
Method of Design, Testing, and Trial None

(3) Utilization of Material:
Appropriate School Setting High school or post-high school educational agency in
Type of Program Pre-employment /cooperation with a hospital
Occupational Focus Hospital ward clerk (Nursing auxiliary personnel)
Geographic Adaptability
Uses of Material General guidelines for outline and lesson plan development
Users of Material Teacher

(4) Requirements for Using Material:
Teacher Competency Registered nurse with ward administration experience
Student Selection Criteria General qualifications for meeting public and maintaining effective communications, both oral and written.
Time Allotment P

Supplemental Media --
Necessary ____ } (Check Which) P
Desirable ____ }

Describe

Source (agency)
(address)

INTRODUCTION

This course guide was prepared to assist teachers in initial classes to be offered for prospective hospital ward clerks.

The guide includes a descriptive statement of each unit, a descriptive statement of each lesson, and suggested teaching methods for each lesson. Each teacher of the initial classes will need to develop a topical outline for each lesson, specific assignments, and, where desirable, information sheets for handout to students.

Clinical practice should be provided for students as soon as possible. The ratio of clinical hours to classroom hours should be progressively increased until, by the sixth week of the course, hours of clinical practice equal or exceed the number of classroom hours.

Students admitted to the course should be high school graduates and meet other admission criteria established by the sponsoring institution. On completion of the course, each graduate will be presented a certificate of graduation.

Following use of this guide by several teachers, a working committee will be formed to develop the guide into a full outline.

This guide was developed by Ida Collie, R.N., in cooperation with staff members of the Curriculum Laboratory. The Guide has been used for up-grading and pre-employment classes sponsored by the W. W. Holding Industrial Education Center in cooperation with Memorial Hospital of Wake County.

Course Description

HOSPITAL WARD CLERK

A course designed to prepare students to function effectively as clerks in the nursing unit of a hospital or clinic. Classroom procedures will introduce students to modern concepts of health and the functional relationships within a hospital, with emphasis on the role of the ward clerk. Classroom activities will include experiences to develop specific skills and personal qualities needed for public relations aspects of the ward clerk role. Clinical practice will be planned to further the students skills within the hospital environment and the nursing unit.

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Course Outline

HOSPITAL WARD CLERK

UNIT 1: HOSPITAL AND COMMUNITY

TIME ALLOTMENT: 6 hours

OBJECTIVE: To help the student understand the overall role of various types of hospitals in the community-at-large.

UNIT DESCRIPTION: A study of the purposes of hospitals, types of hospitals, and the desirable relationship of hospital to community.

LESSONS:

1. Purposes of Hospitals
2. Types of Hospitals
3. Relationship of Hospital to Community

LESSON 1: PURPOSES OF HOSPITALS

TIME ALLOTMENT: 2 hours, approximately

OBJECTIVE: To help the student understand the various purposes hospitals may serve in a community.

LESSON DESCRIPTION: A study of the curative, rehabilitative, preventive, educational, and research responsibilities of the hospital, factors which influence the primary purpose of a particular hospital, and the importance of each purpose to the community.

SUGGESTED TEACHING METHODS: Have students list purposes of different types of hospitals and then discuss each purpose fully. List nearby hospitals which illustrate differences that result from different primary purposes, thus making the student more aware of facilities available in the community while clarifying each purpose.

SUGGESTED REFERENCES:

Harmer and Henderson. Textbook of the Principles and Practice of Nursing.

LESSON 2: TYPES OF HOSPITALS

TIME ALLOTMENT: 2 hours, approximately

OBJECTIVE: To help the student understand different types of hospitals, activities common to hospitals, and members of the health team who carry out these activities.

LESSON DESCRIPTION: A study of ways in which hospitals are classified, the variety of activities which are required for functioning of a hospital, and the numbers and types of workers necessary to carry out the various activities.

SUGGESTED TEACHING METHODS: Discuss fully the types of hospitals, using examples from Lesson 1; show films to illustrate types of hospitals, hospital activities, or roles of hospital personnel; make written assignment to concerning Lessons 1 and 2 which may be carried out in class or in the library.

SUGGESTED REFERENCES:

Harmer and Henderson. Textbook of the Principles and Practice of Nursing.

Fuerst and Wolff. Fundamentals of Nursing.

LESSON 3: RELATIONSHIP OF HOSPITAL TO COMMUNITY

TIME ALLOTMENT: 2 hours, approximately

OBJECTIVE: To help the student understand the interdependence of hospital and community and to be aware of the role of hospital personnel in maintaining good public relations.

LESSON DESCRIPTION: A study of ways the hospital affects the community including employment and service opportunities; quality of health care available; health education; promotion of community attitudes, causes of unfavorable attitudes, how a favorable public image can be maintained, and advantages of public enthusiasm and interest.

SUGGESTED TEACHING METHODS: Discuss lesson topics; show films to depict community life and hospital activities; make written assignment based on lesson content.

SUGGESTED REFERENCES:

Harmer and Henderson. Textbook of the Principles and Practice of Nursing.

Fuerst and Wolff. Fundamentals of Nursing.

Films: "The Old North State" (Available from Southern Bell Telephone Co.)

"Health Careers" (Available from local Health Careers Office or from the N. C. Hospital Association.)

UNIT II: HOSPITAL ORGANIZATION

TIME ALLOTMENT: 18 hours

OBJECTIVE: To help the student learn about the organization of a hospital, the relationship of nursing units to other areas of the hospital, and the organization and division of the responsibilities of the nursing unit.

UNIT DESCRIPTION: The study of hospital structure, including organization of hospitals in general, nursing service organization, nursing unit organization, and areas of responsibility within the nursing unit.

LESSONS:

1. General Organization of Hospitals
2. Nursing Service Organization
3. Nursing Unit Organization

LESSON 1: GENERAL ORGANIZATION OF HOSPITALS

TIME ALLOTMENT: 6 hours, approximately

OBJECTIVE: To help the student understand the organization of hospitals and the importance of understanding organizational relationships.

LESSON DESCRIPTION: A study of the organizational structure of hospitals, including names and titles of key personnel in the affiliating hospital.

SUGGESTED TEACHING METHODS: Discuss organizational structure, including horizontal and vertical lines of authority and communication channels; explain meaning and value of organizational charts; explain organizational chart of affiliating hospital, supplying names and titles of key personnel. Each student should be provided with a copy of the organizational chart of the affiliating hospital, with space for entering names and titles of personnel the ward clerk should know.

SUGGESTED REFERENCES:

Harmer and Henderson. Textbook of the Principles and Practice of Nursing.

Organizational chart of affiliating hospital.

LESSON 2: NURSING SERVICE ORGANIZATION

TIME ALLOTMENT: 6 hours, approximately

OBJECTIVE: To help the student understand areas of responsibility within nursing service and within the nursing unit.

LESSON DESCRIPTION: A study of nursing service organization in the affiliating hospital; patterns of nursing care utilized in the affiliating hospital; and roles of various hospital personnel in carrying out the activities of a nursing unit.

SUGGESTED TEACHING METHODS: Hand out prepared copies of organizational charts to students; discuss nursing service organization, first in general, then specifically as in the affiliating hospital; have students write in names of key personnel in nursing service; introduce role differentiation of various members of the nursing team.

SUGGESTED REFERENCES:

Organizational chart of nursing service in the affiliating hospital.

LESSON 3: NURSING UNIT ORGANIZATION

TIME ALLOTMENT: 6 hours, approximately

OBJECTIVE: To help the student understand the organization of a nursing unit and the role of the ward clerk within the unit.

LESSON DESCRIPTION: A study of the specific tasks performed by the ward clerk, as related to the various activities carried on within the nursing unit; study of job descriptions and use of the job description to clarify areas of responsibility.

SUGGESTED TEACHING METHODS: Discuss fully the activities of the nursing unit, roles of various personnel, ward clerk participation in certain activities, use of job descriptions for defining areas of responsibility, extent and limitations of the ward clerk role; give a written assignment so that the student may apply her knowledge of nursing unit activities, role of the ward clerk, and interpersonal relations within the nursing unit. Orientation tour and period of observation in selected nursing units should follow this lesson.

SUGGESTED REFERENCES:

Ward Clerk Job Description from the affiliating hospital.

UNIT III: UNDERSTANDING THE ROLE OF WARD CLERK

TIME ALLOTMENT: 22 hours

OBJECTIVE: To help the student develop the personal attributes needed for a satisfactory relationship with other hospital personnel and the patient.

UNIT DESCRIPTION: A study of appropriate behaviors for hospital personnel, clear communications, good personal appearance, understanding the patient and family, and various aspects of ward clerk duties in relationships with others.

LESSONS:

1. Appropriate Behaviors for Hospital Personnel
2. Communications
3. Personal Appearance
4. Understanding Patient and Family
5. Duties of the Ward Clerk

LESSON 1: APPROPRIATE BEHAVIORS FOR HOSPITAL PERSONNEL

TIME ALLOTMENT: 4 hours

OBJECTIVE: To help the student learn appropriate behaviors for hospital personnel.

LESSON DESCRIPTION: A study of appropriate behaviors for hospital personnel: positive attitudes, courtesy in person-to-person contacts and in telephone conversations, ethical practices and moral standards.

SUGGESTED TEACHING METHODS: Present recorded lecture on attitudes. Discuss development of favorable attitudes. Show a film on courtesy. Have students write a paper on some phase of desirable behavior.

SUGGESTED REFERENCES:

Dietz, Professional Adjustments 1.

Keane, Essentials of Nursing.

The Bible, Matthew 5, 6, and 7, Sermon on the Mount.

Recorded lecture: McFarland, Dr. Kenneth. "The Lamplighters." (Available from Carolina Power and Light Company.)

Film: "By Jupiter" (Available from N. C. State Board of Health.)

LESSON 2: COMMUNICATIONS

TIME ALLOTMENT: 6 hours

OBJECTIVE: To help the student learn to communicate clearly within the bounds of acceptable legal and ethical standards.

LESSON DESCRIPTION: A study of acceptable legal and ethical standards in oral and written communications.

SUGGESTED TEACHING METHODS: Have Records Librarian lecture on standards to be observed regarding the patient's chart, follow with discussion. Have Administrator lecture on what type of information should be released to representatives of news media, law enforcement officers, insurance representatives, and any seeker of information. Invite an educational representative from the telephone company to discuss the proper use of the telephone. Have students engage in mock telephone conversations and record for playback and criticism.

SUGGESTED REFERENCES:

Lesnik and Anderson, Nursing Practice and the Law.

Dietz, Professional Adjustments 1.

Carney, Etiquette in Business.

Price, A Handbook and Charting Manual for Student Nurses.

LESSON 3: PERSONAL APPEARANCE

TIME ALLOTMENT: 6 hours

OBJECTIVE: To provide opportunities for students to learn to make the most of personal appearance.

LESSON DESCRIPTION: A study of how to cultivate natural attributes: good countenance; pleasing voice, avoidance of distracting mannerisms and offensive personal habits; good personal hygiene; well-groomed hair; good taste in make-up, jewelry, dress, and accessories; good posture; and desirable personal qualities needed for effective relations with others.

SUGGESTED TEACHING METHODS: Have students contrast affected speech with the voices of television or radio announcers. Discuss meaning of personality. Show films on good grooming, posture, and countenance. Demonstrate good posture and have students return the demonstrations. Invite an outside person to speak on subject of charm. Present recorded lecture on countenance. Have students conduct a panel discussion on personal hygiene.

SUGGESTED REFERENCES:

Films:

"Roots of Happiness"

"The Inside Story" (Mental Health)

"Making the Most of Your Face"

"Body Care and Grooming"

"Dynamic Posture"

Recorded Lecture:

McFarland, "Ropes of Gold"

Books:

Carney, Etiquette in Business Charm.

Fuerst and Wolff, Fundamentals of Nursing.

LESSON 4: UNDERSTANDING PATIENT AND FAMILY

TIME ALLOTMENT: 3 hours

OBJECTIVE: To help the student understand the patient as an individual and a member of a family and the community.

LESSON DESCRIPTION: A study of the patient as an individual with mental, physical, and spiritual needs and some possible effects of illness on his interaction with his family and community.

SUGGESTED TEACHING METHODS: Show a film depicting the patient as an individual. Have students recount illnesses they may have had or some they have known and some of the effects of illnesses they have observed.

SUGGESTED REFERENCES:

Films:

"The Patient is a Person"

"Mrs. Stephens Needs a Nurse"

Books:

McGhie, Psychology Applied to Nursing

Sellew, Sociology and its Use in Nursing.

Averill and Kempf, Psychology Applied to Nursing.

Keane, Essentials of Nursing.

Fuerst and Wolff, Fundamentals of Nursing.

LESSON 5: DUTIES OF THE WARD CLERK

TIME ALLOTMENT: 3 hours

OBJECTIVE: To help the student understand her role as a member of a team working for optimal care of the patient.

LESSON DESCRIPTION: A study of the role of the ward clerk as depicted in the job description.

SUGGESTED TEACHING METHODS: Have students review job descriptions from several institutions, especially the one from their affiliating hospital. Discuss differentiation of responsibilities of each member of the nursing team.

SUGGESTED REFERENCES:

"Ward Clerks' Duties," Hospitals, April 16, 1956, p. 24

Job Descriptions of Affiliating Hospital and Several Other Nearby Hospitals.

UNIT IV: FUNDAMENTALS OF WARD CLERK PRACTICE

TIME ALLOTMENT: 28 hours

OBJECTIVE: To help the student learn fundamentals of the ward clerk role within a unit and in relation to other departments.

COURSE DESCRIPTION: A study of how to follow hospital procedures; the use of nursing unit and hospital equipment; the use, content, and care of the patient's chart; special forms required for certain charts; requisitions related to patient care, the chart, and interdepartmental communications; forms and requisitions related to nursing unit management; and daily care of the nursing unit.

LESSONS:

1. Following Hospital Procedures
2. Use of Nursing Unit and Hospital Equipment
3. The Patient's Chart
4. Special Forms Required for Certain Charts
5. Requisitions Related to Patient Care, the Chart, and Interdepartmental Communications
6. Forms and Requisitions Related to Nursing Unit Management
7. Daily Care of the Nursing Unit

LESSON 1: FOLLOWING HOSPITAL PROCEDURES

TIME ALLOTMENT: 6 hours

OBJECTIVE: To help the student gain a beginning understanding of hospital procedures and practices.

LESSON DESCRIPTION: A study of hospital procedures and practices related to patient care and to functions of various departments such as Nursing, Dietary, Pharmacy, Central Service, Laboratory, X-Ray, and Physical Therapy. Emphasis will be given to medical terminology needed for clerical duties related to each.

SUGGESTED TEACHING METHODS: Have students compile a manual for ward clerks for use in their affiliating hospital. This may be duplicated for each nursing station. Following is a suggested list of items to include:

- Job Description
- Accident-Incident Report
- Admission Procedure
- Chart Forms
- Kardex Model Form
- Condition Sheet
- Central Service Requisitions
- Dietary Department Forms
- Discharge Procedure
- Dumb Waiter-Use of
- Fire Procedure
- Housekeeping Forms
- Inter-Communication-Use of Equipment
- Laboratory Requisitions
- Operating Room Forms
- Pharmacy Forms
- Physical Therapy Forms
- Repairs Request Forms
- Shopping Service-Information
- Supplies-List of Sources
- Telephone-Policies Regarding Use
- Television-Policies
- Time Record-Model
- Transfers-Procedure and Forms
- Tube System (Pneumatic) Use of
- X-Ray Forms and Requisitions

Have students learn basic units and symbols of the metric and apothecary systems.

Have students learn combining forms used in medical terminology.

Encourage good handwriting.

Require use of abbreviations, symbols, common drug names, and medical terms in written and oral communications. Give students copies of abbreviations and symbols.

Have students study photostatic copies of doctors' orders made from old charts--without identity, of course. Students may then be taken to the clinical area for further study of orders.

SUGGESTED REFERENCES:

Clark and Clark, Guide to Medical Terminology.

Selected manual of drugs and solutions

Physician's Desk Reference

Selected Medical Dictionary

Manuals of departments in the affiliating hospital

LESSON 2: USE OF NURSING UNIT EQUIPMENT

TIME ALLOTMENT: 6 hours

OBJECTIVE: To help the student learn to use equipment available in the nursing unit.

LESSON DESCRIPTION: A study of the use of the addressograph, dumb waiter, pneumatic tube system, labeling machine, inter-communication system, and other specilized equipment in the nursing unit.

SUGGESTED TEACHING METHODS: Discuss, demonstrate, and have students practice operating available equipment in affiliating hospital. Help them learn to interpret written instructions for each item. They may practice following instructions by threading the movie projector.

SUGGESTED REFERENCES:

Manuals for operation of each item of equipment.

LESSON 3: THE PATIENT'S CHART

TIME ALLOTMENT: 6 hours

OBJECTIVE: To help the student learn the purpose of the patient's chart and how to fulfill ward clerk responsibilities for selected portions of the chart.

LESSON DESCRIPTION: A study of the purpose of the chart and how to carry out the ward clerk's responsibilities for the graphic sheet, the medication and treatment cards, the Kardex, and their relation to the chart.

SUGGESTED TEACHING METHODS: Make written assignment on the purpose of the patient's chart.

Give each student a chart, medicine cards, and Kardex card to practice on as the teacher instructs in the use of each form by the use of transparencies on the overhead projector.

Follow with supervised practice in the hospital.

SUGGESTED REFERENCES:

Ward Clerk Manual(which student previously prepared)

Nursing Service Manual from affiliating hospital.

Price, A Handbook and Charting Manual for Student Nurses.

Fuerst and Wolff, Fundamentals of Nursing, pp. 424-438.

Harmer and Henderson, Textbook of the Principles and Practice of Nursing.

LESSON 4: SPECIAL FORMS REQUIRED FOR CERTAIN CHARTS

TIME ALLOTMENT: 2 hours

OBJECTIVE: To help the student learn to use special forms required for certain patient's charts.

LESSON DESCRIPTION: A study of special forms and their specific use for certain patients' records, including diabetic records, blood pressure graphs, intake and output records, consultation reports, operative and/or delivery permits, sterilization permits, contraceptive device permits, anesthesia records, release from responsibility (for discharge against the doctor's advice), permit for disposal of fetus or limb, autopsy permits, and incident reports. This study includes legal requirements and hospital policies related to signing and witnessing permits.

SUGGESTED TEACHING METHODS: Use overhead transparencies to demonstrate how forms are filled out. Have students practice carrying out procedure for all forms the ward clerk may be responsible for in the affiliating hospital.

SUGGESTED REFERENCES:

Procedure and Policy Manuals of Affiliating Hospital.

LESSON 5: REQUISITIONS RELATED TO PATIENT CARE, THE CHART AND INTERDEPARTMENTAL COMMUNICATIONS

TIME ALLOTMENT: 3 hours

OBJECTIVE: To help the student learn to use requisitions related to patient care, the chart, and interdepartmental communications.

LESSON DESCRIPTION: A study of requisitions used for tests or therapy in other departments, such as pharmacy, laboratory, X-ray, dietary, physical therapy, EKG, EEG, BMR, central service, and others. Some special reports are also studied: one for use of volunteer workers, showing which patients may use the shopping service cart; and one from X-ray department stating whether the X-ray has been completed. How to schedule a routine and how to carry out ward procedures for special tests and therapy are stressed.

SUGGESTED TEACHING METHODS: Use overhead transparencies to project forms, have students learn to fill them in, following instructions given in manuals. Stress importance of careful checking when patients are having multiple tests. Have students carry out procedures under supervision in the hospital.

SUGGESTED REFERENCES:

Procedure and Policy Manuals of Affiliating Hospital.

LESSON 6: FORMS AND REQUISITIONS RELATED TO NURSING UNIT MANAGMENT

TIME ALLOTMENT: 3 hours

OBJECTIVE: To help the student learn to use forms and requisitions related to nursing unit management.

LESSON DESCRIPTION: A study of the use of forms and requisitions related to nursing unit management, such as record of patients' scheduled tests or therapy in other departments, requisitions for supplies and equipment, loan slips, requests for repairs, return of supplies and equipment for credit, requisitions for linen, time cards and running record of each employee's time, vacation, sick leave, etc., permit for vacation, leave, etc., daily assignment sheets, daily census reports, condition sheet, and others.

SUGGESTED TEACHING METHODS: Use overhead projector to demonstrate use of forms; follow with supervised practice in hospital.

SUGGESTED REFERENCES:

Procedure and Policy Manuals of Affiliating Hospital.

LESSON 7: DAILY CARE OF THE NURSING UNIT

TIME ALLOTMENT: 2 hours

OBJECTIVE: To help the student learn responsibilities of the ward clerk in daily case of the nursing unit.

LESSON DESCRIPTION: A study of means for maintaining an efficient working area, such as an up-to-date bulletin board of personnel on duty and notices, visiting hours prominently posted, a notebook file of memoranda, a manual for ward clerks, a procedure manual and a policy manual for nursing service; a clean, neat working area; and well-stocked supply cupboards.

SUGGESTED TEACHING METHODS: Discuss daily care of the nursing unit; follow with further study in the hospital.

SUGGESTED REFERENCES:

Selected Manuals as Needed.

Archer, Brecker, and Frakes, General Office Practice

UNIT V: WARD CLERK PARTICIPATION IN SELECTED NURSING UNIT ACTIVITIES

TIME ALLOTMENT: 10 hours

OBJECTIVE: To help the student learn to apply principles of medical asepsis, to some of the activities in which the ward clerk participates and to follow hospital procedure in relation to selected activities,

UNIT DESCRIPTION: A study of the prevention and control of disease; admission, transfer, and discharge of the patient; and other selected activities in which the ward clerk may participate.

LESSONS:

1. Prevention and Control of Disease
2. Admission, Transfer, and Discharge of Patients
3. Selected Activities in Which the Ward Clerk May Participate

LESSON 1: PREVENTION AND CONTROL OF DISEASE

TIME ALLOTMENT: 6 hours

OBJECTIVE: To help the student learn principles of medical asepsis as applied to self-protection and prevention of transfer of organisms.

LESSON DESCRIPTION: A study of the causes of diseases and their prevention through the practice of medical asepsis.

SUGGESTED TEACHING METHODS: Use overhead transparencies to project pictures of various pathogenic microorganisms; discuss some of the diseases caused by each and how their spread of organisms may be controlled. Make an agar plate from washed hands and after suitable incubation period show the growth to students; emphasize ease with which personnel can transfer organisms if medical asepsis is not carried out.

Discuss the importance of good hygiene and good personal habits.

Show films: "Mr. Scattergerm", Parts II and III

"Hospital Sepsis"

LESSON 2: ADMISSION, TRANSFER, AND DISCHARGE OF PATIENTS

TIME ALLOTMENT: 2 hours

OBJECTIVE: To help the student learn the hospital procedures for admitting, transferring, and discharging patients.

LESSON DESCRIPTION: A study of procedures and forms involved in admitting, transferring, and discharging patients including discharge by death.

SUGGESTED TEACHING METHODS: Discuss routines of affiliating hospital for each procedure; use overhead transparencies to project forms used and demonstrate method of filling them in.

Have students practice in clinical area, under supervision.

SUGGESTED REFERENCES:

Fuerst and Wolff, Fundamentals of Nursing.

Policy and Procedure Manuals of Affiliating Hospital.

Keane, Essentials of Nursing.

Fuerst and Wolff, Fundamentals of Nursing.

LESSON 3: SELECTED ACTIVITIES IN WHICH THE WARD CLERK MAY PARTICIPATE

TIME ALLOTMENT: 2 hours

OBJECTIVE: To help the student know how to assist with selected tasks that are within her abilities but are not a routine part of ward clerk responsibilities.

LESSON DESCRIPTION: A study of the techniques for certain tasks not specifically assigned to the ward clerk such as transporting specimens, filling water pitchers, obtaining linen, and transporting sterile supplies. Discuss the handling of clean and sterile supplies, contaminated materials, and various types of specimens.

SUGGESTED TEACHING METHODS: Demonstrate how specimens should be transported, how to refill a pitcher with ice, how to handle contaminated material, how to handle clean and sterile items.

SUGGESTED REFERENCES:

Policy and Procedure Manuals of Affiliating Hospital.

Keane, Essentials of Nursing.

Fuerst and Wolff, Fundamentals of Nursing.

UNIT VI: BECOMING A HOSPITAL EMPLOYEE

TIME ALLOTMENT: 10 hours

OBJECTIVE: To help the student make the transition to employee status.

UNIT DESCRIPTION: A study of factors involved in assuming responsibility for one's job, citizenship responsibilities, and suitable behaviors in applying for and resigning from a position.

LESSONS:

1. Assuming Responsibility for One's Job
2. Citizenship Responsibilities
3. Applying for and Resigning from a Position

LESSON 1: ASSUMING RESPONSIBILITY FOR ONE'S JOB

TIME ALLOTMENT: 2 hours

OBJECTIVE: To help the student learn to assume moral and legal responsibility for the job.

LESSON DESCRIPTION: A study of one's moral and legal obligation to perform the job that has been accepted.

SUGGESTED TEACHING METHODS: Have students make oral reports; follow with discussion.

Recorded lecture.

SUGGESTED REFERENCES:

Carney, Etiquette in Business.

Dietz, Professional Adjustments 1.

Morison and Farris, Approaches for Co-Workers in Professional Nursing.

Recorded Lecture: by Dr. Kenneth McFarland.

LESSON 2: CITIZENSHIP RESPONSIBILITIES

TIME ALLOTMENT: 4 hours

OBJECTIVE: To help the student learn the importance of assuming responsibility for the privilege of citizenship.

LESSON DESCRIPTION: A study of what it means to be a citizen: some of the privileges, responsibilities, and some ways the ward clerk may meet these obligations. Emphasis is given to responsibility, acceptance of responsibility for one's own actions, and responsibility for one's economic welfare, keeping informed on current events, how to vote intelligently on various issues, how to pay taxes, how to assume home responsibilities, and how to serve one's community.

SUGGESTED TEACHING METHODS: Have students participate in the panel discussion; follow with written assignment.

SUGGESTED REFERENCES:

Dietz, Professional Adjustments 1.

Morison and Farris, Approaches for Co-Workers in Professional Nursing.

LESSON 3: APPLYING FOR AND RESIGNING FROM A POSITION

TIME ALLOTMENT: 4 hours

OBJECTIVE: To help the student learn what to consider when looking for a job, how to apply for a position, and how to leave a position in good standing.

LESSON DESCRIPTION: A study of how to choose a job that will be rewarding personally and economically, some ways to help decide when to change jobs, and the proper etiquette for applying for or leaving a position.

SUGGESTED TEACHING METHODS: Have students write letters of application and of resignation.

Discuss methods of choosing a job and considerations in resigning from a position.

SUGGESTED REFERENCES:

Morison and Farris, Approaches for Co-Workers in Professional Nursing.

SUGGESTED REFERENCES

Archer, Fred C., Brecker, Raymond F., & Frakes, John C. General Office Practice; Second Edition. New York: Gregg Publishing Division, McGraw-Hill Book Company, Inc., 1963.

Averill, Lawrence and Kempf, Florence C. Psychology Applied to Nursing; Fifth Edition. Philadelphia: W. B. Saunders Company, 1956.

Carney, Marie L. Etiquette in Business. New York: Gregg Publishing Division, McGraw-Hill Book Company, Inc., 1948.

Clark, Wallace & Clark, Anne. Guide to Medical Terminology. Philadelphia: F. A. Davis Company, 1959.

Dietz, Lena Dixon. Professional Adjustments 1; Fourth Edition. Philadelphia: F. A. Davis Company, 1957.

Fuerst, Elinor V. & Wolff, LuVerne. Fundamentals of Nursing; Second Edition. Philadelphia: J. B. Lippincott Company, 1959.

Harmer, Bertha & Henderson, Virginia. Textbook of the Principles and Practice of Nursing; Fifth Edition. New York: MacMillan Company, 1960.

Keane, Claire B. Essentials of Nursing. Philadelphia: W. B. Sanders Company, 1964.

Lesnik, Milton Jack, & Anderson, Bernice E. Nursing Practice and the Law; Second Edition. Philadelphia: J. B. Lippincott Company, 1955.

McGhie, Andrew. Psychology As Applied to Nursing; Third Edition. Baltimore: Williams and Wilkins, 1963.

Morison, Luella J. & Farris, Mary Agnes. Approaches for Co-Workers in Professional Nursing. St. Louis: C. V. Mosby Company, 1962.

Physician's Desk Reference. Oradell, New Jersey: Medical Economics, 1964.

Price, Alice L. A Handbook and Charting Manual for Student Nurses, Second Edition. St. Louis: C. V. Mosby Company, 1958.

Sellew, Gladys. Sociology and its Use in Nursing Service; Fifth Edition. Philadelphia: W. B. Saunders Company, 1957.

Winters, Margaret Campbell. Protective Body Mechanics in Daily Life and in Nursing. Philadelphia: W. B. Saunders Company, 1952.

SUGGESTED FILMS AND RECORDINGS:

Available from Film Library, North Carolina State Board of Health, Raleigh:

"Body Care and Grooming"
"By Jupiter"
"Dynamic Posture"
"Hospital Sepsis"
"Making the Most of Your Face"
"Mr. Scattergerm"
"Roots of Happiness"
"The Inside Story" (Mental Health)
"The Patient Is a Person"

Available from Health Careers for North Carolina, 619 Oberlin Road, Raleigh:

"Health Careers"

Available from Smith, Kline, and French Drug Company, 1500 Spring Garden Street, Philadelphia:

"Mrs. Reynolds Needs a Nurse."

Available from Southern Bell Telephone Company, Raleigh, North Carolina:

"Old North State"

RECORDED LECTURES:

Available from Carolina Power and Light Company, Raleigh, North Carolina. Request from any Electric Power and Light Company.

Dr. Kenneth McFarland's

"Wake the Town and Tell the People."
"The Lamplighters."
"Ropes of Gold."
"The Man in Salesman."

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PML 1001

COURSE OUTLINE

THE NURSES' ASSISTANT

August, 1965

TENTATIVE DRAFT

CURRICULUM LABORATORY
DEPARTMENT OF COMMUNITY COLLEGES
STATE BOARD OF EDUCATION
RALEIGH NORTH CAROLINA

VT 006114

M E M O R A N D U M

TO: The ERIC Clearinghouse on Vocational and Technical Education
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(Address) Education Building, Raleigh, North Carolina 27602

DATE: June 15, 1967

RE: (Author, Title, Publisher, Date) Mary Elizabeth Milliken, R.N.; "The Nurses' Assistant"; Curriculum Laboratory, N. C. Dept. of Community Colleges; August, 1965.

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Level of Group Representative of hospitals throughout the State
Method of Design, Testing, and Trial Teacher evaluations after use

(3) Utilization of Material:
Appropriate School Setting Educational agency or educational division of hospital
Type of Program Pre-employment
Occupational Focus Nurse aides and orderlies (Nursing auxiliary personnel)
Geographic Adaptability N A
Uses of Material Basis for lesson planning
Users of Material Teacher

(4) Requirements for Using Material:
Teacher Competency Registered nurse with teaching experience
Student Selection Criteria According to hospital employment policies

Time Allotment P

Supplemental Media --
Necessary ____ Desirable ____ (Check Which) P

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INTRODUCTION

The continuing shortage of nursing personnel has created need for a nurses'-assistant who is prepared to perform those duties associated with patient care and ward management which require only limited educational preparation.

This course outline was prepared to assist teachers throughout the State in pre-employment education of nurses' assistant; it is designed for approximately 330 hours of instruction, consisting of classroom, laboratory, and clinical experiences. Clinical practice should begin in the third unit and increase progressively throughout the remainder of the course. All clinical assignments must be planned and supervised by the teacher so that students will learn to apply classroom learnings to hospital practice. Insofar as possible, the student should develop during the course acceptable skill in performance of nursing procedures included in the outline.

The curriculum committee believes that the nurses' assistant should have a well-defined role on the nursing team and that the registered nurse must provide leadership in delegating responsibilities to non-professional personnel. For this reason, the course outline is limited to basic procedures commonly required in the care of convalescent and subacutely ill patients. Procedures related to acute illness, such as oxygen therapy, and procedures requiring depth of knowledge, such as traction and drainage tubes, have been omitted as being inappropriate to the role of the nurses' assistant. Patients whose condition requires depth of knowledge and highly developed skills should have the direct care of appropriate licensed personnel, either the registered nurse or the licensed practical nurse.

Admission requirements to the nurses' assistant course are established cooperatively by the sponsoring institution and the affiliating hospital. All students admitted to the course should be potentially employable by the hospital. Standards of achievement during the course will be established by the educational

institution. Graduates will receive certificates on satisfactory completion of the course.

The nurses' assistant who has completed this course is a beginning practitioner at the time of employment. The employing institution should assume responsibility for follow-up supervision and for an ongoing program of in-service education appropriate to the nurses' assistant level. In a few carefully selected cases, the institution may desire to upgrade a practitioner with individual instruction in more complex procedures. The committee recommends that such upgrading should be carefully planned, directed by a competent supervisor with teaching experience, and followed by ongoing evaluation of performance.

The work of the committee developing this outline was sponsored by the Curriculum Laboratory of the N. C. Department of Community Colleges. Committee members, representing hospitals and community college institutions throughout the State, are as follows:

Mrs. Peggy Cecil, R.N.	Forsyth Memorial Hospital
Miss Ida Collie, R.N.	W. W. Holding Industrial Education Center
Mrs. Joyce Goforth, R.N.	Wilson Technical Institute
Mrs. Ruth Jones, R.N.	W. W. Holding Industrial Education Center
Miss Ruth Parker, R.N.	Valdese General Hospital
Mrs. Marcia Powell, R.N.	James Sprunt Institute
Mrs. Mary E. Milliken, R.N.	Curriculum Laboratory

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Course Description

NURSES' ASSISTANT

A course designed to prepare qualified men and women to give effective nursing care to selected patients, to make and report observations, and to carry out routine aspects of ward management. Classroom teaching is centered around modern concepts of health, functional relationships within a hospital, fundamentals of effective interpersonal relations, and nursing procedures related to daily needs of patients and to common therapeutic measures. Throughout the course emphasis is given to the role of the nurses' assistant. Clinical experiences provide opportunities for applying classroom learnings to practice in the hospital setting.

Course Outline

NURSES' ASSISTANT

UNIT I: INTRODUCTION TO ROLE OF THE NURSES' ASSISTANT

TIME ALLOTMENT: 15 to 25 hours

OBJECTIVE: To help the student develop awareness of the scope of the health field and beginning understanding of health facilities, modern nursing, and the role of the nurses' assistant.

UNIT DESCRIPTION: A study in broad perspective of the field of nursing, with emphasis on current trends related to division of responsibility among various types and levels of health workers.

SUGGESTED REFERENCES:

Abdallah, Mary C. Nurse's Aide Study Manual.

Cherescavich. A Textbook for Nursing Assistants.

Knoedler. The Nurse Assistant.

Ross. Personal and Vocational Relationships in Practical Nursing.

LESSONS:

1. Trends in Nursing
2. Modern Health Facilities
3. Modern Nursing
4. The Nurses' Assistant Today

LESSON 1: TRENDS IN NURSING

OBJECTIVE: To help the student develop awareness of nursing as it is today, in the the light of historical backgrounds and social forces which have influenced its development.

LESSON OUTLINE:

I. Introduction

II. Origins of Nursing

III. Survey of history

- A. First hospitals
- B. First nursing organizations
- C. Early nursing education
- D. The Nightingale Period
- E. Early nursing in America
- F. Nursing in the twentieth century

IV. Forces which influence care of the sick

- A. Social change
- B. War
- C. Economic trends
- D. Scientific discoveries
- E. Educational advances
- F. Political philosophy
  - 1. Value of the individual
  - 2. Responsibilities of government to the citizen
- G. Trends in medicine

V. Current status in nursing

- A. Levels of education
- B. Influences on future developments

C. Importance of auxiliary personnel in care of the sick

VI. Summary

LESSON 2: MODERN HEALTH FACILITIES

OBJECTIVE: To help the student understand the types of modern health facilities and health services and become aware of the organizational plan of the modern hospital.

LESSON OUTLINE:

I. Introduction to purposes of lesson

II. Purposes of health facilities

- A. Care of the sick
- B. Prevention of illness
- C. Rehabilitation
- D. Education
- E. Research

III. Types of health facilities (local, state, and federal)

- A. For inpatient care
- B. For outpatient care

IV. Classification of hospitals

- A. According to primary purpose
- B. According to types of patients
- C. According to ownership
- D. According to size

V. Organization of the modern hospital

- A. Influences on organizational pattern
  1. Type
  2. Size
  3. Primary purpose
- B. Reasons for departmentalization

C. Organizational relatiohships

1. Vertical lines of authority and communication

2. Horizontal lines of authority and communication

D. Examples of hospital departments

VI. Summary

LESSON 3: MODERN NURSING

OBJECTIVE: To help the student understand modern nursing concepts which are basic to effective patient care.

LESSON OUTLINE:

I. Introduction to purposes of lesson

II. Philosophy of modern nursing

- A. In relation to education
  - 1. Importance of education at all levels
  - 2. Effects on functions performed (role)
- B. In relation to other health workers
- C. In relation to patients
  - 1. Worth of the individual
  - 2. Rights of all to receive health care
  - 3. Right to quality nursing

III. Nursing care patterns

- A. Functional method
- B. Case method
- C. Meaning of comprehensive nursing
- D. Meaning of team nursing

IV. Roles in nursing

- A. The supervisor
- B. The head nurse
- C. The team leader
- D. The nursing team
  - 1. Registered nurse

2. Licensed practical nurse

3. Nurses' assistant

4. Ward clerk

V. Hospital relations

A. Functions of nursing service

B. Worker relationships within nursing service

C. Interdepartmental relations

VI. Summary

LESSON 4: THE NURSES' ASSISTANT TODAY

OBJECTIVE: To help the student understand the role of the nurses' assistant and set personal objectives for developing the qualities and skills needed for effective performance.

LESSON OUTLINE:

I. Introduction to lesson

II. Importance of the nurses' assistant

III. Qualifications of the nurses' assistant

- A. Personal traits needed in care of the sick
- B. Personal habits to be developed
- C. Personal hygiene
- D. Relations with patients
- E. Attitudes
  1. Toward one's job
  2. Toward one's uniform
  3. Toward other people
  4. Toward oneself
  5. Toward the patient

IV. Functions of the nurses' assistant

- A. Variations
- B. Knowing policies of employing hospital
- C. Limitations
  1. As established by hospital policies
  2. As established by law
  3. As established by educational preparation
  4. As established by personal qualities

V. Setting personal objectives

A. Striving for excellence

B. Habit formation

C. Attitude toward learning

D. Attitude toward change

VI. Summary

UNIT II: UNDERSTANDING EFFECTS OF ILLNESS

TIME ALLOTMENT: 10 to 15 hours

OBJECTIVE: To help the student develop understanding of common effects of illness on patient, family, and community, and beginning skills in helping patients adjust to illness and/or hospitalization.

UNIT DESCRIPTION: A study of the diverse effects of illness on the patient, family, and community and the role of health workers in helping the patient and family to make adjustments.

SUGGESTED REFERENCES:

Abdallah. Nurse's Aide Study Manual.

Cherescavich. A Textbook for Nursing Assistants.

Knoedler. The Nurse Assistant.

LESSONS:

1. Common Effects of Illness
2. Common Reactions to Hospitalization
3. Aiding Adjustment to Illness and/or Hospitalization

LESSON 1: COMMON EFFECTS OF ILLNESS

OBJECTIVE: To help the student understand some common effects of illness and how the nurses' assistant applies such understanding in patient care.

LESSON OUTLINE:

I. Introduction

II. Those affected by illness

- A. Patient
- B. Family
- C. Community
- D. Health workers
- E. Others according to role of patient in society
- F. Others according to the type of illness

III. Effects of illness on the family

- A. According to the role of the patient
  1. The wage-earner
  2. The homemaker
  3. A child
  4. Elderly person
- B. According to the illness
  1. Accident
  2. Communicable disease
  3. Serious illness
  4. Chronic illness
  5. Illness having long-term effects

IV. Effects of illness on the patient

A. Psychological

1. Common emotional reactions

2. Possible mental changes

B. Physical

1. Examples of altered body function

a. Digestive disturbances

b. Joint diseases

2. Examples of loss of function

a. Fracture

b. Injury to sensory organs

3. Examples of general effects on body function

a. Loss of appetite

b. Problems in elimination

c. Changes in sleep patterns

d. Weakness

V. Using knowledge of effects of illness

A. To understand the patient

B. To understand the family

C. To understand self

VI. Summary

LESSON 2: COMMON REACTIONS TO HOSPITALIZATION

OBJECTIVE: To help the student understand how hospitalization may affect the patient and family and how such knowledge is applied in patient care.

LESSON OUTLINE:

I. Introduction

II. Reactions of the family

III. Reactions of the patient

IV. Influences on reactions

- A. Previous experience
- B. Attitudes toward hospitals
- C. The illness
  1. Symptoms
  2. Amount of pain
  3. Whether surgery is expected
- D. Behavior of hospital personnel

V. Examples of behaviors on admission to the hospital

VI. Summary

LESSON 3: AIDING ADJUSTMENT TO ILLNESS AND/OR HOSPITALIZATION

OBJECTIVE: To help the student understand the importance of patient-personnel relations, how to admit a patient according to hospital procedure, and how to help the patient and family make a beginning adjustment to hospitalization.

LESSON OUTLINE:

I. Introduction

II. Importance of first contact with personnel

- A. Effect of first hospital experience
  - 1. Judgment of hospital and staff
  - 2. Expectations regarding other experiences
- B. How to establish rapport
  - 1. With the patient
  - 2. With the family

III. Admission procedure of affiliating hospital

IV. Helping the patient to adjust

- A. Information on the unit
  - 1. Location of supplies
  - 2. Location of bathroom
  - 3. How to call the nurse
- B. Information on hospital routines
  - 1. Time for meals
  - 2. Doctor's rounds
- C. Giving opportunity for questions

V. Importance of each contact with personnel

VI. Summary

UNIT III: MAKING OBSERVATIONS ON PATIENTS

TIME ALLOTMENT: 45 to 50 hours

OBJECTIVE: To help the student develop beginning skill in making reliable observations on patients and in reporting to appropriate nursing personnel.

UNIT DESCRIPTION: A study of common effects of illness in relation to observations the nurses' assistant should be able to make and report with accuracy and dependability.

SUGGESTED REFERENCES:

Abdallah. Nurse's Aide Study Manual.

Anderson. Basic Patient Care.

Cherescavich. A Textbook for Nursing Assistants.

Knoedler. The Nurse Assistant.

Leake. A Manual of Simple Nursing.

LESSONS:

1. How to Make Reliable Observations
2. How to Observe Respiratory and Circulatory Function
3. How to Measure Body Temperature
4. How to Observe Body Specimens
5. General Observations to Be Reported

LESSON 1: HOW TO MAKE RELIABLE OBSERVATIONS

OBJECTIVE: To help the student understand the importance of observations on patients and develop beginning skill in using nursing vocabulary to report observations and other information on patients.

LESSON OUTLINE:

I. Introduction

II. Types of symptoms

A. Objective

B. Subjective

III. Making observations

A. Methods

1. Inspection

2. Palpation

3. Instrumental

B. How to be accurate

1. Knowing what to look for

2. Avoiding influence of opinion

3. Knowing how to use instruments

4. Knowing appropriate vocabulary

IV. Receiving subjective reports

A. Recognizing significance in patient's statement

B. Asking for more information

C. Separating statements of fact from assumptions

Example: "I have indigestion"

V. General rules for making observations

VI. General rules for reporting observations

VII. Summary

LESSON 2: HOW TO OBSERVE RESPIRATORY AND CIRCULATORY FUNCTION

OBJECTIVE: To help the student develop awareness of the importance of respiration and circulation, how to make reliable observations of respiratory and circulatory function, how to detect significant deviations from normal function, and how to avoid common errors in obtaining respiratory and pulse rates.

LESSON OUTLINE:

I. Introduction

II. Respiratory function

- A. Purpose
- B. Structures involved
- C. Why interference with respiration is serious
- D. How to count the respiratory rate
- E. Signs of abnormal function to be reported
- F. Vocabulary related to respiratory function

III. Circulatory function

- A. Purpose
- B. Structures involved
- C. Why changes in circulation may be serious
- D. How to count the pulse rate
- E. Signs of abnormal function to be reported
- F. Vocabulary related to circulatory function

IV. How to be reliable in observing respiration and pulse

- A. Common causes of error
- B. How to avoid errors

V. Summary

LESSON 3: HOW TO MEASURE BODY TEMPERATURE

OBJECTIVE: To help the student understand the significance of body temperature, how to take temperatures according to hospital procedures and aseptic principles, how to avoid error, and how to record information according to hospital practice.

LESSON OUTLINE:

I. Introduction

II. Influences on body temperature

III. Significance of change in body temperature

IV. Measurement of body temperature

- A. The clinical thermometer
  - 1. Structure
  - 2. How to take a reading
  - 3. How to shake the mercury down
  - 4. How to handle thermometer aseptically
    - a. Before use
    - b. After use
  - 5. Care of thermometers
- B. Areas used for measuring body temperature
- C. Methods
  - 1. Oral
  - 2. Rectal
  - 3. Axillary

V. How to be reliable in measuring body temperature

- A. Causes of error
- B. How to avoid errors

VI. Recording temperature, pulse, and respiration

VII. Summary

LESSON 4: HOW TO OBSERVE BODY SPECIMENS

OBJECTIVE: To help the student develop awareness of normal and abnormal characteristics of body specimens, indications of abnormal body function as related to specimens, and understanding of methods for collecting specimens and maintaining intake-output records.

LESSON OUTLINE:

I. Introduction

II. Types of specimens the assistant handles

A. Urine

B. Stool

C. Sputum

D. Emesis

III. Observations to be reported

A. Urine specimen

1. Abnormal color

2. Abnormal amount

3. Stones

B. Stool specimens

1. Abnormal color

2. Abnormal consistency

3. Parasites

C. Sputum

1. Consistency

2. Color

3. Amount

D. Emesis

1. Consistency

2. Color

3. Amount

4. Odor

IV. Observations on body functions

A. Voiding

1. Frequency and amount

2. Inability to void

3. Pain

B. Defacation

1. Frequency

2. Absence

3. Pain

C. Vomiting

1. Time of occurrence

2. Possible related factors

D. Coughing

1. Type

2. Whether productive

3. Frequency

V. Collecting specimens

A. Why specimens are collected

B. Principles related to collection of any specimen

C. Method

1. Urine

2. Stool

3. Sputum

D. Disposition of specimens

E. Reporting collection and disposition of a specimen

VI. Summary

LESSON 5: GENERAL OBSERVATIONS TO BE REPORTED

OBJECTIVE: To help the student develop awareness of general observations on patients which may be of significance and should be reported to appropriate personnel.

LESSON OUTLINE:

I. Introduction

II. Possible significance of general observations

III. Examples of observations to be reported

- A. Change in patient's color
  - 1. Skin
  - 2. Nails
  - 3. Conjunctiva
- B. Pain
- C. Changes in body function
- D. Changes in behavior
- E. Changes in mental state or orientation
- F. Unfavorable emotional states

IV. Rules for making reliable observations

V. Summary

UNIT IV: SAFETY MEASURES IN CARE OF THE SICK

TIME ALLOTMENT: 25 to 30 hours

OBJECTIVE: To help the student develop understanding of medical asepsis, safety, and emergency situations in relation to the role of the nurses' assistant.

UNIT DESCRIPTION: A study of methods used to protect patients and personnel from infections and accidents and the role of the nurses' assistant in the event of internal or external disaster.

SUGGESTED REFERENCES:

Abdallah. Nurse's Aide Study Manual.

Anderson. Basic Patient Care.

Cherescavich. A Textbook for Nursing Assistants.

Knoedler. The Nurse Assistant.

Leake. A Manual of Simple Nursing.

LESSONS:

1. Medical Asepsis
2. Fundamentals of Safety in Patient Care
3. Internal Disaster
4. External Disaster

LESSON 1: MEDICAL ASEPSIS

OBJECTIVE: To help the student understand basic information on microorganisms, the meaning of medical asepsis, and how to apply principles of asepsis in performance of hospital duties.

LESSON OUTLINE:

I. Introduction to lesson

II. Meaning of medical asepsis

III. Why aseptic technique is necessary

- A. Presence of microorganisms
  - 1. In environment
  - 2. In human body
    - a. On skin
    - b. In mouth and nose
    - c. In feces
    - d. In drainage from wounds
    - e. In genitourinary secretions
- B. How organisms are transmitted
- C. Common examples of organisms
- D. Transfer of organisms in hospitals

IV. Controlling transfer of organisms

- A. Clean technique
- B. Mechanical cleansing
- C. Disinfection
- D. Antisepsis
- E. Sterilization

V. Controlling bacteria in routine procedures

A. Bedmaking

B. Care of the unit

C. Handling bedpans

D. Handling patient property

E. Filling water pitchers

F. Handling linens

G. Preparing bathroom for patient use

VI. Hospital procedures

A. Cleaning the discharge unit

B. Disinfecting equipment

VII. Nursing technique

A. Clean

B. Sterile

VIII. Summary

LESSON 2: FUNDAMENTALS OF SAFETY IN PATIENT CARE

OBJECTIVE: To help the student understand common causes of accidents in hospitals, how to practice safety for self and others, how to use hospital equipment safely, and how to practice safety in common and special nursing situations.

LESSON OUTLINE:

I. Introduction

II. General rules for self-protection

III. General rules for safe practice

IV. Maintaining a safe environment for the patient

V. Safe use of movable equipment

- A. Wheelchairs
- B. Stretchers

VI. Safe use of electrical equipment

VII. Rules related to the patient's condition

- A. The blind patient
- B. The confused patient
- C. The unconscious patient
- D. The irresponsible patient
- E. The seriously ill patient

VIII. Rules related to the patient's age

- A. The infant and child
- B. The elderly patient

IX. Rules related to the patient's therapy

- A. Oxygen
- B. Radiation
- C. Drugs
- D. Heat and cold

X. Safety during patient care

A. The bath

B. Getting the patient out of bed

C. Ambulation

D. Performance of procedures

XI. Examples of common hospital accidents

A. To patients

B. To personnel

C. To public

XII. How to prevent accidents in the hospital

XIII. Summary

LESSON 3: INTERNAL DISASTER

OBJECTIVE: To help the student understand types of internal disaster which may occur in the hospital, the hospital plan for internal disaster, and how the nurses' assistant role is affected if internal disaster occurs.

LESSON OUTLINE:

I. Introduction

II. Meaning of internal disaster

III. Types of internal disaster

A. Explosions

1. Common causes

2. Effect on hospital function

3. Role of the assistant

4. Prevention

B. Fire

1. Common causes

2. Effect on hospital function

3. Role of the assistant

4. Prevention

C. Food poisoning

1. Common causes

2. Effect on hospital function

3. Role of the assistant

4. Prevention

IV. The hospital plan for internal disaster

V. Rules affecting all personnel in event of an internal disaster

VI. Summary

LESSON 4: EXTERNAL DISASTER

OBJECTIVE: To help the student understand the meaning of external disaster, the hospital plan for various types of external disasters, and the effect of external disaster on the role of the nurses' assistant.

LESSON OUTLINE:

I. Introduction

II. Meaning of external disaster

III. Types of external disaster

A. Industrial accidents

1. Common examples

2. Effects on the community

3. Effects on hospital functioning

4. Role of the assistant

B. Fires

1. Common examples

2. Effects on the community

3. Effects on hospital functioning

4. Role of the assistant

C. Transportation accidents

1. Common examples

2. Effects on the community

3. Effects on hospital functioning

4. Role of the assistant

D. Natural disaster

1. Common examples

2 Effects on the community

3. Effects on hospital functioning

4. Role of the assistant

IV. The hospital plan for external disaster

V. Rules affecting all personnel in event of an external disaster

VI. Summary

UNIT V: MEASURES TO PROMOTE THE PATIENT'S COMFORT

TIME ALLOTMENT: 35 to 40 hours

OBJECTIVE: To help the student develop beginning skills in those aspects of patient care appropriate to the role of the nurses' assistant.

UNIT DESCRIPTION: A study of bedside nursing procedures used in assisting patients with daily needs.

SUGGESTED REFERENCES:

Abdallah, Mary C. Nurse's Aide Study Manual.

Anderson, Maja C. Basic Patient Care.

Cherescavich. A Textbook for Nursing Assistants.

Knoedler, Evelyn L. The Nurse Assistant.

Leake, Mary. A Manual of Simple Nursing.

LESSONS:

1. Care of the Patient's Unit
2. Assisting the Patient with Personal Hygiene
3. Maintaining the Patient's Body Function
4. Diversional Activities

LESSON 1: CARE OF THE PATIENT'S UNIT

OBJECTIVE: To help the student develop understanding of nursing principles and beginning skill in performing procedures related to care of the patient's unit.

LESSON OUTLINE:

I. Introduction

II. Requirements of a comfortable environment

III. The patient's bed

- A. Requirements of a comfortable bed
- B. How to strip a bed
- C. How to make a bed
- D. Applying principles of asepsis

IV. Daily care of the unit

- A. The bedside table
- B. Other furniture
- C. Supplies
- D. Flowers

V. Summary

LESSON 2: ASSISTING THE PATIENT WITH PERSONAL HYGIENE

OBJECTIVE: To help the student develop understanding of nursing principles and beginning skill in performing procedures related to the patient's hygiene.

LESSON OUTLINE:

I. Introduction

II. Assisting the patient with daily bath

A. Bedbath

B. Tub or shower bath

III. Assisting the patient with oral hygiene

A. General mouth care

B. Care of dentures

C. Special mouth care

IV. Assisting the patient with grooming

A. Importance of grooming

B. Care of the hair

1. Routine

2. Long hair

C. Shaving the male patient

D. Care of hands and feet

E. Use of cosmetics

1. Makeup

2. Deodorants

3. Use of scented materials in the hospital

V. Summary

LESSON 3: MAINTAINING THE PATIENT'S BODY FUNCTION

OBJECTIVE: To help the student develop beginning skill in applying nursing principles to the performance of procedures related to maintaining body function.

LESSON OUTLINE:

I. Introduction

II. Assisting patients with their diets

III. Maintaining circulation

- A. The backrub
- B. Activity for the bed patient
  - 1. Change of position
  - 2. Movement of extremities
  - 3. Deep breathing
- C. Ambulation

IV. Maintaining joint mobility

- A. Passive exercise
- B. Encouraging patient use of joints

V. Maintaining urinary function

- A. Assisting patients to void
- B. Role of the assistant in relation to catheters
- C. Care of the incontinent patient
  - 1. Importance of frequent changing
  - 2. Trying to control incontinence
    - a. Scheduled voidings
    - b. Getting patient out of bed
- D. Intake-output records

VI. Maintaining bowel function

A. Importance of defecation record

B. Patients most likely to develop problems

C. Promoting regular elimination

D. Care of the patient with bowel incontinence

VII. Assisting the patient with nausea and vomiting

A. Effects of nausea on the patient

B. Assisting during episodes of vomiting

C. Measures to minimize nausea

VIII. Special skin care

A. Common causes of skin problems

B. Preventing irritation

C. Preventing skin breakdown

IX. Stimulating mental function

X. Results of nursing neglect

A. Physical

B. Emotional

C. Mental

XI. Summary

LESSON 4: DIVERSIONAL ACTIVITIES

OBJECTIVE: To help the student develop awareness of the importance of diversional activities for selected patients and understanding of types of diversional activities the nurses' assistant can promote.

LESSON OUTLINE:

I. Introduction

II. Purpose of diversion

III. Effects of diversional activities

IV. Types of patients needing diversion

V. Types of diversion the nurses' assistant can encourage

VI. Results of nursing neglect of diversional activities

VII. Summary

UNIT VI: MEASURES RELATED TO THE PATIENT'S ILLNESS

TIME ALLOTMENT: 80 to 85 hours

OBJECTIVE: To help the student develop beginning skill in the performance of nursing procedures related to care of the isolated patient, in carrying out orders for unsterile irrigations and simple therapeutic measures, and in meeting selected needs of the surgical patient.

UNIT DESCRIPTION: A study of simple procedures commonly ordered by the doctor and appropriate to the role of the nurses' assistant.

SUGGESTED REFERENCES:

Abdallah. Nurse's Aide Study Manual.

Anderson. Basic Patient Care.

Cherescavich. A Textbook for Nursing Assistants.

Knoedler. The Nurse Assistant.

Leake. A Manual of Simple Nursing.

LESSONS:

1. Care of the Patient in Isolation
2. Irrigations
3. Heat and Cold
4. Procedures Related to the Surgical Patient

LESSON 1: CARE OF THE PATIENT IN ISOLATION

OBJECTIVE: To help the student develop understanding of principles related to isolation precautions and beginning skill in carrying out isolation technique.

LESSON OUTLINE:

I. Introduction

II. Indications for isolation of a patient

A. Protection of the patient

B. Protection of others

III. Types of isolation

A. Mask only

B. Gown and mask

C. Gown and glove

D. Linen

E. Body materials

IV. Isolation technique

A. Handwashing

B. Gown

1. Putting gown on

2. Removing gown

3. Placement of gown for re-use

C. Mask

D. Glove

E. Protection of shoes

V. Procedure of affiliating hospital

A. Private room

B. Ward unit

VI. Nursing responsibilities to the patient in isolation

VII. Summary

LESSON 2: IRRIGATIONS

OBJECTIVE: To help the student develop understanding of related nursing principles and beginning skill in performance of selected irrigations as ordered by the physician.

LESSON OUTLINE:

I. Introduction

II. General purpose of irrigations

III. Areas of body commonly irrigated

IV. Enemas

- A. Purpose
- B. Types
- C. Administration
  1. Preparation of materials
  2. Preparation of patient
  3. Giving solution
  4. Assisting patient following enema
  5. Observing results
  6. Aftercare of equipment

V. Unsterile vaginal irrigation

- A. Purpose
- B. Types
- C. Administration
  1. Preparation of materials
  2. Preparation of patient
  3. Giving solution
  4. Assisting patient following irrigation

5. Observations to be reported

6. Aftercare of equipment

VI. Perineal irrigation

A. Purpose

B. Types

C. Administration

1. Preparation of materials

2. Preparation of patient

3. Pouring solution

4. Assisting patient following irrigation

5. Observations to be reported

6. Aftercare of equipment

D. Recent trends in relation to perineal cleaning

VII. Summary

LESSON 3: HEAT AND COLD

OBJECTIVE: To help the student develop understanding of related principles and beginning skill in performance of selected procedures involving use of heat or cold, as ordered by the physician.

LESSON OUTLINE:

I. Introduction

II. Effects of heat

A. Immediate

B. Prolonged

III. Effects of cold

A. Immediate

B. Prolonged

IV. How water bottle and/or K-pad

A. Preparation

B. Placement

C. Aftercare

V. Ice bag and/or K-Kooler

A. Preparation

B. Placement

C. Aftercare

VI. Unsterile compresses

A. Types

B. Technique

C. Procedure

D. Observations to be reported

VII. Sitz bath

A. Purpose

B. Technique

C. Procedure

D. Observations to be reported

E. Aftercare of equipment

VIII. Heat lamps

A. Purpose

B. Technique

C. Procedure

D. Observations to be reported

E. Aftercare of equipment

IX. Soaks

A. Types

B. Technique

C. Procedure

D. Observations to be reported

E. Aftercare of equipment

X. Responsibilities in using heat and cold

A. Related to effectiveness of treatment

B. Related to safety of the patient

XI. Summary

LESSON 4: PROCEDURES RELATED TO THE SURGICAL PATIENT

OBJECTIVE: To help the student develop awareness of the needs of surgical patients and beginning skill in performing selected aspects of preoperative and postoperative patient care.

LESSON OUTLINE:

I. Introduction

II. The surgical prep

- A. Purpose
- B. Areas to be shaved
- C. Procedure

III. Preparation of patient on day of surgery

- A. Bath
- B. Oral hygiene
- C. Care of hair
- D. Removal of nail polish
- E. Voiding

IV. Preparation of the surgical bed

- A. Purpose
- B. Procedure
- C. Supplies for the unit

V. The postoperative patient

- A. Importance of close observation by nursing personnel
- B. Assisting with voiding
- C. Comfort measure
- D. Intake and output records

VI. Summary

UNIT VII: BECOMING A HOSPITAL EMPLOYEE

TIME ALLOTMENT: 80 to 85 hours

OBJECTIVE: To help the student make the transition to a fully responsible employee role, fulfill citizenship responsibilities as a wage-earner, and set personal standards for quality performance as a member of the nursing team.

UNIT DESCRIPTION: A study of the nurses' assistant as a practitioner, with emphasis on effective job performance and fulfillment of citizenship responsibilities.

SUGGESTED REFERENCES:

Abdallah. Nurse's Aide Study Manual.

Anderson. Basic Patient Care.

Cherescavich. A Textbook for Nursing Assistants.

Knoedler. The Nurse Assistant.

Leake. A Manual of Simple Nursing.

LESSONS:

1. Being a Responsible Wage-Earner
2. Applying for and Resigning from a Position
3. Maintaining High Standards

LESSON 1: BEING A RESPONSIBLE WAGE-EARNER

OBJECTIVE: To help the student develop understanding of personal and citizenship responsibilities of the wage earner in a democratic society.

LESSON OUTLINE:

I. Introduction

II. Responsibilities of the wage-earner

A. To community

B. To family

C. To self

III. Taxation and wage-earner

A. Purpose of taxes

1. Local

2. State

3. Federal

B. Types of taxes

1. Sales

2. Excise

3. Income

4. On specific items

C. Benefits to the individual

D. Variations in taxation

E. How the good citizen views taxation

IV. Management of income

A. Use of a budget

B. Buying habits

1. Planned purchasing

2. Impulse buying

3. Cash payments

4. Credit buying

V. Planning for the future

A. Insurance

B. Savings plans

C. Investments

D. Retirement plans

VI. Summary

LESSON 2: APPLYING FOR AND RESIGNING FROM A POSITION

OBJECTIVE: To help the student develop understanding of how to apply for a position, how to leave a position, and how to maintain effective relationships with the employer.

LESSON OUTLINE:

I. Introduction

II. How to apply for a position

- A. Obtaining information on positions
- B. Filling in an application form
  - 1. General rules
  - 2. Giving references
- C. The interview
  - 1. Obtaining an appointment
  - 2. Appropriate dress
  - 3. Appropriate behaviors
  - 4. Answering questions
  - 5. Asking questions
- D. Accepting a position
  - 1. Verbal agreements
  - 2. Written agreements

III. Employer-employee relations

- A. What an employee owes the employer
- B. What the employer owes the employee

IV. How to leave a position

- A. Written notice of resignation
- B. The terminal interview

V. Summary

LESSON 3: MAINTAINING HIGH STANDARDS

OBJECTIVE: To help the student develop an appreciation for standards of excellence in nursing practice, respect for the role of the nurses' assistant, and a desire for continued growth as a person and as a practitioner.

LESSON OUTLINE:

I. Introduction

II. Qualities patients want in hospital personnel

III. Qualities nurses want in member of the nursing team

IV. Job satisfaction

- A. Meaning
- B. Why it is desirable
- C. Effect on performance

V. Striving for excellence as a practitioner

VI. Summary

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PML 1003

COURSE OUTLINE

PERSONAL CARE AND FAMILY AIDE

APRIL, 1966

Developed by:

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Consultant

CURRICULUM LABORATORY
DEPARTMENT OF COMMUNITY COLLEGES
STATE BOARD OF EDUCATION
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DATE: June 14, 1967

RE: (Author, Title, Publisher, Date) Martha Janes, R.N.; "Personal Care and Family Aide"; Curriculum Laboratory, N. C. Dept. of Community Colleges; April, 1966.

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Uses of Material Basis for lesson plans
Users of Material Teachers

(4) Requirements for Using Material:
Teacher Competency Registered nurse with public health experience
Student Selection Criteria Maturity, responsibility, and ability to function with minimal supervision
Time Allotment P

Supplemental Media --
Necessary _____ } (Check Which) P
Desirable _____

Describe

Source (agency)
(address)

INTRODUCTION

In recent years the demand for health services has been increasing, and shortages of health personnel continue to be critical. The Social Security Amendments of 1965 are expected to increase markedly the need for health workers at all levels and to require that health services be extended beyond those currently available.

In order to provide assistance to individuals and families with personal care and home-related problems, it is anticipated that relatively large numbers of nonprofessional workers must be prepared to assist in meeting demands for such service. It is hoped that this course outline will facilitate the pre-employment preparation of such workers through the institutions of the North Carolina Department of Community Colleges.

The course outline is designed to prepare enrollees to provide non-professional assistance with personal care and/or home-related problems. The overall purpose is twofold: to prepare individuals for employment and orientation to nonprofessional roles in community agencies; and, secondly, to prepare individuals to assist families with activities of homemaking and promotion of family well-being in situations not requiring professional direction. The graduate of the course is not qualified to render nursing care; hence role interpretation and guidance toward appropriate employment must be integral aspects of the instructional plan.

The course outline has been limited to general topics, because of the variety of work situations graduates may enter. Lesson plans developed within the framework of the outline should be adapted to meet the specific needs of each class in terms of local employment opportunities, requirements of agencies, and educational level of enrollees. The outline is designed for 220 hours of instruction, to include student activities designed to develop specific skills. By scheduling class time for four hours daily throughout one quarter, the educational institution may gain additional recruits among those who must retain their present jobs during the course. By scheduling more hours per day, the institution can have graduates available in a shorter period of time for employment and on-the-job training by community agencies. The need for non-professional employees in certain communities may be sufficiently urgent to justify this plan of scheduling, if enrollees can benefit from a full day of instruction.

Employment opportunities for the graduate include such areas as public health agencies, public welfare agencies, private agencies providing home services, institutions which provide care for dependent individuals, and families who need assistance with tasks not requiring professional supervision. Possible job titles for such roles include clinical aide, home aide, health

aide, homemaker's assistant , cottage parent, house parent, day-care aide, or kindergarten aide. Community opportunities for employment vary according to the types and numbers of local resources utilizing nonprofessional personnel to provide services to families and individuals. It is expected that the graduate who accepts employment in an agency or institution will receive thorough orientation, as this course is not designed to prepare the individual to function in any specific agency. Such on-the-job training should clarify and extend the employee's role by building on the basic preparation provided in this course.

Variability in community needs and opportunities, employment policies of agencies and institutions, and level of students' educational achievement, make it necessary to adapt the course content at the local level. Designing an instructional plan to meet community and student needs effectively can best be accomplished with the assistance of a local advisory committee, with representation from all service and health agencies in the community. This group should provide information and recommendations to the administration and faculty of the educational institution in regard to the following:

Community needs for nonprofessional service and health workers

Competencies students should be helped to develop

Employment criteria for nonprofessional personnel, as established by each local agency, local institution, or State Merit System

Minimum admission standards

Faculty requirements

Professional personnel available in the community to participate in the instructional program

The State Advisory Committee and various consultants have offered recommendations which may prove helpful as guidelines until specific policies can be developed locally.

The competencies students should develop are reflected in the course outline. Essentially these are encompassed by such generalities as the ability to follow instructions, ability to work effectively with professional personnel, skill in providing specific services to individuals and families, skill in adapting to a wide variety of home situations, basic understanding of human behavior and ability to work effectively with others, skill in organizing a work plan and in helping others to improve work and personal habits, and willingness to work within a specified role.

Employment policies of service and health agencies may vary from one community to another. In some cases, these policies may be established by the State Merit System. Representatives of these agencies and other potential employers thus can interpret these policies, which in turn will influence admission standards, course content, and graduation requirements.

A community survey will provide valuable information on employment opportunities. This survey should include public and private community agencies, institutions, day-care centers, and a sufficient sample of individual health and social service personnel to determine community needs for home services. If the needs of a specific agency are sufficient for enrollment of a class, the course should be adapted to the requirements of that agency. If it appears that graduates will enter diverse fields, the course should be kept general in nature. Student goals and employment opportunities in the community thus influence to a great extent the instructional plan developed by the faculty.

Admission standards will be affected by policies of potential employers in the community. Minimum requirements should include basic skills in communications and simple mathematics and demonstration of interest in and a desire to serve others in an assisting role. Until admission standards can be determined empirically, the following might serve:

Evidence of completion of eighth grade or equivalent, or

Schools and College Ability Test, Level 3: Verbal, 248
Quantitative, 254
Total, 254

The nature of the course is such that subject matter from a variety of fields is covered, though not in depth. It is probable that a registered nurse would have adequate preparation for teaching this content. The planning of lessons and student activities, utilization of community resources, and adapting course content to community needs will challenge the teacher's resourcefulness; therefore, prior experience in teaching and thorough familiarity with community resources are desirable. In addition to the coordinating teacher, numerous professional workers can be utilized where appropriate to provide specific information on agencies or to direct student activities. Such resource personnel include:

Social workers from public welfare agencies, Family Service Society, or health agencies

Public health nurses

Physical therapists

Occupational therapists

Nutritionists

Health educators

Special education teachers

All such participants in the instructional program should be thoroughly familiar with the purposes of the course, student level, and specific objectives for their areas of instruction.

Guidelines for this course outline have been provided by the Advisory Committee for the Home Health Aide:

Mrs. Martha Allan, R.N.	Wake County Health Department
Mr. H. K. Collins, President	Durham Technical Institute
Miss Miriam Daughtry, R.N.	Department of Community Colleges
Dr. William H. Denton	Department of Community Colleges
Mrs. Betty Elliott, R.N.	Mecklenburg Health Department
Miss Mary I. Gordon, R.N.	Department of Preventive Medicine University of North Carolina
Miss Nancy Hall	Forsyth County Department of Public Welfare
Miss Elizabeth Holley, R.N.	State Board of Health
Dr. Burns Jones	State Board of Health
Mrs. Betty McCrary	Rowan Technical Institute
Mrs. Myra J. Mitchiner	State Board of Public Welfare
Mrs. Jane Norwood	State Board of Public Welfare
Mrs. Annie May Pemberton	State Board of Public Welfare
Mr. Curtis Phillips	Rowan Technical Institute
Mr. Gene Phillips	Rowan Technical Institute
Miss Frances Sellars, R.N.	Wake County Health Department
Mr. Carl C. Staley, Jr.	State Board of Public Welfare
Mr. Robert Williams	W. W. Holding Technical Institute

Much appreciation is due this group for the valuable assistance provided, both through committee meetings and individual conferences.

A. J. Bevacqua
Coordinator
Curriculum Laboratory

COURSE DESCRIPTION

THE PERSONAL CARE AND FAMILY AIDE

A course designed to prepare students to render services to individuals and families who need assistance with personal care or home problems. Classroom teaching emphasizes interpersonal relationships, needs of individuals at various life stages, basic principles of nutrition and meal preparation, home organization and management, community resources, effects of illness on individuals and families, and methods for assisting individuals with the activities of daily living. Student activities are intended to develop specific skills needed for assisting others with personal care or with home activities.

The assisting role of the Personal Care and Family Aide is the focus of each lesson, with emphasis on limitations imposed by legal control of health workers, by policies of employing agencies and institutions, and by the short period of educational preparation.

PERSONAL CARE AND FAMILY AIDE

COURSE OBJECTIVES:

1. To promote interest in and concern for individuals or families with needs for personal care within the home or other setting.

2. To promote awareness of needs of individuals as influenced by age, illness, circumstance, heredity and environment.

3. To promote awareness of the challenges and satisfactions of helping others.

4. To promote understanding of health needs and other services as they influence the individual, the home and the community.

5. To prepare individuals to function safely and effectively in assisting individuals or families in various situations.

6. To promote understanding of the role of the Personal Care and Family Aide and limitations of that role imposed by educational preparation, legislation, and policies of the employer.

LENGTH OF COURSE: Approximately 220 hours.

LESSON I: INTRODUCTION TO HEALTH SERVICES

LESSON OBJECTIVE: To help the student understand the meaning and scope of health care, factors affecting health needs, types of health workers, and the role of the Personal Care and Family Aide as a member of the health team.

TIME ALLOTMENT: 12 hours.

OUTLINE OF LESSON:

I. Introduction to course

   A. Overview of course

   B. The meaning of health

      1. Physical

      2. Mental

      3. Emotional

   C. Influences on health

II. History of health and family services

   A. Past developments

   B. Present trends

III. Factors affecting health care

   A. Educational advances

   B. Social change

   C. Economic change

   D. Federal legislation

   E. Personal attitudes

IV. The service teams in various settings

   A. Team members

      1. Health

      2. Social service

      3. The recipient

B. Roles of team members

C. Interaction of team members

1. Relationships

2. Division of responsibilities

3. Advantages of team approach

D. Legal factors affecting roles and practice

V. Qualifications for the Personal Care and Family Aide

A. Personal habits

1. Those important for personal health protection

2. Those important for acceptance by others

B. Personal qualities

1. Meaning of personality

2. Desirable personality traits

C. Goals for improvement

VI. Personal Care and Family Aide as a member of the health team

A. Pre-employment preparation

1. Importance

2. Responsibilities

a. The school

b. The student

B. Employment

1. Agencies

2. Private employment

3. Work agreements

4. Social Security

5. Labor laws

6. Taxes

C. Ethics

1. Meaning

2. Importance

   a. Involvement in private affairs of others

   b. Knowledge of confidential information

   c. Access to property of others

3. Examples of ethical behaviors

   a. In relation to individuals or families being served

   b. In relation to members of the health team

   c. In relation to employment agreements

   d. In relation to role of the Aide

SUGGESTED RELATED ACTIVITIES:

1. Films available from the North Carolina State Board of Health:

   a. "Home Care"

   b. "Living Insurance"

   c. "Body Care and Grooming"

   d. "Helping Hands for Julie"

   e. "Almost a Miracle"

   f. "Cleanliness and Health"

   g. "The Human Body"

2. Visiting speakers: prospective employers, social workers, public health nurses, physical therapists, health educators, nutritionists, and others.

3. Have students prepare a list of desirable personal qualities for the Personal Care and Family Aide and rate themselves as "satisfactory" or "need to improve".

4. Have students prepare a daily health care calendar for themselves for the period of one year.

LESSON II: UNDERSTANDING HUMAN RELATIONSHIPS

LESSON OBJECTIVE: To help the student develop better understanding of human behavior in order to establish effective relationships with others.

TIME ALLOTMENT: 12 hours.

OUTLINE OF LESSON:

I. Introduction to lesson

II. Definitions

- A. Attitudes
- B. Behavior
- C. Emotions
- D. Worth of the individual

III. Basic needs of individuals

- A. Love
- B. Security
- C. Recognition
- D. Self-respect
- E. Others

IV. Influences on behavior

- A. Basic needs
  - 1. Characteristic behaviors when needs are not met
  - 2. Characteristic behaviors when methods of meeting needs are threatened
- B. Past learnings
- C. Interests and values
- D. Behavior of others
- E. Current circumstances
- F. Illness
- G. Others

V. Human relationships

A. Understanding self

1. Attitudes

a. Toward oneself

b. Toward one's job

c. Toward other individuals

2. Basic needs

3. Behavior habits

4. Relations with others

B. Understanding others

1. Causes of behavior

2. Effects of behavior

3. Personal influence on behavior of others

4. Behavioral change under stress

C. Communicating with others

1. In person

2. By telephone

VI. Making behavior acceptable to others

A. Appropriate attitudes

B. Acceptable behaviors

C. Effective communications

VII. Fulfilling responsibilities of the Personal Care and Family Aide

A. To individuals and families

B. To supervisors

C. To members of the service team

D. To others

SUGGESTED RELATED ACTIVITIES:

1. Films:

   a. "By Jupiter"

   b. "Working for Public Health Through Recognition of Feelings"

2. Group discussions:

   a. Development of favorable attitudes toward an uncooperative family

   b. How to overcome prejudice

3. Demonstration: Proper use of the telephone, by representatives from the telephone company

4. Handout pamphlet, available from Department of Mental Health, Raleigh:

   a. "Mental Health Is - - - 1,2,3"

LESSON III: UNDERSTANDING FAMILY LIVING

LESSON OBJECTIVE: To help the student become aware of differences in families and to understand how role of the Aide would vary according to family and the situation creating need for assistance.

TIME ALLOTTMENT: 8 hours.

OUTLINE OF LESSON:

I. Introduction to lesson

II. Principal functions of today's family

A. Reproduction

B. Physical, emotional, economic support

C. Education of children

D. Promoting responsible citizenship

III. Family relationships

A. Variations in family roles

1. Husband

2. Wife

3. Children

4. Others

B. Adult influence in the home

1. On children

2. On home environment

3. On economic resources

4. On home management

5. On health practices

6. On attitudes toward illness

C. Differences in families

1. Customs

2. Interests

3. Values

4. Financial responsibility

5. Respect for education

6. Interpretation of family roles

7. Religious practices

8. Desire for self-improvement

IV. Family responsibilities for health

A. Examples

1. Health protection

2. Teaching health habits

3. Securing medical attention when needed

4. Obtaining health information

B. Differences in acceptance of health responsibilities

V. Possible threats to family life

A. In relation to roles

1. Disagreement

2. Failure to fulfill responsibilities

B. Economic problems

C. Lack of discipline

D. Illness

1. When the "breadwinner" is ill

2. When the homemaker is ill

3. When a child is ill

VI. Role of the Personal Care and Family Aide

A. Using knowledge of family life

1. Roles

2. Effects of threat

3. Disorganization during illness

B. Adjusting to differences in families

C. Maintaining high personal standards

D. Respecting differences of others

E. Assisting in teaching good health practices

F. Relations with professional workers

SUGGESTED RELATED ACTIVITIES:

1. Films:

   a. "Family Life"

   b. "You and Your Family"

   c. "Home Again"

   d. "Roots of Happiness"

2. Group Discussions:

   a. Variations in family roles

   b. Variations in role of Aide in several situations

3. Speakers from community agencies:

   a. Public health nurse

   b. Medical social worker

   c. Case worker from public welfare

   d. Counselor from Family Service Society

LESSON IV: ORGANIZATION AND MANAGEMENT

LESSON OBJECTIVE: To help the student develop understanding of organization and management and beginning skill in applying principles to performance of duties.

TIME ALLOTMENT: 12 hours.

OUTLINE OF LESSON:

I. Introduction to lesson

II. Principles of organization

- A. Survey needs
- B. Construct a plan
- C. Proceed in logical sequence

III. General rules for home management

- A. Use of time
- B. Conservation of energy
- C. Utilization of space
- D. Utilization of equipment and materials
- E. Conservation of materials

IV. General rules for management of resources

- A. Use of a budget
- B. Buying habits
  - 1. According to needs
  - 2. Credit buying
- C. Planning ahead
  - 1. Insurance
  - 2. Savings
  - 3. Investments
  - 4. Retirement

V. Role of the Personal Care and Family Aide

A. Factors affecting role

1. Individual or family needs for assistance

2. Role of individual needing care

3. Age of individual needing care

4. Family members able to assume responsibilities

B. Developing a work plan

C. Examples of effective management

D. Examples of poor management

E. Setting a good example

F. Assisting family members with organization and management

G. Securing cooperation of family

SUGGESTED RELATED ACTIVITIES:

1. Time and motion studies on performance of household tasks. List ways to conserve time and energy.

2. Preparation of a personal or family budget.

3. Development of work schedule for a hypothetical family; group evaluation of individual schedules.

4. Practice in improvising equipment to use in a home lacking common conveniences.

5. Practice in use of automatic appliances.

6. Red Cross films on home nursing to illustrate improvision of equipment.

LESSON V: PROVIDING A SAFE HOME ENVIRONMENT

LESSON OBJECTIVE: To help the student recognize hazards in the environment and develop a sense of responsibility to provide a clean, safe environment.

TIME ALLOTMENT: 12 hours.

OUTLINE OF LESSON:

I. Introduction to lesson

   A. Meaning of environment

   B. Types of environment

      1. Physical

      2. Social

   C. Significant environmental influences on individuals

II. The environment and health

   A. Examples

      1. Favorable

      2. Unfavorable

   B. Modification of the environment to promote health

      1. Physical health

      2. Mental health

   C. Characteristics of a healthful environment

III. Principles of controlling the environment

   A. Providing a clean environment

      1. Prevention of disease

      2. Control of illness

      3. Control of insects and vermin

      4. Use of disinfectants

B. Providing a safe environment

1. Safe working practices

2. Correct use of equipment

3. Proper care of equipment

C. Improving the environment

1. Utilizing available resources

2. Improvising

IV. Hazards in the home

A. Types of hazards

1. Mechanical

2. Electrical

3. Burns

4. Poisons

5. Microorganisms

B. Elimination of hazards

1. Recognizing hazards

2. Methods of elimination

C. Causes of home accidents

1. Carelessness

2. Indifference

3. Ignorance

V. Common home emergencies

A. Examples

1. Those involving children

2. Those involving the elderly

3. Those common to other age groups

B. How to administer simple first aid

1. Principles to follow

2. Limiting factors

3. Legal implications

VI. Role of the Personal Care and Family Aide

A. In care of the environment

B. In control of hazards

C. In home emergencies

D. In relation to self-protection during performance of duties

SUGGESTED RELATED ACTIVITIES:

1. Films:

a. "Accidents Don't Just Happen"

b. "Too Young to Burn"

c. "Children at Play with Poison"

d. "Rescue Breathing"

e. "A Matter of Seconds"

f. "How to Have an Accident in the Home"

2. Laboratory demonstrations and practice in selected first aid measures.

3. Have students prepare a list of hazards in their own homes.

4. Practice in making simulated telephone reports of a home emergency:

a. To family physician

b. To agency supervisor

c. To police

d. To fire department

e. To rescue squad or ambulance service

5. Demonstration and practice(on model or Resusci-Anne)of resuscitation.

6. Lecture, demonstrations and supervised practice in use of fire extinquishers and home methods of extinquishing small fires. Should be directed by member of fire department.

LESSON VI: EFFECTS OF ILLNESS

LESSON OBJECTIVE: To help the student understand the effects of illness and begin to develop skill in recognizing ways the Personal Care and Family Aide assists individuals and families.

TIME ALLOTTMENT: 8 hours.

OUTLINE OF LESSON:

I. Introduction to the lesson

II. Effects of illness on the individual

A. Physiological

B. Emotional

C. Behavioral

III. Effects of illness on the family

A. According to role of the patient

1. Wage earner

2. Homemaker

3. Child

4. Elderly person

B. According to type of illness

1. Acute

2. Long-term

3. Chronic

4. Terminal

5. Communicable

6. Disabling accident

IV. Effects of illness on the home environment

A. Common problems

B. Examples of adjustments which may be needed

C. Recognizing illness as a threat

1. To adjustment

2. To self-image

V. Controlling effects of illness

A. Organization of home environment

1. To provide for needs of sick

2. To minimize family inconvenience

B. Maintenance of family unity

C. Provision of assistance by qualified persons

1. Role of professional staff

2. Role of Aides

VI. Role of the Personal Care and Family Aide

A. Using information about illness

1. To understand the patient

2. To understand the family

3. To make work plan

4. To protect self

B. Developing assisting skills

SUGGESTED RELATED ACTIVITIES:

1. Films:

a. "Living Insurance"

b. "Guard Your Heart"

2. Have students write a short paper on an illness they or someone else had and describe the effects observed

LESSON VII: NUTRITIONAL NEEDS

LESSON OBJECTIVE: To help the student understand basic principles of nutrition and the role of the Personal Care and Home Aide in assisting others to improve nutrition.

TIME ALLOTMENT: 20 hours.

OUTLINE OF LESSON:

I. Introduction to the lesson

II. The importance of nutrition

- A. Effects of good nutrition
- B. Effects of poor nutrition
- C. Purposes of food
- D. Functions of nutrients
- E. Sources of nutrients
- F. The "Basic Four"

III. Factors affecting nutritional needs

- A. Age
- B. Sex
- C. Activity
- D. Illness
- E. Faulty metabolism
- F. Other

IV. Meal planning

- A. Considerations
  1. Family size
  2. Food habits
  3. Age of family members
  4. Likes and dislikes

5. Religious restrictions

6. Special requirements

B. Advantages of a weekly menu

C. Providing a balanced diet

D. Food misinformation

V. Storage of foods

A. For convenience

B. For preservation

VI. Meal preparation

A. Definition of cooking terms

B. Preparation of meats

C. Preparation of vegetables

D. Preparation of eggs, fish and salads

E. Menu in relation to preparation time

F. Conservation of food nutrients

VII. Meal Serving

A. Attractive servings

B. Appropriate servings

1. In amount

2. According to age

3. According to needs

C. Table setting

D. Serving foods at proper temperatures

VIII. Sanitation in food handling

A. Prevention of spoilage

B. Prevention of contamination

C. Causes and effects of food poisoning

D. Importance of order in the kitchen

E. Proper preparation of dishes for washing

F. Sanitary methods of dishwashing

IX. Role of the Personal Care and Family Aide

A. Recognizing family need for guidance

B. Providing nutritional needs

1. For a family

2. For a dependent individual

SUGGESTED RELATED ACTIVITIES:

1. Films:

a. "Cooking: Kitchen Safety"

b. "Wonderful World of Food"

c. "More Food for Your Money"

d. "Food Preparation"

e. "An Outbreak of Salmonella Infection"

f. "Mr. Scattergerm", Parts II and III

g. "Better Breakfast"

h. "Design for Happy Mealtime"

i. "Four Food Groups"

j. "Nonfat Dry Milk"

k. "Nutrition: Sense and Nonsense"

l. "The Color of Health"

2. Field trips to food stores for practice in shopping techniques, selection of foods, price comparison and recognizing false advertising.

3. Preparation of sample menus to meet nutritional needs at various age levels.

4. Preparation of posters or charts to illustrate good or faulty nutrition.

5. Handout pamphlets, available from State Board of Health:

a. "A Guide to Good Eating"

b. "Food for Fitness"

c. "Foods to Build Red Blood"

d. "Make The Team With Good Nutrition"

e. ""Going Steady with Good Nutrition"

f. "Milk for Everyone"

g. "Does Your Child Eat A Good Lunch"

h. "Food For Everyone"

i. "Get Your Vitamins from the Food You Eat"

j. "Get Your Minerals"

k. "Mother, This is for You"

LESSON VIII: LIFE SPAN: CHILDHOOD AND ADOLESCENCE

LESSON OBJECTIVE: To help the student develop attitudes and skills necessary for assisting children with their needs at various stages of development.

TIME ALLOTMENT: 16 hours.

OUTLINE OF LESSON:

I. Introduction to the lesson

II. Factors affecting growth and development

A. Heredity

B. Environment

C. Nutrition

D. Illness or accident

III. Stages in development

A. Infancy

1. Physical growth

2. Motor development

3. Socialization

B. Pre-School

1. Physical growth

2. Motor development

3. Socialization

C. Childhood

1. Physical growth

2. Motor development

3. Socialization

D. Adolescence

1. Physical growth

2. Motor skills

3. Socialization

4. Common problems

IV. Needs of children

A. Physical

B. Intellectual

C. Emotional

D. Social

V. Typical behaviors of children

A. Infancy

B. Pre-School

C. Childhood

D. Adolescence

VI. Health protection of children

A. Prevention of illness

B. Prevention of accidents

C. Protection from threat and insecurity

VII. The child with special problems

A. Examples

B. General rules

1. Accept the child

2. Assist the child according to professional direction

3. Encourage independence

4. Assist the family

a. To accept child as he is

b. To carry out professional directions

VIII. Role of the Personal Care and Family Aide

A. In care of normal child

B. In care of sick child

C. In care of retarded child

SUGGESTED RELATED ACTIVITIES:

1. Films:

   a. "Bathing Your Baby"

   b. "Answering the Child's Why"

   c. "Meeting the Needs of Adolescents"

   d. "Fears of Children"

   e. "Introducing the Mentally Retarded"

   f. "Why Tommy Won't Eat"

   g. "Discovering Individual Differences"

   h. "Each Child is Different"

2. Visits to community facilities for child care

3. Field trip to a rehabilitation center

4. Make written assignment based on lesson content

5. Handout sheets, available from State Board of Health:

   a. "Accident Hazards-Birth to 6 Months"

   b. "Accident Hazards-6 Months to 2 Years"

   c. "Accident Hazards- 2 to 3 Years"

   d. "Accident Hazards- 3 to 6 Years"

   e. "Accident Hazards- 6 to 8 Years"

   f. "Accident Hazards- 8 to 12 Years"

LESSON IX: LIFE SPAN - ADULTHOOD

LESSON OBJECTIVE: To help students become aware of problems and needs of adults and how they may better assist adults with whom they work.

TIME ALLOTMENT: 8 hours.

OUTLINE OF LESSON:

I. Introduction to the lesson

II. Meaning of maturity

- A. Period of independence
- B. Accepting adult responsibilities
- C. Characteristics of the mature person

III. Factors influencing needs of adults

- A. Heredity
- B. Environment
- C. Attitudes
- D. Degrees of adjustment
- E. Physical influences

IV. Needs of young adults

- A. Physical
- B. Social
- C. Economic
- D. Establishment of a home
- E. Adjustments

V. Needs of the middle-aged person

- A. Physical
- B. Social
- C. Economic

D. A plan for the future

E. Adjustments

VI. Common problems of adulthood

A. Financial responsibilities

B. Rearing of children

C. Responsibilities

1. To family

2. To employer

3. To self

D. Outside pressures

E. Health problems

F. Adjustments

1. To the aging process

2. To loss of family members

3. To children leaving home

4. To use of time

5. Other

VII. Role of the Personal Care and Family Aide

A. Assisting in adjustments to illness

B. Recognizing own adjustments as an adult

SUGGESTED RELATED ACTIVITIES:

1. Speaker from or visit to a Family Service Society.

2. Written assignment based on lesson content.

LESSON X: LIFE SPAN: SENESCENCE

LESSON OBJECTIVE: To help students learn about the aging process, needs resulting from these changes, and the responsibilities of the Personal Care and Family Aide in assisting the elderly.

TIME ALLOTMENT: 8 hours.

OUTLINE OF LESSON:

I. Introduction to the lesson

II. Definitions

- A. Geriatrics
- B. Senescence
- C. Aging
- D. Senility

III. The aging process

- A. Effects
  - 1. Physical
  - 2. Mental
  - 3. Emotional
- B. Behavior changes
- C. Necessity for adjustments

IV. Needs during senescence

- A. Physical
- B. Psychological
- C. Social
- D. Spiritual

V. Problems of senescence

- A. Economic
- B. Housing

C. Loss of purpose

D. Threat of illness and accidents

E. Loss of family and friends

F. Inadequate community resources

G. Changes in body function

VI. Assisting the aging person

A. Recognizing problems, fears and insecurities

B. Obtaining assistance with spiritual needs

C. Encouraging self-care in activities of daily living

D. Protecting from hazards

E. Providing good nutrition

F. Providing good skin care

G. Understanding behavior

H. Maintaining individuality and independence

I. Maintaining body functions

J. Assisting in adjustments

1. Use of time

2. Personal habits

3. Social activities

4. Handling of finances

5. Family relationships

6. Acceptance of limitations

VII. Role of the Personal Care and Family Aide

A. Personal qualities needed to work with the aged

B. As a member of health team

C. As an employee of a social agency

D. As a family employee

SUGGESTED RELATED ACTIVITIES:

1. Films:
   a. "The Proud Years"
   b. "Second Chance"
   c. "Adventures in Maturity"
   d. "The Critical Decades"
2. Field trip to a nursing home.
3. Guest speakers or auxiliary instructional personnel:
   a. Public health nurse
   b. Social case worker
   c. Physical therapist
4. Handout folder, available from State Board of Health, Raleigh:
   a. "Safety For The Aging"

LESSON XI: ASSISTING OTHERS WITH PERSONAL CARE

LESSON OBJECTIVE: To help the student develop assisting skills in those aspects of personal care appropriate to the role of the Personal Care and Family Aide.

TIME ALLOTMENT: 80 hours

OUTLINE OF LESSON:

I. Introduction to lesson

II. Assisting others with personal care

- A. The bath
  - 1. Tub
  - 2. Shower
  - 3. Bed bath
- B. Oral hygiene
- C. Grooming
  - 1. Daily care of hair
  - 2. Shampoo
  - 3. Shaving
  - 4. Care of nails

III. Assisting with needs related to comfort and protection

- A. Bedmaking
- B. Turning and positioning
- C. Special skin care
- D. Getting in and out of bed

IV. Assisting with nutritional needs

- A. Feeding the patient
- B. Observing intake and output
  - 1. Measurement

2. Recording

V. Assisting with elimination

A. Promoting regularity

B. Using facilities

1. Bathroom

2. Bedside commode

3. Bedpan or urinal

C. Observing elimination

1. Significant changes

2. Reporting or recording

VI. Assisting with special needs

A. Encouraging oral medications

B. Encouraging medical care

C. Assisting with special exercises

D. Encouraging acceptance of special diet

E. Other

VII. Assisting with activity and diversion

A. Needs of various age groups

B. Needs of those with specific handicaps

C. Encouraging full participation according to professional direction

D. Encouraging acceptance of limitations

VIII. Making observations

A. Body temperature

1. How to read a clinical thermometer

2. How to take the temperature

3. Care of thermometers

B. Changes

1. Physical

2. Emotional

3. Behavioral

IX. Using and caring for equipment

A. Wheelchair

B. Crutches

C. Walker

D. Splint

E. Sling

F. Brace

G. The hospital bed

X. Role of the Personal Care and Family Aide

A. Developing assisting skills

B. Following professional direction

C. When to seek help from supervisor

D. Providing self-protection

1. Handwashing

2. Body mechanics

3. Practicing within specified role

SUGGESTED RELATED ACTIVITIES:

1. Teacher demonstrations of selected assisting skills. Note: It is suggested that a nursing procedure manual be used as a reference by the teacher for this lesson.

2. Student laboratory practice and return demonstrations of selected assisting skills.

3. Practice in taking and recording body temperature.

4. Practice in making accurate observations, reporting orally, and preparing written records.

5. Group discussions: How to cope with problems, such as the patient who refuses to take prescribed medication.

6. Student practice in providing diversion for various age groups and for those with special problems.

7. Practice in care and use of equipment.

8. Films:*

   a. "Handwashing in Patient Care"

   b. "Prevention of Disability from Stroke"

9. Home visits with members of the health team.

10. Suggested auxiliary instructional personnel:

    a. Social case worker

    b. Public health nurse

    c. Physical therapist

    d. Nutritionist

    e. Specialists in gerontology and/or care of exceptional children

11. Handout pamphlet, available from State Board of Health:

    a. "Home Nursing Handbook"

*Red Cross Home Nursing Care Films - a series of ten - may be ordered individually from State Board of Health, Film Library, or from the Red Cross. See "Health Education Visual Aids, 1965-66" (Catalogue of the Film Library), pages 65-66, for a description of each film.

LESSON XII: OBSERVING AND REPORTING

LESSON OBJECTIVE: To help the student understand the importance of observing and to develop beginning skill in making reliable observations and reporting to appropriate persons.

TIME ALLOTMENT: 4 hours.

OUTLINE OF LESSON:

I. Introduction to the lesson

II. Importance of reliable observations

A. To the physician

1. Diagnosis

2. Results of treatment

3. Planning care

4. Detecting new needs

5. Preventing complications

B. To supervisor

1. Evaluating change

2. Determining need for medical attention

3. Planning other referrals

4. Modifying services

III. Significant observations

A. Physical

1. Severe pain

2. Loss of consciousness

3. Changes in body functions

4. New symptoms

5. New complaints

6. Other

B. Mental change

C. Behavioral change

D. Change in capacity for self-care

IV. Reporting observations

A. Importance

B. General rules

1. Report to proper persons only

2. Be accurate

3. Have all information needed

4. Use judgment on what to report

5. Report at proper time

6. Report observations, not opinions

C. Oral reports

1. Principles

2. General rules

3. When to use

D. Written reports

1. Principles

2. General rules

3. When to use

4. Disposition

E. Legal implications

V. Role of the Personal Care and Family Aide

A. In making observations

B. In reporting to professional personnel

SUGGESTED RELATED ACTIVITIES:

1. Student practice in making oral and written reports.

2. Class discussion: The Aide and confidential information.

3. Further practice in making observations in a hypothetical situation.

4. Practice in identifying opinions, inconsistencies, inaccuracies, and misuse of terminology in oral or written reports.

5. Practice in identifying significant information in description of a patient's condition.

6. Films:

   a. "The Eye of the Beholder"

LESSON XIII: COMMUNITY HEALTH RESOURCES

LESSON OBJECTIVE: To help the student become aware of community resources and understand types of services available through community agencies.

TIME ALLOTMENT: 8 hours.

OUTLINE OF LESSON:

I. Introduction to the lesson

II. Conditions affecting community health

- A. Economic factors
- B. Education
- C. Medical services
- D. Health facilities
- E. Health education

III. Need for community health agencies

- A. For health protection
- B. For control of disease
- C. For assistance with special problems

IV. Agencies

- A. Types
  - 1. Official
    - a. Local
    - b. State
    - c. Federal
  - 2. Volunteer
- B. Examples
  - 1. Agencies which provide for community sanitation
  - 2. Agencies which promote safety

3. Agencies which assist with family problems

4. Agencies which promote health

V. Interaction of agencies

A. Interaction within the home

B. Importance of coordinated efforts

1. Avoiding duplication of services

2. Providing for comprehensive services

VI. Role of the Personal Care and Family Aide

A. Know of available agencies

B. Refer problems to supervisor

C. Know how to secure agency services

D. Promote community use of resources

SUGGESTED RELATED ACTIVITIES:

1. Field trips to community agencies.

2. Speakers from appropriate community agencies.

3. Handout pamphlet, available from State Board of Health:

a. "It's Your Health Department"

4. Film:

a. "Health In Our Community"

LESSON XIV: BECOMING AN EFFECTIVE PERSONAL CARE AND FAMILY AIDE

LESSON OBJECTIVE: To help the student prepare for employment, recognize responsibilities in applying for or leaving a position, and develop understanding of personal obligations as a citizen and as a participant in community services to others.

TIME ALLOTMENT: 12 hours.

OUTLINE OF LESSON:

I. Introduction to the lesson

II. Securing a position

- A. The letter of application
- B. The form of application
- C. The personal interview
  - 1. Making the appointment
  - 2. Importance of appearance
  - 3. Questions to be asked
- D. Contracts

III. Employer - employee relations

- A. Responsibilities of employer to employee
- B. Responsibilities of employee to employer

IV. Resigning a position

- A. The letter of resignation
- B. The terminal interview

V. Role of the Personal Care and Family Aide

- A. Job opportunities
- B. Limiting factors to role
  - 1. Policies of employing agency
  - 2. The Nurse Practice Act

3. Education and experience

4. Personal qualifications

C. Responsibilities to self

1. Continuing to grow as an individual

2. Setting goals for improvement

3. Achieving job satisfaction

SUGGESTED RELATED ACTIVITIES:

1. Practice in writing a letter of application.

2. Practice in writing a letter of resignation.

3. Role playing: the job interview.

4. Speakers from prospective employing agencies.

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*Single Copy

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COURSE OUTLINE

PSYCHIATRIC AIDE

June, 1966

Curriculum Committee:

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CURRICULUM LABORATORY
DEPARTMENT OF COMMUNITY COLLEGES
STATE BOARD OF EDUCATION
RALEIGH, NORTH CAROLINA

VT 00116

M E M O R A N D U M

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) Roger G. Worthington (Agency) Vocational-Technical Division Department of Community Colleges

(Address) Education Building, Raleigh, North Carolina 27602

DATE: June 15, 1967

RE: (Author, Title, Publisher, Date) Mary Elizabeth Milliken, "Psychiatric Aide"; Curriculum Laboratory, N. C. Dept. of Community Colleges; June, 1966.

Supplementary Information on Instructional Material

Provide information below which is not included in the publication. Mark N/A in each blank for which information is not available or not applicable. Mark P when information is included in the publication. See reverse side for further instructions.

(1) Source of Available Copies:
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(quantity prices)

(2) Means Used to Develop Material:
Development Group Curriculum committee of psychiatric nurses
Level of Group State and mental hospital
Method of Design, Testing, and Trial Tentative outline evaluated by committee, revised, used by selected institutions, evaluated by teachers, and revised and developed more fully to incorporate teacher suggestions.

(3) Utilization of Material:
Appropriate School Setting Hospital (mental) or educational agency in affiliation
Type of Program Pre-employment /with mental hospital
Occupational Focus Psychiatric aides
Geographic Adaptability N A
Uses of Material Lesson planning
Users of Material Teacher

(4) Requirements for Using Material:
Teacher Competency Registered nurse with psychiatric experience
Student Selection Criteria According to hospital employment requirements

Time Allotment P

Supplemental Media --
Necessary ____ } (Check Which) P
Desirable ____

Describe

Source (agency)
(address)

INTRODUCTION

With continuing shortages of professional personnel, there is urgent need for training programs to prepare nonprofessional workers for assisting with patient care in psychiatric institutions. This course outline has been developed to facilitate the offering of such courses through institutions of the North Carolina Department of Community Colleges, in affiliation with appropriate clinical facilities.

The outline covers classroom content and suggests student activities and clinical experiences to accompany each lesson. The teacher should further develop lesson topics and include laboratory and clinical learning experiences which are appropriate to the affiliating hospital.

Student practice in patient care should begin following Unit III, with the number of hours devoted to clinical practice increasing progressively until equal to or exceeding the time allotted to classroom instruction.

Time allotments stated in the course outline apply to classroom and nursing laboratory only. With the course scheduled for one quarter, the teacher will have a minimum of 148 hours for planned clinical experiences.

Students admitted to the psychiatric aide course should meet employment requirements of the affiliating hospital, in addition to admission criteria established by the sponsoring institution. Upon satisfactory completion of the course, each graduate will be presented a certificate of graduation by the sponsoring institution.

Course Description

PSYCHIATRIC AIDE

Designed to introduce students to basic concepts and skills needed for participating in the care of mentally and emotionally ill patients. Classroom study includes modern concepts in prevention of illness, rehabilitation, and care of the sick; basic procedures for care of patients; and the role of the psychiatric aide as a member of the health team. Correlated clinical practice provides opportunities to apply classroom learnings to care of patients, with the assistance and supervision of the teacher.

The Psychiatric Aide

COURSE OBJECTIVES:

To prepare qualified individuals for participation on the psychiatric health team by promoting

1. awareness of influences and variations in human behavior, both normal and deviant.
2. awareness of common mental and emotional illnesses.
3. understanding of the role of psychiatric aides in patient care and in relation to other members of the health team.
4. understanding of self as a means of improving interpersonal relationships and patient rapport.
5. beginning skill in performing selected aspects of patient care.
6. understanding of responsibilities as a citizen and as an employee of a psychiatric hospital.

LENGTH OF COURSE: Eleven weeks.

COURSE HOURS PER WEEK: Thirty to forty.

UNIT I: INTRODUCTION TO HEALTH SERVICES

TIME ALLOTMENT: 12 hours.

OBJECTIVE: To help the student acquire a general understanding of modern concepts of health, community health services, the health team, and the role of the psychiatric aide.

UNIT DESCRIPTION: Introduces the student to modern concepts of health, to health agencies, to the place of the psychiatric aide within the hospital organization, and to the responsibilities of the psychiatric aide as a member of the nursing team.

LESSONS:

1. The Psychiatric Aide as a Member of the Health Team
2. Community Health Agencies
3. Organization of Hospitals
4. Qualifications of Health Workers

SUGGESTED REFERENCES:

Robinson, Alice M. The Psychiatric Aide; Third Edition. Philadelphia: J. B. Lippincott Company, 1964.

Ross, Carmen F. Personal and Vocational Relationships in Practical Nursing; Second Edition. Philadelphia: J. B. Lippincott Company, 1965.

Thompson, Ella & LeBaron, Margaret. Simplified Nursing; Seventh Edition. Philadelphia: J. B. Lippincott Company, 1960.

LESSON 1: THE PSYCHIATRIC AIDE AS A MEMBER OF THE HEALTH TEAM

LESSON TIME: 3 hours.

OBJECTIVE: To introduce the student to modern concepts of health and to the role of the psychiatric aide.

OUTLINE OF LESSON:

I. Orientation to course
   - A. Purpose and objectives
   - B. Overview of the instructional plan
   - C. Policies affecting students
     1. Those of the educational agency
     2. Those of the affiliating hospital

II. Modern concepts of health
   - A. Meaning of health
   - B. Components of health
     1. Physical
     2. Mental
     3. Emotional
   - C. Health services
     1. Purposes
        - a. Prevention
        - b. Care of the sick
        - c. Rehabilitation
     2. Trends
     3. Community needs
     4. Types

III. Becoming a psychiatric aide

A. Adjustments

1. To student role

2. To the hospital environment

3. To responsibility for the well-being of others

B. Overview of psychiatric aide responsibilities

1. To the hospital

2. To the health team

3. To patients

4. To co-workers

5. To self

IV. Job descriptions

A. Purpose

B. Uses

C. Value to the employee

D. Example

Job description of psychiatric aide in the affiliating hospital

LESSON 2: COMMUNITY HEALTH AGENCIES

LESSON TIME: 3 hours.

OBJECTIVE: To help the student become aware of types of health agencies in the community, of services offered, and of the relationship of each to the affiliating hospital.

OUTLINE OF LESSON:

I. Types of health organizations
   - A. Official
     - 1. Meaning
     - 2. Examples
   - B. Volunteer
     - 1. Meaning
     - 2. Examples

II. Agencies concerned with health protection
   - A. Types
   - B. Functions
   - C. Examples
     - 1. Local
     - 2. State
     - 3. Federal

III. Agencies concerned with care of the sick
   - A. Types
     - 1. Hospitals
     - 2. Nursing homes
     - 3. Public health agencies

4. Nonresidential

5. Other

B. Examples

1. Local

2. State

3. Federal

IV. Agencies concerned with rehabilitation

A. Types

1. Hospital departments

2. Community agencies

B. Functions

C. Examples

1. Local

2. State

3. Federal

V. Agencies associated with affiliating hospital

A. Referring patients to the hospital

B. Offering follow-up services

VI. Role of the psychiatric aide in relation to health agencies

A. Promoting understanding of services available

B. Promoting community support

LESSON 3: ORGANIZATION OF HOSPITALS

LESSON TIME: 3 hours.

OBJECTIVES: To help the student understand about hospital organization, departmental functions, the importance of interdepartmental cooperation, and the place of the psychiatric aide in the organizational structure.

OUTLINE OF LESSON:

I. Hospitals
   - A. Purposes
   - B. Types
   - C. Departments

II. Understanding an organizational chart
   - A. Relationships
     - 1. Vertical
     - 2. Horizontal
   - B. Communication lines
   - C. Lines of authority

III. Hospital personnel
   - A. Those who aid in evaluation and diagnosis
   - B. Those who participate in therapeutic procedures
   - C. Those who provide other services

IV. Interdepartmental relations
   - A. Importance of each department
   - B. Necessity for effective communications
   - C. Maintenance of cooperative attitudes
   - D. Effects on patient care

V. The psychiatric aide

A. Within total organization of the hospital

B. Within nursing service

C. Relations with personnel of other departments

LESSON 4: QUALIFICATIONS OF HEALTH WORKERS

LESSON TIME: 3 hours.

OBJECTIVE: To help the student become aware of the knowledge, skills, and personal traits needed by members of the health team and to encourage each student to set personal goals for achievement and self-improvement.

OUTLINE OF LESSON:

I. Personal characteristics
   - A. Importance in relations with others
   - B. Relation to achievement and satisfactions in living
   - C. Examples

II. The patient's viewpoint
   - A. Importance of personnel-patient relationships
   - B. Potential effects of the health worker's characteristics
     - 1. Favorable
     - 2. Unfavorable

III. Needs of the psychiatric aide
   - A. Types of knowledge
   - B. Work habits
   - C. Personal traits
   - D. Attitudes

IV. How to improve personal qualities
   - A. Self assessment
   - B. Identification of changes needed
   - C. Setting goals
   - D. Developing a plan

V. Guidelines for personal growth as a psychiatric aide

UNIT II: MEETING MENTAL AND EMOTIONAL NEEDS

TIME ALLOTMENT: 20 hours.

OBJECTIVE: To help the student acquire basic knowledge and understanding of human behavior, common adjustment problems, and effects of mental and emotional needs on interpersonal relations.

UNIT DESCRIPTION: Introduces the student to some of the fundamentals of human behavior, life situations which require adjustment, defense mechanisms, and applications of knowledge about human behavior to personal living and to patient care.

LESSONS:

1. Understanding human behavior
2. Adjustment
3. Using Knowledge of Mental and Emotional Needs

SUGGESTED REFERENCES:

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LESSON I: UNDERSTANDING HUMAN BEHAVIOR

LESSON TIME: 12 hours.

OBJECTIVE: To help the student understand fundamentals of human behavior as related to interpersonal relations.

OUTLINE OF LESSON:

I. Personality development

   A. Infancy

   B. Preschool

   C. Six to twelve

   D. Adolescence

   E. Middle age

   F. Old age

II. The emotions

   A. Positive emotions

   B. Negative emotions

   C. Unhealthful use of emotions

   D. Healthful use of emotions

   E. Influence of emotions on behavior

III. Behavior

   A. Influences

   B. Habit patterns

   C. Interpretation

      1. Indication of emotional state

      2. Indication of degree of adjustment

      3. Indication of attitudes

      4. Indication of illness

IV. Defense mechanisms

A. Meaning

B. Purpose

C. Common examples

V. Influences on human relations

A. Understanding oneself

B. Understanding others

C. Using knowledge of behavior in interpersonal relations

VI. Related clinical activities

A. Assignment to selected patient

1. To observe behavior

2. To establish rapport

B. Conference

1. Report on behavior observed

2. Discussion of student-patient interaction

LESSON 2: ADJUSTMENT

LESSON TIME: 6 hours.

OBJECTIVE: To help the student understand common problems of adjustment and mechanisms used by people in attempting to cope with life situations.

OUTLINE OF LESSON:

I. Adjustment
   - A. Meaning
   - B. Examples
     1. Situations requiring adjustment
     2. Behavior changes to effect adjustment

II. Threats to adjustment
   - A. Problems of each developmental stage
   - B. Change in life situation
   - C. Crisis situations

III. Mechanisms of adjustment
   - A. Meaning
   - B. Examples
     1. Healthful
     2. Unhealthful

IV. Poor adjustment
   - A. Common causes
   - B. Degrees
   - C. Dangers

D. Some characteristics of a poorly adjusted person

E. General rules for improving adjustment

V. Related clinical activities

A. Assignment to selected patient

1. To observe behavior

2. To identify signs of poor adjustment

B. Conference

1. Report on patient behavior

2. Discussion of student-patient interaction

LESSON 3: USING KNOWLEDGE OF MENTAL AND EMOTIONAL NEEDS

LESSON TIME: 2 hours.

OBJECTIVE: To help the student understand how to apply knowledge of mental and emotional needs of people to patient care, to interpersonal relations, and to the student's own life situation.

OUTLINE OF LESSON:

I. Interpersonal relations
   - A. Meaning
   - B. Influences
   - C. Factors in improvement
     1. Developing self-understanding
     2. Striving to understand behavior of others

II. Mental health
   - A. Meaning
   - B. Influences
   - C. Factors in improvement
     1. Recognizing threats to adjustment
     2. Learning to cope effectively with life problems

III. Therapeutic use of self
   - A. Meaning
   - B. Influences
   - C. Examples
     1. Effective psychiatric aide-patient relations
     2. Changes in patient behavior as rapport develops

IV. The health team
   - A. Participants

B. How it functions

C. Role of the psychiatric aide

D. Team conferences

1. Purposes

2. Value in identifying and planning to meet mental and emotional needs

V. Related clinical activities

A. Assignment to social service

1. To observe admission procedure

2. To observe discharge procedure

3. To observe patient behavior

4. To observe interaction of social worker with patient

B. Assignment to admissions ward

1. To observe behavior

2. To observe patient for indications of emotional influence on behavior

3. To observe effects of personnel behavior on patient behavior

UNIT III: DAILY CARE OF PATIENTS

TIME ALLOTMENT: 60 hours.

OBJECTIVE: To help the student learn basic principles of patient care and specific procedures for assisting patients with their daily needs.

UNIT DESCRIPTION: Introduces the student to daily physical needs of patients, measures used to assist patients in meeting these needs, and measures for preventing or correcting problems related to daily needs. Emphasis is on the basic principles underlying nursing technique, performance of specific procedures, and development of skill in observing and reporting. Each student will have opportunities for supervised practice in the clinical area.

LESSONS:

1. Maintaining Body Cleanliness
2. Maintaining Good Nutrition
3. Maintaining Elimination Processes
4. Encouraging Appropriate Activities
5. Understanding and Influencing Sleep Patterns
6. Improving the Hospital Environment
7. Making and Reporting Observations

SUGGESTED REFERENCES:

Procedure Book of affiliating hospital.

Thompson, Ella & LeBaron, Margaret. Simplified Nursing; Seventh Edition. Philadelphia: J. B. Lippincott Company, 1960.

LESSON 1: MAINTAINING BODY CLEANLINESS

LESSON TIME: 12 hours.

OBJECTIVE: To help the student develop beginning skill in performance of procedures related to the patient's cleanliness and in recognizing and coping with related problems.

OUTLINE OF LESSON:

I. Cleanliness and grooming
   - A. Importance
     - 1. To self
     - 2. To others
   - B. Influences
     - 1. Early learning
     - 2. Illness
     - 3. Other

II. Common patient attitudes toward cleanliness
   - A. Excessive concern with cleanliness
   - B. Resistance to cleanliness

III. Procedures for maintaining cleanliness
   - A. The bath
     - 1. Bedbath
     - 2. Tub bath
     - 3. Shower bath
   - B. Care of hair
   - C. Care of hands, feet, and nails
   - D. Care of clothing

E. Use of cosmetics

F. Use of psychiatric razor

IV. Problems related to skin care

A. Irritated skin

B. Dry or scaly skin

C. Skin with poor circulation

1. Pressure areas

2. Extremities

V. Problems related to hair

A. Matted hair

B. Treatment of pediculosis

C. Giving a shampoo

D. Role of the beautician or barber in meeting special problems

E. Patient who resists care of the hair

VI. Problems related to oral hygiene

A. Patient with sordes

B. Patient with poor dental health

VII. Teaching the patient self-care

A. Recognizing readiness for self-care

B. Indications of need for learning hygienic habits

C. Ways to promote interest in self-care

VIII. Related clinical activities

A. Assignment to selected patient

1. To assist with physical care

2. To observe problems related to cleanliness and grooming

B. Conference

1. Problems encountered

2. Indications a procedure should be modified

3. Indications that self-care should be encouraged

C. Observation of special activities

1. "Charm class" for patients

2. Activities in beauty shop and barber shop

D. Performance of procedures

1. Mouthwash

2. Prescribed treatments for poor oral hygiene

3. Care of matted hair

4. Treatment of pediculosis

5. Giving a shampoo

6. Care of pressure areas

7. Care of decubitus ulcers

8. Use of lotions and creams for topical application

9. Use of heat lights

E. Cooperative planning with other workers

1. Planning with beautician on specific hair problem of a patient

2. Group planning for coping with patient attitudes or specific behaviors

LESSON 2: MAINTAINING GOOD NUTRITION

LESSON TIME: 8 hours

OBJECTIVE: To help the student understand body needs for a balanced diet, problems commonly resulting from poor diet, methods used to promote good nutrition for patients, and measures for coping with patients' nutritional problems.

OUTLINE OF LESSON:

I. The balanced diet
   - A. Meaning
   - B. Why the body needs a balanced diet
   - C. Effects of diet on health

II. Common dietary problems
   - A. The overweight patient
   - B. The underweight patient
   - C. The patient with poor eating habits
   - D. The patient on special diet
   - E. The patient who refuses food

III. Methods for assisting with the patient's nutrition
   - A. Feeding patients
   - B. Assisting patients to feed self
   - C. Assisting patient to develop improved eating habits
   - D. Use of special feeding methods
     1. Tube feeding
     2. Intravenous fluids
     3. Hypodermoclysis

IV. The intake record

A. Purpose

B. Methods for measuring intake

C. Recording intake

D. Significant observations related to diet and fluid intake

V. Common problems related to the patient's nutrition

A. The patient who refuses food

1. Possible reasons for refusal

a. Physical

b. Mental or emotional

2. Use of persuasion

3. Measures used when nutritional status is deteriorating

B. The patient who is unable to feed self

1. Principles for feeding a patient

2. Emotional needs of patients who must be fed

C. The patient with poor eating habits

1. Causes

2. Influencing eating habits

D. The patient who has difficulty swallowing

1. Dangers

2. Controlling choking during feeding

VI. Related clinical activities

A. Assignment to selected patient

1. To assist with meal

2. To observe for feeding problems

B. Performance of procedures

1. Feeding a patient

2. Measuring and recording intake

C. Observation of procedures

1. Tube feeding

2. Administration of parenteral fluids

LESSON 3: MAINTAINING ELIMINATION PROCESSES

LESSON TIME: 16 hours.

OBJECTIVE: To help the student understand the importance of elimination to health, significant observations related to processes of elimination, and measures used to correct problems of elimination.

OUTLINE OF LESSON:

I. Elimination of body wastes

   A. Routes

      1. Skin

      2. Respiratory system

      3. Urinary system

      4. Colon

   B. Relation to health

      1. Influences

      2. Individual variations

      3. Effects of waste accumulation

II. Normal function

   A. Urinary

      1. Characteristics of urine

      2. Average output

      3. Variations (nonpathologic)

   B. Bowel

      1. Characteristics of feces

      2. Average rate

      3. Variations

III. Common problems related to urinary function

A. The patient on output record

1. Review measurement of liquids

2. Recording urinary output

B. The patient with indwelling catheter

1. Purposes of indwelling catheter

2. Dangers of indwelling catheter

3. Daily care of indwelling catheter

4. Observing and recording changes related to urinary function

C. The patient with urinary incontinence

1. Effects of prolonged incontinence

a. Physical

b. Psychological

2. Nursing care

3. Positive approaches to re-establishing bladder control.

IV. Problems related to bowel function

A. Constipation

1. Prevention

2. Measures for correction

B. Impaction

1. Causes

2. Symptoms

3. Treatment

4. Prevention

C. Promoting effective bowel function

1. Daily habits

2. Laxatives

3. Suppositories

4. Enemas

D. Controlling loose stools

1. Possible causes

2. Observing and reporting loose stools

3. Measures commonly used to control loose stools

V. Administration of enemas

A. The cleansing enema

1. Purposes

2. Types of solutions commonly used

3. Preparation of enema

4. Methods of giving enemas

5. Observing and recording enema results

B. Other types of enemas

1. Purposes

2. Types of solutions

3. Preparation

4. Administration

VI. Insertion of suppositories

A. Procedure

B. Examples of suppositories used to promote elimination

VII. Role of the psychiatric aide

A. Observing and reporting significant observations

1. On urine

2. On feces

3. On patient habits

B. Recording

1. Output of urine

2. Bowel function

C. Influencing patient's habits

1. Intake of fluids

2. Diet

3. Regularity

D. Recognizing significant attitudes toward elimination

VIII. Related clinical activities

A. Assignment to selected patients

1. To observe elimination while performing daily care

2. To maintain output record

3. To observe urine and feces for abnormal characteristics

B. Performance of procedures

1. Enema

2. Insertion of suppository

LESSON 4: ENCOURAGING APPROPRIATE ACTIVITIES

LESSON TIME: 6 hours.

OBJECTIVE: To help the student learn about activity and diversion, measures commonly used to influence the patient's activities, and responsibilities of the psychiatric aide.

OUTLINE OF LESSON:

I. Activity

- A. Importance to health
- B. Influences
  - 1. Physical
  - 2. Mental and emotional
- C. Types of activity
  - 1. For the bedfast patient
  - 2. For ambulatory patients
  - 3. For patients with a specific disability

II. Diversion

- A. Meaning
- B. Purpose
  - 1. Group
  - 2. Individual
- C. Influences on selection of type for specific patient
- D. Types of diversional activities
- E. Possible effects
  - 1. Favorable
  - 2. Unfavorable

III. Common problems

A. The patient who is underactive

1. Possible reasons for inactivity

2. Measures for promoting patient participation

a. For the bedfast patient

b. For the ambulatory patient

B. The patient who is overactive

1. Possible reasons

2. Measures used to control excessive activity

IV. Responsibilities of the psychiatric aide

A. As a participant in planning

B. Encouraging patient activities as planned

C. Reporting and recording

1. Degree of participation

2. Apparent effects

V. Related clinical activities

A. Assignment to selected patients

1. To assist with daily needs, including activity

2. To observe and report patient response to activity and diversion

B. Participation in planning diversion for various types of patients

1. Bedfast

2. Overactive

3. Underactive

4. Cooperative

5. Resistant

C. Assignment or visit to hospital departments

1. Occupational therapy

2. Recreational therapy

3. Vocational rehabilitation

4. Physical therapy

LESSON 5: UNDERSTANDING AND INFLUENCING SLEEP PATTERNS

LESSON TIME: 4 hours.

OBJECTIVE: To help the student understand the importance of rest and sleep to health, some factors which alter sleep patterns, and measures used to influence the patient's sleep and rest.

OUTLINE OF LESSON:

I. Sleep and rest
   - A. Importance
     - 1. To physical health
     - 2. To mental and emotional health
   - B. Factors which affect sleep patterns
   - C. Significance of sleep patterns in disturbed patients

II. Measures used to control sleep and rest
   - A. General
   - B. Specific

III. Mental illness and sleep
   - A. Why sleep is affected
   - B. Common patterns
     - 1. The underactive patient
     - 2. The overactive patient

IV. Responsibilities of the psychiatric aide
   - A. In team planning for specific patients
   - B. In daily care of patients
     - 1. Following patient's plan
     - 2. Controlling naps

3. Promoting participation by patient in activities

4. Observing and recording patient behavior

a. Recognizing significant behavior or change

b. Using terminology related to activity, mental and emotional status, and behavior

V. Related clinical activities

A. Assignment to selected patient

1. To assist with daily care

2. To observe sleep and activity patterns

3. To implement plan for patient's sleep and activity

B. Conference

1. Observations on assigned patient

2. Group discussion of appropriate plans for patients

a. The patient who sleeps excessively

b. The patient who is unable to sleep

LESSON 6: IMPROVING THE HOSPITAL ENVIRONMENT

LESSON TIME: 6 hours.

OBJECTIVE: To help the student understand the importance of environment to patients and personnel, the measures necessary to maintain a clean and safe environment, and hospital procedures to be followed in specific situations.

OUTLINE OF LESSON:

I. Effects of environment
   - A. On personnel
   - B. On patients

II. Factors which influence environment
   - A. Cleanliness
   - B. Use of color
   - C. Lighting
   - D. Ventilation
   - E. Neatness
   - F. Safety
   - G. Human element

III. Care of the hospital environment
   - A. Daily cleaning
   - B. Terminal cleaning of a patient unit
   - C. Disinfection of an isolation unit
   - D. Creating favorable conditions
     1. Physical
     2. Social

IV. Hazards in the hospital environment

A. Accidents

1. To patients

2. To visitors

3. To personnel

B. Bacterial

C. Human

V. Prevention of accidents

A. Fire

B. Falls

C. Assault

D. Control of dangerous objects

VI. Hospital procedures

A. Fire plan

B. Moving patients

C. Reporting accidents

1. Patient

2. Personnel

VII. Related clinical activities

A. Practice in use of hospital equipment

1. Wheelchair

2. Stretcher

3. Hydraulic lift

4. Restraints

B. Participation in fire drill

C. Assignment to selected patient requiring use of hospital equipment

D. Conference

1. Hazards observed

2. Plan to correct existing hazard

3. Use of hospital forms for reporting an accident

   a. To a patient

   b. To self

LESSON 7: MAKING AND REPORTING OBSERVATIONS

LESSON TIME: 8 hours.

OBJECTIVE: To help the student understand types of observations which are significant, common terminology used in reporting observations, procedures for making oral reports, and procedures for making written reports.

OUTLINE OF LESSON:

I. Importance of observations
   - A. In diagnosis
   - B. In detecting change in condition
   - C. In evaluation of therapeutic plan

II. How to observe accurately
   - A. Knowing what to report
   - B. Making objective observations
   - C. Avoiding opinions and judgments

III. How to make reliable reports
   - A. Use of appropriate vocabulary
   - B. Making oral reports
   - C. Making written reports
     1. Use of the patient's chart
     2. Principles of charting
     3. Use of the daily notes
     4. Use of special forms

IV. Related clinical activities
   - A. Assignment to selected patient
     1. Daily care
     2. Observations on respiratory and circulatory functions
   - B. Practice in charting

UNIT IV: PROCEDURES

TIME ALLOTMENT: 40 hours.

OBJECTIVE: To help the student learn about aseptic technique and selected procedures related to care and observation of patients.

UNIT DESCRIPTION: Introduces the student to medical asepsis, selected therapeutic procedures, patient records, observations of patient condition, collection of specimens, and hospital policies in specific situations. Following classroom discussion of each procedure, students will have opportunities for supervised practice in the classroom and/or clinical area as opportunities arise. Emphasis is given to basic principles of technique related to each procedure studied.

LESSONS:

1. Medical Asepsis
2. Dressings and Bandages
3. Collection of Specimens
4. Observation of Cardinal Symptoms
5. Use of Heat and Cold as Therapeutic Measures
6. Care of the Body After Death

SUGGESTED REFERENCES:

Garnett, T. V. and Barbata, J. C. Collection of Laboratory Specimens and Diagnostic Procedures. Paterson, New Jersey: Littlefield, Adams and Company, 1964.

Procedure Book of affiliating hospital

Thompson, Ella & LeBaron, Margaret. Simplified Nursing; Seventh Edition. Philadelphia: J. B. Lippincott Company, 1960.

LESSON 1: MEDICAL ASEPSIS

LESSON TIME: 6 hours.

OBJECTIVE: To help the student learn principles of medical asepsis and develop beginning skill in applying aseptic technique to patient care.

LESSON OUTLINE:

I. Medical asepsis

   A. Meaning

   B. Importance

   C. Examples

II. Problems related to medical asepsis

   A. Presence of microorganisms

   B. Transfer of microorganisms

   C. Difficulties of destroying microorganisms

   D. Types of microorganisms to which hospital personnel are commonly exposed

   E. Responsibilities of the attendant in control of microorganisms

III. Control of microorganisms

   A. Antisepsis

      1. Meaning

      2. Methods

   B. Disinfection

      1. Meaning

      2. Methods

   C. Sterilization

      1. Meaning

      2. Methods

IV. Medical asepsis in nursing procedures

A. Importance

B. Examples of techniques applicable to procedures

1. Clean

2. Antiseptic

3. Sterile

V. Isolation technique

A. Purpose

B. Principles

C. Types

D. Procedure of affiliating hospital

VI. Related clinical activities

A. Demonstrations

1. Isolation technique

2. Medical asepsis as applied to routine ward duties

B. Assignment to selected patients

1. In isolation

2. Requiring special attention to aseptic technique in daily care

LESSON 2: DRESSINGS AND BANDAGES

LESSON TIME: 4 hours.

OBJECTIVE: To help the student develop beginning skill in applying various types of dressings and bandages with appropriate technique.

OUTLINE OF LESSON:

I. Dressings
   A. Purpose
   B. Types
      1. According to purpose
      2. According to materials
      3. According to technique

II. Bandages
   A. Purpose
   B. Types
   C. Influences on choice of type

III. Technique
   A. For applying dressings
      1. Clean
      2. Sterile
   B. For securing a dressing
      1. Small
      2. Large
   C. For applying bandages
      1. Roll
      2. Triangle

IV. Related clinical activities

A. Assignment to selected patients

B. Application of dressings

C. Application of bandages

LESSON 3: COLLECTION OF SPECIMENS

LESSON TIME: 3 hours.

OBJECTIVE: To help the student learn how to collect various types of specimens with appropriate technique and how to test a diabetic urine specimen.

OUTLINE OF LESSON:

I. Specimens
   - A. Importance
   - B. Types

II. Collection of specimens
   - A. Urine
     1. Single, voided
     2. Clean catch
     3. Twenty-four hour
     4. Special
   - B. Stool
   - C. Sputum
   - D. Throat
   - E. Skin lesion
   - F. Other

III. Specimens collected by the physician
   - A. Spinal fluid
   - B. Cervical smear
   - C. Fluid from a body cavity
   - D. Other

IV. Observing and recording information on specimens

A. Examples of significant observations

B. Related vocabulary

V. When to save a specimen

A. Potential value

B. Examples

C. Care

1. Preservation

2. Labeling

D. Reporting

VI. Diabetic specimens

A. Importance

B. Testing

1. For sugar

2. For acetone

C. Recording

1. Test results

2. Other information

VII. Related clinical activities

A. Procedures

1. Collection of a urine specimen

2. Testing of urine for sugar and acetone

3. Collection of a stool specimen

B. Observation of medical procedures

1. Lumbar puncture

2. Cervical smear

3. Aspiration of joint or body cavity

LESSON 4: OBSERVATION OF CARDINAL SYMPTOMS

LESSON TIME: 18 hours.

OBJECTIVE: To help the student understand the importance of the cardinal symptoms and develop beginning skill in obtaining and recording observations on temperature, pulse, respiration, and blood pressure.

OUTLINE OF LESSON:

I. The cardinal symptoms
   - A. Meaning
   - B. Importance
   - C. Individual variability
   - D. Possible significance of changes

II. Body temperature
   - A. Methods of measurement
     1. Oral
     2. Rectal
     3. Axillary
   - B. Care of the clinical thermometer
   - C. Avoidance of errors
   - D. Recording temperatures
     1. Graphic sheet
     2. Daily notes
   - E. Related vocabulary

III. The pulse
   - A. Sites for obtaining pulse rate
   - B. How to count the pulse rate

C. Other observations on pulse

D. Avoidance of errors

E. Recording observations on pulse

1. Graphic sheet

2. Daily notes

F. Related vocabulary

IV. Respiration

A. Obtaining the respiratory rate

B. Other observations related to respiration

C. Recording observations on respiration

1. Graphic sheet

2. Daily notes

D. Related vocabulary

V. Taking blood pressure

A. Method

B. Common causes of error

C. Recording

1. Graphic sheet

2. Daily notes

D. Related blood pressure

VI. Practice in recording observations

A. Graphic sheets

B. Daily notes

C. Other ward records or chart forms

VII. Related clinical activities

A. Practice in making observations

1. Temperature, pulse, and respiration

2. Blood pressure

3. Related symptoms

B. Practice in recording observations

1. Temperature, pulse, and respiration

2. Blood pressure

3. Related symptoms

LESSON 5: USE OF HEAT AND COLD AS THERAPEUTIC MEASURES

LESSON TIME: 6 hours.

OBJECTIVE: To help the student learn to perform therapeutic procedures involving the use of heat and cold.

OUTLINE OF LESSON:

I. Heat as a therapeutic measure

   A. Effects of heat

   B. Dangers in the use of heat

   C. Methods of applying heat

      1. Moist

      2. Dry

   D. Observing and recording patient reactions to heat

   E. Related vocabulary

II. Cold as a therapeutic measure

   A. Effects of cold

   B. Dangers in use of cold

   C. Methods

   D. Observing and recording patient reactions to cold

   E. Related vocabulary

III. Principles and techniques of selected procedures

   A. Utilizing moist heat

   B. Utilizing dry heat

   C. Utilizing cold

IV. Related clinical activities

A. Demonstrations

1. Hot water bottle

2. Ice bag

3. Sitz bath

4. Heat lamp

5. Compresses

a. Hot

b. Cold

6. Packs

a. Hot

b. Cold

B. Supervised practice in performance of selected procedures

LESSON 6: CARE OF THE BODY AFTER DEATH

LESSON TIME: 3 hours.

OBJECTIVE: To help the student understand the hospital procedure for care of a body after death and responsibilities of the psychiatric aide, including ethical and legal aspects.

OUTLINE OF LESSON:

I. Care of the body after death
   - A. Ethical aspects
   - B. Legal aspects

II. Procedure of affiliating hospital
   - A. Care of the body
   - B. Removal of the body
   - C. Forms to be completed

III. Role of the psychiatric aide

IV. Related clinical activities
   - A. Assisting in care of the body after death
   - B. Caring for the body with supervisory assistance
   - C. Completing all hospital forms

UNIT V: PATIENT PLACEMENT

TIME ALLOTMENT: 14 hours.

OBJECTIVE: To help the student understand hospital procedures related to patient assignment to a hospital area or to temporary absences from the area.

UNIT DESCRIPTION: Introduces the student to the procedures and hospital policies related to admission of patients, discharge of patients, absence from the hospital without permission, absence for home visitation, and transfer of patients from one hospital area to another. Emphasis is on the possible effects of changing status on the patient, responsibilities of the aide, and record-keeping for each situation.

LESSONS:

1. Admission of a New Patient
2. Discharge of a Patient
3. The Patient on Home Visitation
4. The Patient Absent Without Leave
5. Tranfer of Patients

SUGGESTED REFERENCES:

Procedure Book of affiliating hospital

Robinson, Alice. The Psychiatric Aide; Third Edition. Philadelphia: J. B. Lippincott Company, 1964.

Thompson, Ella & LeBaron, Margaret. Simplified Nursing; Seventh Edition. Philadelphia: J. B. Lippincott Company, 1960.

LESSON 1: ADMISSION OF A NEW PATIENT

LESSON TIME: 6 hours.

OBJECTIVE: To help the student learn to follow hospital procedure for admitting a patient and to have good interpersonal relations with patient and family.

OUTLINE OF LESSON:

I. Admission to the psychiatric hospital

- A. Effects
  - 1. On family
  - 2. On patient
- B. Importance of first personnel contacts with patient
  - 1. Establishing rapport
    - a. With patient
    - b. With family
  - 2. Observations
    - a. Patient-family relationship
    - b. Patient behavior
    - c. Appearance
    - d. Ability to communicate
- C. Responsibilities of social service department
- D. Responsibilities of the psychiatric aide

II. Common problems related to types of admissions

- A. Voluntary admission
- B. Commitment
- C. Emergency admission
- D. Medical certification

III. The admission ward

A. Purpose

B. Differences from other wards

C. Role of the aide on the admission ward

D. Procedure of affiliating hospital

1. Receiving the patient

2. Care of clothes

3. Observations to be recorded

4. Physical examination

IV. Setting up admission records

A. The patient's chart

B. Ward records

C. Forms for other departments

V. Related clinical activities

A. Assignment to the admitting office

B. Assignment to the admission ward

LESSON 2: DISCHARGE OF A PATIENT

LESSON TIME: 2 hours.

OBJECTIVE: To help the student learn to follow hospital procedure for discharging a patient and to maintain good rapport with patient and family throughout the discharge proceedings.

OUTLINE OF LESSON:

I. Importance of psychiatric aide-patient relations at time of discharge
   - A. Potential effects
   - B. How to terminate the relationship

II. Discharge procedure of affiliating hospital
   - A. Preparation of the patient
     1. Clothing and valuables
     2. Grooming
     3. Instructions for aftercare
        - a. Importance
        - b. Responsibilities
   - B. Notification of other departments
   - C. Hospital policies related to discharge

III. Closing the patient's chart
   - A. Final comments
     1. Significant observations
     2. Name of person accepting responsibility for patient
   - B. Final disposition

IV. Discharge and readmission trends

A. Recent statistics

B. Influences

C. Rates for affiliating hospital

V. Aftercare

A. Importance

B. Responsibilities

1. Planning

2. Provision of services

C. Agencies

1. Clinics

2. Halfway houses

D. Role of the family

E. Common problems

VI. Related clinical activities

A. Assignment to patient scheduled for discharge

B. Discharge of a patient

LESSON 3: THE PATIENT ON HOME VISITATION

LESSON TIME: 2 hours.

OBJECTIVE: To help the student learn to follow hospital procedure for releasing patients for home visitation, to keep records related to home visitation, and to be aware of potential problems associated with home visitation.

OUTLINE OF LESSON:

I. Home visitation
   - A. Purpose
   - B. Variations
   - C. Responsibilities

II. Procedures
   - A. Preparation of patient
   - B. Release to family
   - C. Records
   - D. Reception of the returned patient
     1. Observations
     2. Records

III. Potential problems
   - A. The patient who does not return when scheduled
   - B. The patient who is disturbed on return to hospital

IV. Related clinical activities
   - A. Participation in team conference
     1. Patient being considered for home visitation
     2. Patient who is disturbed on return

B. Preparation and release of patient for home visitation

C. Reception of a patient returning from home visitation

LESSON 4: THE PATIENT ABSENT WITHOUT LEAVE

LESSON TIME: 2 hours.

OBJECTIVE: To help the student understand responsibilities of the psychiatric aide when a patient is found to be absent from the hospital without leave.

OUTLINE OF LESSON:

I. Absence without leave

   A. Why patients leave without permission

   B. Types of patients likely to leave

II. Procedure when a patient is missing from assigned area

   A. Whom to notify

   B. Forms to fill out

   C. Notations on the patient's chart

III. Procedure when patient is found

   A. Whom to notify

   B. Forms to fill out

   C. Observations

   D. Notations on the chart

IV. Related clinical activities

   A. Note policies of assigned area which are for the purpose of preventing absence without leave

   B. List steps the psychiatric aide would follow if a very disturbed patient is missing from the assigned area

LESSON 5: TRANSFER OF PATIENTS

LESSON TIME: 2 hours.

OBJECTIVE: To help the student learn to follow hospital procedure in transferring patients, to take all necessary precautions, and to keep records associated with transfer of a patient from one hospital area to another.

OUTLINE OF LESSON:

I. Patient transfer
   - A. Reasons
   - B. Common reactions of the patient

II. Transfer procedure of affiliating hospital
   - A. Preparation of patient
   - B. Notification of other departments
   - C. Escort for the patient
   - D. Orientation of transferred patient to new area
     1. Personnel
     2. Other patients
     3. Ward policies
   - E. Changes on chart
   - F. Changes on ward records

III. Common problems related to transfer
   - A. Causes
   - B. Prevention

IV. Related clinical activities
   - A. Assisting with transfer of patient to another area
   - B. Receiving and orienting a patient who has been transferred to the student's assigned ward

UNIT VI: CARE OF PSYCHIATRIC PATIENTS

TIME ALLOTMENT: 30 hours

OBJECTIVE: To help the student learn about common manifestations of mental and emotional illness and their influence on hospital organization and patient care.

UNIT DESCRIPTION: Introduces the student to common psychiatric conditions, therapeutic principles, and the role of the psychiatric aide in caring for patients with selected manifestations of mental or emotional illness.

LESSONS:

1. Placement of Patients
2. Care of Patients With Mental and Emotional Disorders
3. The Therapeutic Milieu

SUGGESTED REFERENCES:

Muller, T. G. Fundamentals of Psychiatric Nursing. Paterson, New Jersey: Littlefield, Adams and Company, 1962.

Robinson, Alice. The Psychiatric Aide; Third Edition. Philadelphia: J. B. Lippincott Company, 1964.

Ross, Carmen F. Personal and Vocational Relationships in Practical Nursing. Philadelphia: J. B. Lippincott Company, 1961.

LESSON 1: PLACEMENT OF PATIENTS

LESSON TIME: 4 hours.

OBJECTIVE: To help the student understand the purposes of patient placement, the differences in types of hospital wards, and the effects on personnel responsibilities.

OUTLINE OF LESSON:

I. Patient assignment

   A. Influences

   B. Purpose of specialized wards

II. The closed ward

   A. Purpose

   B. Rules

   C. Schedules

   D. Responsibilities

      1. Patient

      2. Psychiatric aide

   E. Identification of closed wards in affiliating hospital

III. The open ward

   A. Purpose

   B. Rules

   C. Schedules

   D. Responsibilities

      1. Patient

      2. Psychiatric aide

   E. Identification of open wards in affiliating hospitals

IV. The convalescent ward

A. Purpose

B. Rules

C. Schedules

D. Responsibilities

1. Patient

2. Psychiatric aide

E. Identification of convalescent wards in affiliating hospital

V. Related clinical activities

A. Assignment to open ward

B. Assignment to closed ward

C. Assignment to convalescent ward

LESSON 2: CARE OF PATIENTS WITH MENTAL AND EMOTIONAL DISORDERS

LESSON TIME: 20 hours.

OBJECTIVE: To help the student develop beginning understanding of nursing principles related to care of selected patients with mental or emotional disorders.

OUTLINE OF LESSON:

I. Psychiatric nursing

   A. Trends

   B. Basic principles

II. Functional disorders

   A. Characteristic behavior

   B. Significant observations

   C. Progress notes

   D. Therapeutic management

   E. Role of the psychiatric aide

III. Organic disorders

   A. Characteristic behavior

   B. Significant observations

   C. Progress notes

   D. Therapeutic management

   E. Role of the psychiatric aide

IV. The withdrawn patient

   A. Characteristic behavior

   B. Significant observations

   C. Progress notes

D. Therapeutic management

E. Role of the psychiatric aide

V. The patient with affective disorder

A. Characteristic behavior

B. Significant observations

C. Progress notes

D. Therapeutic management

E. Role of the psychiatric aide

VI. The patient with personality disorder

A. Characteristic behavior

B. Significant observations

C. Progress notes

D. Therapeutic management

E. Role of the psychiatric aide

VII. The psychoneurotic patient

A. Characteristic behavior

B. Significant observations

C. Progress notes

D. Therapeutic management

E. Role of the psychiatric aide

VIII. The convulsive patient

A. Characteristic behavior

B. Significant observations

C. Progress notes

D. Therapeutic management

E. Role of the psychiatric aide

IX. The mentally retarded patient

A. Characteristic behavior

B. Significant observations

C. Progress notes

D. Therapeutic management

E. Role of the psychiatric aide

X. The alcoholic patient

A. Characteristic behavior

B. Significant observations

C. Progress notes

D. Therapeutic management

E. Role of the psychiatric aide

XI. The drug addict

A. Characteristic behavior

B. Significant observations

C. Progress notes

D. Therapeutic management

E. Role of the psychiatric aide

XII. Related clinical activities

A. Assignment to selected patients

B. Patient-care conferences

1. With instructor

2. With professional staff

LESSON 3: THE THERAPEUTIC MILIEU

LESSON TIME: 6 hours.

OBJECTIVE: To help the student understand the meaning of the therapeutic milieu and its various aspects.

OUTLINE OF LESSON:

I. The therapeutic milieu
   - A. Meaning
   - B. Influences
   - C. Aspects
     1. Physical
     2. Social
   - D. Role of the psychiatric aide

II. Personnel-patient relations
   - A. Attitudes
     1. Of psychiatric aide
     2. Of patient
     3. Indications
        - a. Verbal
        - b. Non verbal
     4. Effect on behavior
   - B. Influencing patient behavior
     1. Objective methods
     2. Subjective methods

III. Patient relations with other members of health team

(Selected representative speakers from various hospital departments)

IV. Related clinical activities

A. Observation and/or participation in work of other departments

B. Assignment to selected patients

C. Oral or written reports

1. Case studies

2. Therapeutic milieu interpreted in terms of needs of a specific patient

UNIT VII: BECOMING A HOSPITAL EMPLOYEE

TIME ALLOTMENT: 6 hours.

OBJECTIVE: To help the student understand personal responsibilities as a hospital employee and as a citizen.

UNIT DESCRIPTION: Promotes further understanding of hospital policies and procedures, job relationships, procedures for applying for or resigning from a position, role of the psychiatric aide as a member of the health team, and various aspects of citizenship.

LESSONS:

1. Assuming Responsibility as a Psychiatric Aide
2. Applying for or Resigning from a Hospital Position
3. Citizenship Responsibilities

SUGGESTED REFERENCES:

Ross, Carmen F. Personal and Vocational Relationships in Practical Nursing. Philadelphia: J. B. Lippincott Company, 1961.

Thompson, Ella & LeBaron, Margaret. Simplified Nursing; Seventh Edition. Philadelphia: J. B. Lippincott Company, 1960.

LESSON 1: ASSUMING RESPONSIBILITY AS A PSYCHIATRIC AIDE

LESSON TIME: 2 hours.

OBJECTIVE: To help the student learn about factors which promote good employer-employee relations.

OUTLINE OF LESSON:

I. What the hospital can expect of employees

   A. Personnel policies

      1. Purpose

      2. Advantages of written policies

         a. To the employee

         b. To the hospital

   B. Employee behaviors

      1. Performance of duties

      2. Interpersonal relations

         a. With supervisors

         b. With co-workers

         c. With patient and family

      3. Off-duty behavior

   C. Appropriate employee attitudes

II. What the employee can expect of the employing hospital

   A. Written personnel policies

      1. Importance

      2. Topics to be covered

   B. Written rules and regulations

   C. Provision for handling of grievances

D. Concern with working conditions

E. Provision for personal development

LESSON 2: APPLYING FOR OR RESIGNING FROM A HOSPITAL POSITION

LESSON TIME: 2 hours.

OBJECTIVE: To help the student learn appropriate behavior when applying for a position or when resigning from a position.

OUTLINE OF LESSON:

I. The personnel office
   - A. Importance of first impressions
   - B. Factors which influence judgments
   - C. General rules for making a favorable impression

II. Applying for a position
   - A. Applications
     1. By letter
     2. Telephone inquiry
     3. Completing an application form
   - B. The job interview
   - C. References

III. Resigning from a position
   - A. The letter of resignation
   - B. The terminal interview
   - C. Importance of leaving a favorable record

IV. Student activities
   - A. Letter-writing
   - B. Role playing
     1. Application interview
     2. Terminal interview

LESSON 3: CITIZENSHIP RESPONSIBILITIES

LESSON TIME: 2 hours.

OBJECTIVE: To help the student be more aware of the responsibilities of adults in relation to community activities and personal living.

OUTLINE OF LESSON:

I. Citizenship

   A. Meaning

   B. Privileges

   C. Responsibilities

   D. Examples of good citizenship

II. Responsibilities in personal living

   A. Observance of community regulations

   B. Cooperation with others to promote group well-being

   C. Fulfillment of financial responsibilities

III. Responsibilities in the community

   A. Support of activities

   B. Loyalty to hospital

   C. Promotion of health

   D. Provide good example

      1. Citizenship

      2. As representative of the health team

   E. Support of community costs

REFERENCES

Babcock, Dorothy E. Introduction To Growth, Development, and Family Life. Philadelphia: F. A. Davis Company, 1962.

Bailard, Virginia and Strang, Ruth. Ways To Improve Your Personality. New York: McGraw-Hill Book Company, 1951.

Committee on Psychiatric Nursing, Group for the Advancement of Psychiatry. Toward Therapeutic Care. New York: Springer Publishing Company, Inc., 1961.

Crawford, A. L. and Buchanan, B. S. Psychiatric Nursing - A Basic Manual. Philadelphia: F. A. Davis Company, 1961.

Garnett, T. V. and Barbata, J. C. Collection of Laboratory Specimens and Diagnostic Procedures. Paterson, N. J.: Littlefield, Adams and Company, 1964.

Gibson, John. Psychiatry for Nurses; Second Edition. Philadelphia: F. A. Davis Company, 1965.

Hall, B. H. et al. Psychiatric Aide Education. New York: Grune and Stratton, 1952.

John, Audrey L. et al. The Nurse in Mental Health Practice. Geneva: World Health Organization, 1963.

Minnesota Department of Public Welfare. Practical Psychiatric Nursing. Report of a Pilot Training and Evaluation Project for Psychiatric Aides, 1962.

Muller, T. G. Fundamentals of Psychiatric Nursing. Paterson, N. J.: Littlefield, Adams and Company, 1962.

Robinson, Alice. The Psychiatric Aide; Third Edition. Philadelphia: J. B. Lippincott Company, 1964.

Ross, Carmen F. Personal and Vocational Relationships in Practical Nursing; Second Edition. Philadelphia: J. B. Lippincott Company, 1965.

Schwartz, M. S. and Shockley, E. L. The Nurse and the Mental Patient. New York: Russell Sage Foundation, 1956.

Thompson, Ella and LeBaron, Margaret. Simplified Nursing; Seventh Edition. Philadelphia: J. B. Lippincott Company, 1960.

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

JUL 15 1965

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SELECTED REFERENCE BOOKS

FOR

DEPARTMENTS OF VOCATIONAL AGRICULTURE

Service Bulletin
Number Four

Department of Agricultural Education

The University of Arizona

Tucson

VT000350

SELECTED REFERENCE BOOKS

FOR

DEPARTMENTS OF VOCATIONAL AGRICULTURE

Service Bulletin
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Department of Agricultural Education

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FOREWORD

This list is intended to serve as a guide for teachers and administrators in selecting reference books for departments of vocational agriculture in Arizona. While considerable study has been given to finding the best references for conditions in the state, the list does not include all books that would be of value in a department library. Effort has been made to keep the list small enough to come within the scope of department budgets, and the books listed have been carefully examined and evaluated.

Vocational agriculture teachers and supervisors in Arizona were requested to give suggestions on useful text and reference materials, and their suggestions have been included. Subject matter specialists in the College of Agriculture, The University of Arizona, assisted in evaluating books in the several fields.

The numbers after the title of the book refer to the list of publishers and book distributors in the front of this bulletin.

Asterisks have been used to indicate the probable usefulness of the various volumes in departments of vocational agriculture. This evaluation is only a suggestion to the teacher who may not be familiar with all of the books listed. The list has been classified into three groups as follows:

**Books that should be in every department library in multiple copies sufficient for student use.

*Those of value as a single copy reference for teacher and students. (The purchase of more than one copy of a book marked with one or no asterisk may be advisable in some departments when the book covers an enterprise of particular importance in the community.)

Titles without asterisks are not considered as an essential part of the <u>minimum</u> library for a department. They are very useful books and should be purchased insofar as funds will permit to enrich and expand the scope of the library after minimum standards have been attained.

Department of
AGRICULTURAL EDUCATION
THE UNIVERSITY OF ARIZONA
TUCSON, ARIZONA

Revised

June - 1965

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LIST OF PUBLISHERS AND DISTRIBUTORS

A number will be found after the title of each book listed. The numbers refer to the publishers, as follows:

1. American Bee Journal, Hamilton, Illinois
2. American Council on Education, 1785 Massachusetts Ave., N.W., Washington 36, D.C.
3. American Society of Agronomy and National Fertilizer Association, Washington, D.C.
4. American Technical Society, 848 E. 58th Street, Chicago, Illinois
5. American Veterinary Publications, Evanston, Illinois
6. American Vocational Association, Inc., 1010 Vermont Ave., N.W., Washington 5, D.C.
7. Arco Publishing Co., Inc., 480 Lexington Ave., New York 17, N.Y.
8. Beacon Feeds, Extension Service Department, Cayuga, New York
9. Charles A. Bennett Co., Inc., 237 N. Monroe Street, Peoria 3, Illinois
10. William C. Brown Co., 135 S. Locust, Dubuque, Iowa
11. Burgess Publishing Co., Minneapolis 15, Minnesota
12. Chemical Publishing Co., 221 Fourth Ave., New York 3, N.Y.
13. Comstock Publishing Associates, 124 Roberts Place, Ithaca, N.Y.
14. Dedant and Company, Hamilton, Illinois
15. Deere and Company, Moline, Illinois
16. Delmar Publishers, Inc., Albany 5, New York
17. Demeter Books, P.O. Box 8645, Knoxville, Tennessee
18. Doubleday Company, Inc., 575 Madison Ave., New York 22, N.Y.
19. Dover Publications, Inc., 180 Varick Street, New York 14, N.Y.
20. Farmers Digest, Ft. Atkinson, Wisconsin
21. Fearon Publishers, Inc., 828 Valencia Street, San Francisco 10, California
22. W. H. Freeman and Company, 660 Market Street, San Francisco 4, California
23. Future Farmers of America Foundation, Inc., U.S. Office of Education, Federal Security Agency, Washington, D.C.
24. Future Farmers Supply Service, P.O. Box 1180, Alexandria, Virginia

LIST OF PUBLISHERS AND DISTRIBUTORS (continued)

25. Goodheart-Willcox Company, Inc., 1322 S. Wabash Ave., Chicago 5, Illinois
26. Lester W. Hanna, Rt. 1, Box 210, Forest Grove, Oregon
27. Harper and Row Publishers, 49 E. 33rd Street, New York 16, N.Y.
28. R. C. Hartman, P.O. Box 950, Redlands, California
29. The Interstate, 19-27 North Jackson Street, Danville, Illinois
30. Iowa State University Press, Press Building, Ames, Iowa
31. Orange Judd Publishing Company, Inc., 15 E. 26th Street, New York 10, N.Y.
32. Lane Publishing Company, Menlo Park, California
33. Lea and Febiger Publishers, 600 Washington Square, Philadelphia 6, Pa.
34. James F. Lincoln Arc Welding Foundation, Cleveland 1, Ohio
35. The Linde Air Products Company, 30 E. 42nd Street, New York 17, N.Y.
36. Macmillan Publishing Company, 60 Fifth Ave., New York 11, N.Y.
37. McGraw-Hill Book Company, 330 W. 42nd Street, New York 36, N.Y.
38. McKay Company, Inc., New York, N.Y.
39. McKnight and McKnight Publishing Company, U.S. Route 66 at Towanda Ave., Bloomington, Illinois
40. Merck and Company, Inc., Rahway, New Jersey
41. Michigan State University Press, Box 752, East Lansing, Michigan
42. Montgomery Ward, Order through your nearest local store or catalog outlet
43. Morrison Publishing Company, 515 Woodlands Drive, Clinton, Iowa
44. National Livestock and Meat Board, 407 S. Dearborn Street, Chicago 5, Illinois
45. Oxford University Press, Inc., 16-00 Pollitt Drive, Fair Lawn, New Jersey
46. Prentice-Hall, Inc., Englewood Cliffs, New Jersey
47. Rinehart, Holt and Winston, Inc., 383 Madison Ave., New York 17, N.Y.
48. Ronald Press Company, 15 E. 26th Street, New York 10, N.Y.
49. A. I. Root Company, Medina, Ohio

LIST OF PUBLISHERS AND DISTRIBUTORS (continued)

50. Sears, Roebuck and Company, Los Angeles 54, California, or through local store

51. Soil Science Society of America, Madison 11, Wisconsin

52. Southern Association of Agriculture Engineers and Vocational Agriculture, Barrow Hall, University of Georgia, Athens, Georgia

53. Springer Publishing Company, Inc., 44 E. 23rd Street, New York 10, N.Y.

54. Stanley Tools, New Britain, Connecticut

55. Supervisor of Documents, 214 State Capitol, Sacramento, California

56. United States Government Printing Office, Superintendent of Documents, Washington 25, D.C.

57. University of California Press, Berkeley 4, California

58. University of Illinois, College of Agriculture, Urbana, Illinois

59. Utah State University, Agricultural Extension Service, Logan, Utah

60. Van Nostrand Company, 120 Alexander Street, Princeton, New Jersey

61. John Wiley and Sons, 440 Fourth Ave., New York 16, N.Y.

62. Williams and Wilkins, 428 E. Preston Street, Baltimore 2, Maryland

63. W. H. Wise and Company, 50 West 47th Street, New York 36, N.Y.

AGRICULTURAL ECONOMICS

Farm Management

*1. Castle, E. N. and Becker, M. H., FARM BUSINESS MANAGEMENT, 1962, 416 pp., $6.50 -36

2. Hall, I. F. and Mortenson, W. P., THE FARM MANAGEMENT HANDBOOK, 1960, 416 pp., $4.45 -29

*3. Hamilton, J. C. and Bryant, W. R., PROFITABLE FARM MANAGEMENT, 1963, 409 pp., $6.48 -46

4. Heady, E. O. and Jensen, H. R., FARM MANAGEMENT ECONOMICS, 1954, 645 pp., $8.95 (text ed.) -46

*5. Mortenson, W. P. and Hall, I. F., APPROVED PRACTICES IN FARM MANAGEMENT, 1961, 246 pp., $3.37 -29

Finance

**1. Brake, J. R., Beer, C. L., Kelsey, M. P., Hill, E. B., Nielson, J. M., and Wirth, M. E., FARM AND PERSONAL FINANCE, 1961, 68 pp., $1.35 -41

*2. Murray, W. G. and Nelson, A. G., AGRICULTURAL FINANCE, 1960, 450 pp., $6.00 -30

Law

*1. Adams, R. L. and Bedford, W. W., EVERYDAY FARM LAW, 1955, 287 pp., $3.15 -29

*2. Beuscher, Jacob H., LAW AND THE FARM, 1960, 406 pp. -53

3. Hannah, H. H. and Storm, D. F., LAW FOR THE VETERINARIAN AND LIVESTOCK OWNER, 1959, 196 pp., $5.17 -29

Marketing

*1. Fowler, S. H., THE MARKETING OF LIVESTOCK AND MEAT, 1961, 740 pp., $6.07 -29

2. Kohls, R. L., MARKETING OF AGRICULTURAL PRODUCTS, 1961, 424 pp., $7.50 -36

*3. Mortenson, W. P., MODERN MARKETING OF FARM PRODUCTS, 1963, 277 pp., $3.55 -29

**4. Snowden, Obed L. and Donahoo, A. W., PROFITABLE FARM MARKETING, 1960, 409 pp. $6.56 (text ed.) -46

*5. U.S.D.A. Yearbook, MARKETING, 1954, 506 pp. -56

Records

*1. Hopkins, J. A. and Turner, D. A., RECORDS FOR FARM MANAGEMENT, 1958, 231 pp., $5.88 (text ed.) -46

AGRONOMY AND SOILS

Cotton

*1. Brown, H. B. and Ware, J. O., COTTON, 1958, 566 pp., $14.00 -37

*2. Cardozier, V. R., GROWING COTTON, 1957, 423 pp., $6.20 -37

Fertilizer

*1. McVickar, M. H., USING COMMERCIAL FERTILIZERS, 1961, 266 pp. $3.82 -29

*2. McVickar, M. H., Bridger, G. L., and Nelson, L. B., FERTILIZER TECHNOLOGY AND USAGE, 1963, 464 pp. -51

*3. Sprague, H. B., HUNGER SIGNS IN CROPS, 1964, 461 pp., $15.00 -38

4. Tisdale, S. L., and Nelson, W. L., SOIL FERTILITY AND FERTILIZERS, 1956, 430 pp., $8.00 -36

Field Crops

*1. Delorit, R. J. and Ahlgren, G. H., CROP PRODUCTION, 1959, 672 pp., $6.92 (text ed.) -46

*2. Hughes, H. D. and Henson, E. R., CROP PRODUCTION, 1957, 620 pp., $7.95 -36

3. Leonard, Warren H. and Wood, D. R., GENERAL FIELD CROPS LABORATORY MANUAL, 1961, 82 pp. -11

**4. Shore, Walter E., FARMING IN THE WEST, 1963, 356 pp. -21

5. U.S.D.A. Yearbook, CROPS IN WAR AND PEACE, 1950-51, 942 pp. -56

6. Wilson, W. K. and Richner, A. C., PRODUCING FARM CROPS, 1962, 336 pp., $4.05 -29

Forages

*1. Hughes, H. D., Heath, M. E., and Metcalfe, D. S., FORAGES, 1962, 683 pp., $7.50 -30

Judging Crops

*1. Dungan, G. H. and Bolin, O. E., JUDGING CROP QUALITY, 1950, 279 pp., $3.15 -29

Range and Pasture

*1. Donahue, R. L., Evans, E. F., and Jones, L. I., RANGE AND PASTURE BOOK, 1956, 415 pp., $5.92 (text ed.) -46

2. McVickar, Malcolm H., APPROVED PRACTICES IN PASTURE MANAGEMENT, 1963, 255 pp., $3.37 -29

3. Sampson, A. W., RANGE MANAGEMENT PRINCIPLES AND PRACTICES, 1952, 570 pp., $8.95 -61

4. Stoddart, L. A. and Smith, A. D., RANGE MANAGEMENT, 1955, 433 pp., $8.95 -37

*5. U.S.D.A. Yearbook, GRASS, 1948, 892 pp. -56

Soils

*1. Berger, K. C., INTRODUCTORY SOILS, 1965, 384 pp., $5.95 -36

2. Cook, R. L., SOIL MANAGEMENT FOR CONSERVATION AND PRODUCTION, 1962, 527 pp., $9.95 -61

*3. Donahue, R. L., SOILS AND INTRODUCTION TO SOILS AND PLANT GROWTH, 1958, 349 pp., $7.50 (text ed.) -46

4. Fosters, A. B., APPROVED PRACTICES IN SOIL CONSERVATION, 1964, 384 pp., $3.37 -29

*5. Millar, C. E. and Turk, L. M., FUNDAMENTALS OF SOIL SCIENCE, 1958, 526 pp., $7.75 -61

*6. U.S.D.A. Yearbook, SOILS, 1957 -56

Weeds

*1. Holmgren, A. H., WEEDS OF UTAH, Special Report #12, 1958, 85 pp., 50¢ -59

2. Isley, Duane, WEED IDENTIFICATION AND CONTROL, 1960, 386 pp., $5.95 -30

3. Klingman, G. C., WEED CONTROL AS A SCIENCE, 1961, 368 pp., $8.50 -61

*4. Robbins, W. W. and Crafts, A. S., WEED CONTROL, 1962, 660 pp., $14.75 -37

ANIMAL SCIENCE

Beef Cattle

1. Diggins, R. V. and Bundy, C. E., BEEF PRODUCTION, 1962, 351 pp., $6.16 (text ed.) -46

2. Ensminger, M. E., BEEF CATTLE SCIENCE, 1960, 791 pp., $6.07 -29

3. Juergenson, E. M., APPROVED PRACTICES IN BEEF CATTLE PRODUCTION, 1964, 353 pp., $3.50 -29

*4. Snapp, R. R., BEEF CATTLE, 1960, 650 pp., $8.75 -61

5. Wagnon, K. A., Albaugh, R., and Hart, G. H., BEEF CATTLE PRODUCTION, 1960, 537 pp., $8.95 -36

Breeding

1. Bogart, R., IMPROVEMENT OF LIVESTOCK, 1959, 436 pp., $7.95 -36

*2. Lasley, John F., GENETICS OF LIVESTOCK IMPROVEMENT, 1963, 342 pp., $8.95 (text ed.) -46

*3. Rice, V. R., Andrews, F. N., Warwick, E. J., and Legates, J. E., BREEDING AND IMPROVEMENT OF FARM ANIMALS, 1962, 517 pp., $9.95 -37

Dairy Cattle

*1. Bundy, C. E. and Diggins, R. V., DAIRY PRODUCTION, 1961, 350 pp., $5.56 -46

2. Coletti, Anthony, HANDBOOK FOR DAIRYMEN, 1963, 310 pp., $4.50 -30

*3. Davis, R. F., MODERN DAIRY CATTLE MANAGEMENT, 1962, 264 pp., $5.25 -46

4. Juergenson, E. M. and Mortenson, W. P., APPROVED PRACTICES IN DAIRYING, 1960, 299 pp., $3.37 -29

5. Reaves, P. M. and Henderson, H. O., DAIRY CATTLE FEEDING AND MANAGEMENT, 1963, 448 pp., $9.95 -61

General Livestock

1. Anderson, A. L. and Kiser, J. J., INTRODUCTORY ANIMAL HUSBANDRY, 1963, 800 pp., $9.50 -36

**2. Bundy, C. E. and Diggins, R. V., LIVESTOCK AND POULTRY PRODUCTION, 1961, 703 pp., $6.96 (text ed.) -46

*3. Cole, E., INTRODUCTION TO LIVESTOCK PRODUCTION, 1962, 766 pp., $8.75 -22

*4. Ensminger, M. E., ANIMAL SCIENCE, 1962, 1091 pp., $7.15 -29

*5. Ensminger, M. E., STOCKMAN'S HANDBOOK, 1962, 742 pp., $7.15 -29

*6. Morrison, F. B., FEEDS AND FEEDING (unabridged), 1956, 1207 pp., $9.50 (text ed.) -43

**7. Morrison, F. B., FEEDS AND FEEDING (abridged), 1961, 522 pp., $4.75 -43

Health and Sanitation

*1. American Veterinary Publications, DISEASES OF CATTLE, 1963, 768 pp. - 5

2. Bailey, J. W., VETERINARY HANDBOOK FOR CATTLEMEN, 1963, 438 pp., $6.75 -53

3. Dykstra, R. R., ANIMAL SANITATION AND DISEASE CONTROL, 1961, 873 pp., $5.17 -29

4. LePage, Geoffrey, MONNIG'S VETERINARY HELMINTHOLOGY AND ENTOMOLOGY, 1962, 600 pp., $11.00 -62

*5. Merck and Co., THE MERCK VETERINARY MANUAL, 1961, 1624 pp., $9.75 -40

*6. U.S.D.A. Yearbook, ANIMAL DISEASES, 1956, 591 pp. -56

Horses

*1. Adams, O. R., LAMENESS IN HORSES, 1963, 312 pp., $10.00 -33

*2. Ensminger, M. E., HORSES AND HORSEMANSHIP, 1963, $5.63 -29

3. Gorman, J. A., THE WESTERN HORSE, 1958, 445 pp., $4.57 -29

Judging

*1. Nordley, J. E., Beeson, W. M., and Fourt, D. L., LIVESTOCK JUDGING HANDBOOK, 1960, 407 pp., $4.45 -29

*2. Trimberger, G. W., DAIRY CATTLE JUDGING TECHNIQUES, 1958, 291 pp., $6.95 (text ed.) -46

3. Youtz, H. G. and Carlson, A. C., JUDGING LIVESTOCK, DAIRY CATTLE, POULTRY AND CROPS, 1962, 195 pp., $5.52 (text ed.) -46

Meats

**1. National Livestock and Meat Board, COLLEGE KIT OF MEATS LITERATURE FOR ANIMAL HUSBANDRY STUDENTS, $1.00 -44

2. National Livestock and Meat Board, MEAT IDENTIFICATION KIT, $6.75 -29

3. Ziegler, P. T., THE MEAT WE EAT, 1962, 548 pp., $5.63 -29

Poultry

*1. American Poultry Association, STANDARD OF PERFECTION, 1962, 571 pp., $7.50 -29

*2. Biddle, G. H. and Juergenson, E. M., APPROVED PRACTICES IN POULTRY PRODUCTION, 1963, 328 pp., $3.37 -29

**3. Bundy, C. E. and Diggins, R. V., POULTRY PRODUCTION, 1960 370 pp., $6.16 (text ed.) -46

4. Card, L. E., POULTRY PRODUCTION, 1961, 395 pp., $7.00 -33

5. Goodman, J. W. and Tudor, D. C., YOUR FUTURE IN POULTRY FARMING, 1960, 412 pp., $6.56 (text ed.) -46

6. Parnell, E. D., PROFITABLE POULTRY PRODUCTION, 1957, 393 pp., $4.95 -61

7. Titus, Harry W., THE SCIENTIFIC FEEDING OF CHICKENS, 1961, 297 pp., $3.15 -29

Sheep

1. Diggins, R. V. and Bundy, C. E., SHEEP PRODUCTION, 1958, 378 pp., $6.56 (text ed.) -46

*2. Ensminger, M. E., SHEEP AND WOOL SCIENCE, 1964, 706 pp., $6.07 -29

3. Juergenson, E. M., APPROVED PRACTICES IN SHEEP PRODUCTION, 1963, 306 pp., $3.37 -29

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1. Ashbrook, F. G., HOW TO RAISE RABBITS FOR FOOD AND FUN, 1960 -31

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1. Bundy, C. E. and Diggins, R. V., SWINE PRODUCTION, 1963, 371 pp., $6.20 -46

*2. Carroll, Krider and Andrews, SWINE PRODUCTION, 1962, 424 pp., $8.75 -37

*3. Cook, G. C. and Juergenson, E. M., APPROVED PRACTICES IN SWINE PRODUCTION, 1959, 292 pp., $3.37 -29

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Buildings and Structures

*1. Ashby, W., Dodge, J. R., and Shedd, C. K., MODERN FARM BUILDINGS, 1959, 390 pp., $7.28 (text ed.) -46

2. Grey, Harold E., FARM SERVICE BUILDINGS, 1955, 438 pp., $8.50 -37

3. Howell, E. L., Coggin, J. K., and Giles, G. W., BUILDING AND EQUIPPING THE FARM SHOP, 1956, 106 pp., $2.65 -29

4. Mix, F. M. and Ciron, E. H., PRACTICAL CARPENTRY, 1963, 480 pp., $5.00 -25

*5. Neubauer, Loren W. and Walker, Harry B., FARM BUILDING DESIGN, 1961, 611 pp., $9.75 -46

6. SAAEVA, PLANNING THE MACHINERY STORAGE AND SHOP STRUCTURE, 1960, 36 pp., $1.00 -52

7. Siegle, H. H., CONCRETE CONSTRUCTION, 1955, 163 pp., $3.50 -29

Field Machinery

**1. Deere, THE OPERATION, CARE AND REPAIR OF FARM MACHINERY, latest edition, free -15

*2. Smith, H. P., FARM MACHINERY AND EQUIPMENT, 1964, 520 pp., $9.50 -37

*3. Stone, A. A. and Gulvin, H. E., MACHINES FOR POWER FARMING, 1957, 616 pp., $6.95 -61

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*1. Israelson, Orson W. and Hansen, Vaughn E., IRRIGATION PRINCIPLES AND PRACTICES, 1962, 382 pp., $10.95 -60

Project Suggestions and Plans

*1. Cook, G. C., 380 THINGS TO MAKE, 1941, 325 pp., $3.60 -29

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*3. Cook, G. C., 600 MORE THINGS TO MAKE, 1953, 470 pp., $3.60 -29

*4. James E. Lincoln Arc Welding Foundation, FARM EQUIPMENT WELDING PLANS, 1959, 90 pp., 50¢ -34

*5. Midwest Plan Service,
- MWPS-2, SWINE EQUIPMENT PLANS, 1959, 56 pp., $1.00 -30
- MWPS-3, SHEEP EQUIPMENT PLANS, 1960, 40 pp., $1.00 -30
- MWPS-4, HOME IMPROVEMENT PLANS, 1962, 48 pp., $1.00 -30
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*6. Phipps, L. J. and Jenne, J. A., IDEAS FOR FARM MECHANICS PROJECTS AND ACTIVITIES, 444 pp., $4.45 -29

Rural Electrification

*1. Brown, Robert H., FARM ELECTRIFICATION, 1956, 367 pp., $7.95 -37

*2. Hamilton, J. R., USING ELECTRICITY FOR THE FARM, 1959, 385 pp., $6.80 (text ed.) -46

3. Montgomery Ward, WIRING SIMPLIFIED, latest edition -42

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Shop Skills and Information

*1. Giachino, J. W., Weeks, William, and Brune, Elmer, WELDING SKILLS AND PRACTICES, 1960, $4.95 - 4

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3. Gross, Fred, HOW TO WORK WITH TOOLS AND WOOD, 1955, 215 pp., 35¢ -54

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**5. Jones, Mack M., SHOPWORK ON THE FARM, 1955, 626 pp., $6.20 -37

**6. Kugler, H. L., ARC WELDING LESSONS FOR SCHOOL AND FARM SHOP, 1957, 343 pp., $1.00 -34

7. The Linde Air Products Co., THE OXY-ACETYLENE HANDBOOK, latest edition -35

*8. The Linde Air Products Co., WELDING AND CUTTING MANUAL, latest edition -35

9. Morford, V. J., FARM ARC WELDING, 1954, 456 pp., $2.00 -34

10. Parker, M. M., FARM WELDING, 1958, 252 pp., $5.60 -37

**11. Phipps, L. J., McColly, H. F., Scranton, L. L., and Cook, G. C., FARM MECHANICS TEXT AND HANDBOOK, 1959, 814 pp., $4.50 -29

12. Smith, Robert E., FORGING AND WELDING, 146 pp., $4.00 -39

**13. Wakeman, T. J. and McCoy, V. L., THE FARM SHOP, 1960, 577 pp., $5.96 -36

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Tractors and Engines

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*2. Brown, Arlen D. and Morrison, I. G., FARM TRACTOR MAINTENANCE, 1962, 215 pp., $3.65 -29

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7. Stephenson, G. E., POWER MECHANICS, 1963, 215 pp., $2.35 -16

FUTURE FARMERS OF AMERICA

General FFA

*1. Bender, R. E., Clark, R. M., and Taylor, R. E., THE FFA AND YOU, 1962, 494 pp., $4.45 -29

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*3. FFA, OFFICIAL CHAPTER SECRETARY'S BOOK, 51 pp., 35¢ -24

**4. FFA, OFFICIAL MANUAL, latest edition, 15¢ -24

5. Kraus, Richard G., RECREATION LEADER'S HANDBOOK, 1955, 294 pp., $6.95 -37

6. Tenney, A. W., PRACTICAL ACTIVITIES FOR FUTURE FARMERS, 1941, 318 pp., $3.00 -29

*7. Wall, Stanley, A MORE EFFECTIVE FFA, 1956, 207 pp., $2.95 -29

Parliamentary Procedure

1. Cruzan, R. M., PRACTICAL PARLIAMENTARY PROCEDURE, 1958, 219 pp., $3.50 -39

*2. Gray, J. D. and Jackson, J. R., LEADERSHIP TRAINING AND PARLIAMENTARY PROCEDURE FOR FFA, 1958, 120 pp., $2.25 -46

**3. Henderson, Melvin and Rucker, H. J., A GUIDE TO PARLIAMENTARY PRACTICE, 20¢ -29

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*5. Sturgis, Alice, LEARNING PARLIAMENTARY PROCEDURE, 1953, 356 pp., $5.50 -37

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*2. Purkey, R. D., HANDBOOK IN SPEECH FOR FUTURE FARMERS, 1959, 354 pp., $4.50 -29

GENERAL AGRICULTURE AND RELATED SUBJECTS

General Agriculture

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3. McNall, P. E., OUR NATURAL RESOURCES, 1964, 280 pp., $4.27 -29

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Yearbooks of Agriculture (see specific subject areas also)

*1. U.S.D.A. Yearbook, TREES, 1949, 944 pp. -56

*2. U.S.D.A. Yearbook, WATER, 1955, 751 pp. -56

*3. U.S.D.A. Yearbook, LAND, 1958, 605 pp. -56

*4. U.S.D.A. Yearbook, FOOD, 1959, 736 pp. -56

*5. U.S.D.A. Yearbook, POWER TO PRODUCE, 1960, 480 pp. -56

*6. U.S.D.A. Yearbook, SEEDS, 1961, 591 pp. -56

*7. U.S.D.A. Yearbook, AFTER A HUNDRED YEARS, 1962, 688 pp. -56

*8. U.S.D.A. Yearbook, A PLACE TO LIVE, 1963, 583 pp. -56

*9. U.S.D.A. Yearbook, FARMER'S WORLD, 1964, 592 pp. -56

GUIDANCE AND VOCATIONS

*1. Byram, Harold M., GUIDANCE IN AGRICULTURAL EDUCATION, 1959, 238 pp., $4.72 -29

2. Costine, Hugh L., LIVE AND LEARN, 1957, 169 pp., $2.95 -29

*3. Hoover, Norman K., HANDBOOK OF AGRICULTURE OCCUPATIONS, 1963, $4.75 -29

*4. Phipps, L. J., YOUR OPPORTUNITIES IN VOCATIONAL AGRICULTURE, 1962, 175 pp., $2.92 -29

*5. Wood, Wilber B., YOUR CAREER IN AGRICULTURE, 1959, 161 pp., $3.75 -46

HORTICULTURE

Fruit

*1. Brooks, Reid M. and Hesse, Claron O., WESTERN FRUIT GARDENING, 1953, 287 pp., $6.00 -57

2. Chandler, William H., DECIDUOUS ORCHARDS, 1957, 492 pp., $7.50 -33

3. Chandler, William H., EVERGREEN ORCHARDS, 1958, 535 pp., $8.50 -33

*4. Scheer, H. H. and Juergenson, E. M., APPROVED PRACTICES IN FRUIT PRODUCTION, 1964, 504 pp., $3.82 -29

5. Schneider, G. W. and Scarborough, C. C., FRUIT GROWING, 1960, 323 pp., $6.72 -46

Gardening and Horticulture

1. Editors, INDCOR GARDENING HANDBOOK, 1958, 143 pp., $2.50 - 7

*2. Edmond, J. B., Senn, T. L., and Andrews, F. S., FUNDAMENTALS OF HORTICULTURE, 3rd ed., 1963, 456 pp., $8.95 -37

*3. Seymour, WISE'S GARDEN ENCYCLOPEDIA, 1963, 1379 pp., $9.95 -63

**4. Sunset, WESTERN GARDEN BOOK, 1961, 383 pp., $3.95 -32

Landscaping

*1. Hoover, N. K., APPROVED PRACTICES IN BEAUTIFYING THE HOME GROUNDS, 1959, 271 pp., $3.50 -29

*2. Sunset, LANDSCAPING FOR MODERN LIVING, 1959, $2.50 -32

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Propagation

1. Garner, Robert J., GRAFTERS HANDBOOK, 1958, 238 pp., $6.75 -45

*2. Hartman, H. T. and Kester, D. E., PLANT PROPAGATION PRINCIPLES AND PRACTICES, 1959, 559 pp., $8.25 -46

*3. University of Arizona, Department of Agricultural Education, FACILITIES, SUPPLIES, BASIC INFORMATION AND LABORATORY EXERCISES FOR TEACHING PLANT PROPAGATION (Dept. of Agric. Educ. - U of A, Tucson, Arizona.)

Vegetables

*1. Knott, James E., HANDBOOK FOR VEGETABLE GROWERS, 1962, 238 pp., $4.95 -60

2. Knott, James E., VEGETABLE GROWING, 1958, 358 pp., $5.00 -33

3. MacGillvray, John H., VEGETABLE PRODUCTION, 1953, 480 pp., $9.50 -37

*4. Ware and McCollum, RAISING VEGETABLES, 1965, 460 pp., $4.95 -29

INSECTS AND PLANT DISEASES

Beekeeping

1. Dadant, Camille P., FIRST LESSONS IN BEEKEEPING, 1960, 121 pp., $1.00 - 1

*2. Eckert, John E. and Shaw, F. R., BEEKEEPING, 1960, 451 pp., $12.50 -36

*3. Root, A. I., ABC AND XYZ OF BEE CULTURE, 1962, 703 pp., $4.95 -49

Insects

*1. Borror, D. J. and DeLong, D. M., AN INTRODUCTION TO THE STUDY OF INSECTS, 1964, 762 pp., $14.50 -47

*2. Frost, S. W., INSECT LIFE AND INSECT NATURAL HISTORY, 1959, 526 pp., $2.45 -19

3. Jaques, HOW TO KNOW THE INSECTS, 1947, 204 pp., $2.25 -10

*4. Metcalfe, C. L., Flint, W. P., and Metcalfe, DESTRUCTIVE AND USEFUL INSECTS, 1962, 1120 pp., $17.50 -37

5. Swain, R. B., THE INSECT GUIDE, 1948, 235 pp., $4.50 -18

*6. U.S.D.A. Yearbook, INSECTS, 1952, 780 pp. -56

Plant Diseases

1. Anderson,H. W., DISEASES OF FRUIT CROPS, 1956, $11.00 -37

2. Dickson, James D., DISEASES OF FIELD CROPS, 1956, 468 pp., $10.00 -37

*3. U.S.D.A. Yearbook, PLANT DISEASES, 1953, 940 pp. -56

4. Walker, J. C., DISEASES OF VEGETABLE CROPS, 1952, $10.50 -37

5. Walker, J. C., PLANT PATHOLOGY, 1957, 699 pp., $12.50 -37

*6. Westcott, Cynthia, PLANT DISEASES HANDBOOK, 1960, $15.00 -60

Spraying and Chemicals

1. Hanna, Lester W., HANDBOOK OF AGRICULTURAL CHEMICALS, 1958, 494 pp. -26

2. Hough, W. S., SPRAYING, DUSTING AND FUMIGATING PLANTS, 1951, 698 pp., $7.95 -36

PROFESSIONAL

Adult and Young Farmer Education

1. Ekstrom, G. F. and McClelland, J. B., ADULT EDUCATION IN VOCATIONAL AGRICULTURE, 1952, 490 pp., $4.00 -29

2. Nichols, Mark, YOUNG FARMERS, THEIR PROBLEMS, ACTIVITIES AND EDUCATIONAL PROGRAM, 1952, 499 pp., $3.50 -29

Public Relations

1. A.V.A., YOUR PUBLIC RELATIONS, 1954, 88 pp., $1.00 - 6

2. Cardozier, V. R., PUBLIC RELATIONS FOR VOCATIONAL AGRICULTURE, 1958, 212 pp. -17

3. Eastman, HOW TO SPEAK AND WRITE FOR RURAL AUDIENCES, 1960, 164 pp.-29

4. Kreitlow, B. W., Aiton, E. W., and Torrence, A. P., LEADERSHIP FOR ACTION IN RURAL COMMUNITIES, 1960, 346 pp., $5.00 -29

5. Read, Hadley, GETTING INFORMATION TO FARM FAMILIES, 1955, 120 pp., $1.00 -58

6. Ward, W. B., REPORTING AGRICULTURE, 1959, 363 pp., $5.00 -13

Teaching Methods and Materials

1. Andrews, D. W. and Juergenson, E. M., SELECTED LESSONS FOR TEACHING AGRICULTURAL SCIENCES, 1961, 339 pp., $5.25 -29

2. Brown, J. W., Lewis, R. B., and Harcleroad, F. F., A-V INSTRUCTION MATERIALS AND METHODS, 1959, 554 pp. -37

3. Krebs, A. H., FOR MORE EFFECTIVE TEACHING, 1954, 136 pp., $2.95 -29

4. Juergenson, E. M. and Tarone, Ernest, TEACHING TRICKS, 1950 139 pp., $2.00 -29

5. Morgan, B., Holmes, G. E., and Bundy, C. E., METHODS IN ADULT EDUCATION, 1963, 189 pp., $3.96 -29

6. O'Brien, M., SHOPWORK TEACHING TRICKS, 1953, 246 pp., $3.00 -29

7. O'Brien, M., DEMONSTRATIONS FOR FARM MECHANICS, 1957, 242 pp., $4.00 -29

*8. Phipps, Lloyd J., HANDBOOK ON AGRICULTURAL EDUCATION IN PUBLIC SCHOOLS, 1965, 774 pp., $8.95 -29

*9. University of Arizona, Department of Agricultural Education, AGRICULTURAL MECHANICS SKILLS WORKBOOK, 1964, 77 pp.

*10. Vocational Agriculture Service, 130 Subject Matter Units, 1328 pp., Approx. $13.00 (can be purchased as single units for 1¢ per page) -58

Vocational and General Education

1. Barlow, M. L., VOCATIONAL EDUCATION, 1965, 301 pp., $4.00 (Nat'l Society for the Study of Education, 5835 Kimbark Ave., Chicago, Ill.)

2. Conference Report, NEW DIMENSIONS IN PUBLIC SCHOOL EDUCATION IN AGRICULTURE, 1962, 120 pp. -29

3. Hamlin, H. M., AGRICULTURAL EDUCATION IN COMMUNITY SCHOOLS, 1949 487 pp., $4.00 -29

4. Hamlin, H. M., THE PUBLIC AND ITS EDUCATION, 1955, 299 pp., $3.50 -29

5. Hamlin, H. M., PUBLIC SCHOOL EDUCATION IN AGRICULTURE, 1962, 328 pp., $5.75 -29

6. Roberts, Roy W., VOCATIONAL AND PRACTICAL ARTS EDUCATION, 1965, 637 pp., $6.00 -27

7. Swanson, G. I., VOCATIONAL EDUCATION FOR RURAL AMERICA, 1959, 354 pp., $4.00 (Nat'l Educ. Assoc., 1201 - 16th Street, N.W., Washington 6, D.C.)

8. Venn, G., MAN, EDUCATION AND WORK, 1964, 184 pp., $1.50 - 2

SUPERVISED FARMING PROGRAMS

*1. Beard, Ward P., STARTING TO FARM, 1958, 265 pp., $2.92 -29

2. Deyoe, George P., FARMING PROGRAMS IN VOCATIONAL AGRICULTURE, 1953, 604 pp., $4.27 -29

*3. Juergenson, E. M., FARMING PROGRAMS FOR SMALL ACREAGES, 1959, 267 pp., $3.50 -29

**4. Hammonds, Carsie and Binkley, Harold, FARM PROGRAMS FOR STUDENTS IN VOCATIONAL AGRICULTURE, 1961, 314 pp., $4.75 -29

*5. North Atlantic Regional Record Book Committee, INSTRUCTOR'S GUIDE FOR THE EFFECTIVE USE OF PLANS, RECORDS, AND ACCOUNTS OF SUPERVISED WORK EXPERIENCE, 1964, 16 pp., $1.00 -16

*6. North Atlantic Regional Record Book Committee, PLANS, RECORDS AND ACCOUNTS OF SUPERVISED WORK EXPERIENCE FOR STUDENTS IN VOCATIONAL AGRICULTURE, 1964, 46 pp., $1.00 -16

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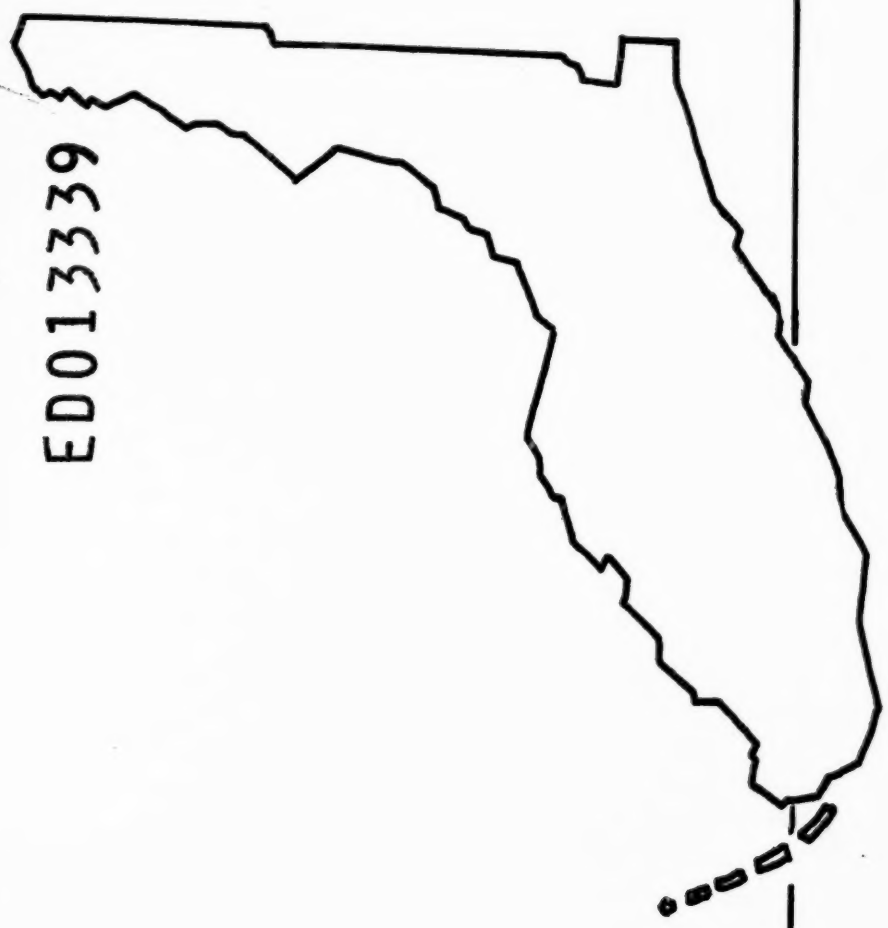

SELECTED REFERENCE BOOKS FOR DEPARTMENTS OF VOCATIONAL AGRICULTURE . . .

THE STATE DEPARTMENT
OF EDUCATION

Floyd T Christian
State Superintendent

TALLAHASSEE, FLORIDA

VT003396

FOREWORD

This publication is intended to serve as a guide for teachers and administrators in selecting reference books for departments of vocational agriculture in Florida.

This list was compiled on the basis of the experiences and recommendations from several other states and the experiences of a number of teachers and staff personnel in Florida. This is by no means a complete list of all publications in this field; however, it is believed that the references listed include some of the best.

The references are grouped into the broad categories of agricultural management, off-farm agricultural occupations, agricultural mechanics, animal science, plant science, soil science, general agriculture, leadership activities, miscellaneous, professional, and yearbooks of agriculture. Within these categories, sub-groupings of general references and references for specific areas such as electricity, beef cattle, or fertilizers have been given.

Many references have been coded as to extent of usefulness, and in some cases, level of use. The fact that some volumes have not been coded does not necessarily mean that a book is not recommended but that a coding was not available at this time. The following coding was used:

S - Books that could be in every department library in multiple copies for student use

R - Books of value as a single copy reference for teacher and student use

J - Suitable for use with junior high school students

H - Suitable for use with senior high school students

A - Suitable for use with young adult and adult students

Some books have been rated as being "excellent," "good," or "fair" references where evidence for such a rating was available. Abbreviations used are:

Ex - Excellent

G - Good

F - Fair

Those reference books considered essential in any department providing instruction in the area indicated have been marked with an asterisk following their rating. Unmarked references have not been rated.

This code is intended to be used as a guide in selecting books for those who may not be familiar with books in certain areas.

Needs should be carefully analyzed before buying books. Before ordering, copies should be obtained for examination if the person ordering it is not familiar with a book. School discount prices are available from most publishers. Check with other teachers and supervisory staff members for their evaluation before placing your order. By following such a sound procedure, your departmental library should become a sound, desirable learning aid to your students. In many cases, it will be possible to order reference books through the school library for reassignment to the department of vocational agriculture.

Clarence J. Rogers, Assistant Professor
Institute of Food and Agricultural Sciences
Department of Agricultural Engineering
University of Florida

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		AGRICULTURAL MANAGEMENT			
89	Snowden & Donahue	Profitable Farm Marketing, 1960, 478 pp.	6.48	S-H	G
89	Hamilton & Bryant	Profitable Farm Management, 1963, 401 pp.	6.48	S-H	G
56	Holland & Mortenson	Approved Practices in Farm Management, 1961, 228 pp.	3.25	S-H	F
58	Iowa State College Staff	Midwest Farm Handbook, 1958, 280 pp.	3.00	S	
56	Hall, Mortenson	Farm Management Handbook, 1960, 425 pp.	4.50	S-HA	F
34	Doane Agriculture Service	Doane Farm Management Guide, 1960, 398 pp.	5.95	R	G*
56	Mortenson	Modern Marketing, 1963, 278pp.	3.75	R-H	G
69	Castle, Becker	Farm Business Management, 1962, 416 pp.	6.50	R	
75	Brake, Beer	Farm and Personal Finance, 1965, 68 pp.	1.50	S-H	G
58	Murray, Nelson	Agricultural Finance, 1960, 450 pp.	6.00	R	
56	Adam, Bedford	Everyday Farm Law, 1955, 287 pp.	3.15	R	F
100	Buescher	Law and the Farmer, 1960 406 pp.	5.50	R-H,A	G*
69	Kohls	Marketing of Agricultural Products, 1961, 425 pp.	7.50		
104	U.S.D.A.	Yearbook, Marketing, 1954, 506 pp.	2.00	R	
89	Hopkins	Records for Farm Management, 1958, 231 pp.	5.88		
17	Chastain, Yeager McGraw	Farm Business Management, 1962, 172 pp.	2.50		
89	Foster	Farm Organization and Management,1965	7.95	R-H,A	
120		Better Farm Management		S-H	

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		OFF-FARM AGRICULTURAL OCCUPATIONS			
56	Hemp & Krebs	A Study Guide for Placement Employment Programs in Agricultural Business and Industry, 1964, 179 p.	2.50	S-H	G
56	Mason	Methods in Distributive Education, 1962, 204 p.	2.70	R	G
56	Stone	Careers in Agri-business and Industry	4.75	R	
123	The Center	Planning and Conducting Cooperative Occupational Experience in Off-Farm Agriculture	1.20	R	Ex.*
124	Science Research Associates	Jobs in Agriculture	1.00	S-H	
125	Robinson, Blackler, Logan	Store Salesmanship, 5th Edition, 1959	3.80	R	G
125	Wingate and Nolan	Fundamentals of Selling, 7th Edition, 1959	4.25	S	Ex.*
123	The Center	Course Guide for Agricultural Machinery - Service Occupations (Set)	6.50	R	Ex.*
123	The Center	Course Guide for Horticulture - Service Occupations (Set)	5.25	R	G *
123	The Center	Course Guide for Agricultural Supply - Sales and Service Occupations (Set)	5.00	R	G *
123	The Center	Course Guide for Agricultural Chemical Technology (Set)		R-A	Ex.*
123	The Center	Occupational Guidance for Off-Farm Agriculture	.30	R	

SOURCE NUMBER	AUTHOR	TITLE, COPYRIGHT DATE AND NUMBER OF PAGES	APPROX. LIST COST	USE AND LEVEL	RATING
		AGRICULTURAL MECHANICS			
		Basic Shop Operations			
66	Foss	Construction & Maintenance for Farm and Home, 1960, 373 p.	6.95	S-H	F
56	Phipps, Cook, McColly, Scranton	Farm Mechanics Text and Handbook, 1959, 814 p.	4.75	S-H, A	Ex.*
12	Sampson, Mowery and Kugler	Farm Shop Skills in Mechanized Agriculture, 1955, 395 p.	5.50	S	
21	Morford	Farm and Dairy Mechanics, 1962, 156 p.	3.75	R	G
72	Ludwig	Metal Work Technology and Practice 1962, 488 p.	4.95	S-H	G
70	Jones	Shopwork on the Farm, 1955, 626 p.	6.50	S-H	G
101	Stanley	Tool Guide (Charts in book form), 1952, 38 p.	.25	S	
69	Wakeman, McCoy	The Farm Shop, 1960, 598 p.	6.00	S-H, A	G
103	Ross & Craig	Modern Farm Shop Book, 1954			
		Buildings and Structures			
6	AAAE&VA	Building Farm Fences, 1954, 36 p.	.80	S-H, A	G*
		Filmstrip	11.00		
6	AAAE&VA	Planning Farm Fences, 1954, 44 p.	.80	S-H, A	G*
		Filmstrip	5.50		
70	Grey	Farm Service Buildings, 1955, 438 p.	8.50		
89	Ashby, Dodge, Shedd	Modern Farm Buildings, 1959 390 p.	7.28	R	G
89	Neubauer and Walker	Farm Building Design, 1961, 611 p.	9.75	F	G

SOURCE NUMBER	AUTHOR	TITLE, COPYRIGHT DATE AND NUMBER OF PAGES	APPROX. LIST COST	USE AND LEVEL	RATING
		Buildings and Structures (Cont'd)			
56	Siegle	Concrete Construction, 1955, 163 p.	3.50		
6	AAAE&VA	Planning Machinery Storage and Shop Structure, 1960, 36 p.	1.00	R	G
		Filmstrip	5.50		
46	Mix, Ciron	Practical Carpentry, 1963, 480 p.	5.00		
66	Foss	Construction and Maintenance for Farm and Home, 1960, 373 p.	6.95	R-H	F
12	Dalzell	Concrete Block Construction, 208 p.	3.75		
129	Portland Cement Association	Cement Mason's Manual for Residential Construction		R-H, A	G**
129	Portland Cement Association	Making Quality Concrete for Farm Construction		S-H, A	G**
129	Portland Cement Association	Ready Mixed Concrete for the Farm		S-H, A	G**
129	Portland Cement Association	Recommended Practices for Laying Concrete Block		S-H, A	G**
		Electricity			
	AAAE&VA	Electrical Terms, 1958, 32 p.	.85	S-H, A	G*
		Filmstrip	11.00		
66	Hienton, Wiant and Brown	Electricity in Agricultural Engineering, 1958, 393 p.	7.75	R	
38	Edison Institute	Electric Motors for the Farm, 1961	See Local Company		
70	Brown	Farm Electrification, 1956, 385 p.	7.95		G*

** All the above may be ordered as spiral-bound book entitled, Concrete and Concrete Masonry Construction from the Department of Agricultural Education, University of Missouri.

SOURCE NUMBER	AUTHOR	TITLE, COPYRIGHT DATE AND NUMBER OF PAGES	APPROX. LIST COST	USE AND LEVEL	RATING
		Electricity (Cont'd)			
6	AAAE&VA	Selecting Farm Electric Motors, Controls, and Drives, 1964, 36 p.	.65	S-H, A	G*
		Filmstrip	5.50		
78	National Board of Fire Underwriters	National Electrical Code, 1962, 450 p.	Free	R-H, A	G*
97	Sears, Roebuck and Company	Simplified Electric Wiring Handbook, latest edition	.39	S-H, A	Ex.*
89	Hamilton	Using Electricity on the Farm, 1959, 385 p.	6.80	S	
6	AAAE&VA	Maintaining the Farm Wiring and Lighting System, 1965 64 p.	1.50	R-H, A	G*
118	Illinois Vo-Ag Service	Electric Motors for Farm Use, 1962, 30 p.	.70	S-J,H,A	G
6	AAAE&VA	Filmstrip, "How Farm Electric Motors Start and Run"	5.50		
		Farm Power and Tractor Maintenance			
46	Purvis	All About Small Gas Engines, 1956, 304 p.	4.50		F
58	Hunt	Farm Power and Machinery Management, 1964, 190 p.	4.50	S-J,H	G
56	Brown and Morrison	Farm Tractor Maintenance, 1962, 215 p.	3.65	S-H,A	G
89	Promersberger, Bishop	Modern Farm Power, 1962, 280 p.	6.92	S-H	G
27	Moses and Frost	Farm Power, 1952, 484 p.	7.50	R	F
6	AAAE&VA	Farm Tractor Tune-up and Service Guide, 1964, 19 p.	1.85	S-H	G
104	U.S.D.A.	Power to Produce (1960 Yearbook), 1960, 480 p.	2.00		

SOURCE NUMBER	AUTHOR	TITLE, COPYRIGHT DATE AND NUMBER OF PAGES	APPROX. LIST COST	USE AND LEVEL	RATING
		Farm Power and Tractor Maintenance (Cont'd)			
46	Atteberry	Power Mechanics, 1961, 99 p.	2.00	R	
31	Stephensen	Power Mechanics, 1963, 215 p.	2.35		
6	AAAE&VA	Tractor Maintenance, 1964, 140 pp.	3.25	S-J,H,A	G*
6	AAAE&VA	Tractor Operation and Daily Care, 1959, 116 pp.	2.00	S-J,H,A	G*
		Filmstrip	22.00		
6	AAAE&VA	Selecting and Storing Tractor Fuels and Lubricants, 1964, 52 pp.	1.20	S-H,A	G*
		Filmstrip	11.00		
6	AAAE&VA	Tractor Hydraulics, 1966, 48 pp.	1.50		G
6	AAAE&VA	Tractor Transmission, 1966, 32 pp.	1.50		G
6	AAAE&VA	Tractor Electric System, 1966, 64 pp.	2.00		G
6	AAAE&VA	Ball and Roller Bearings, 1966, 32 pp.	.50		G
55	IT & T Shop	Small Gas Engines,1963, 312 pp. Service Manual	4.95	S-H	G*
12	Frazell	Tractor and Crawlers, 308 pp.	7.50		
31	Stephensen	Small Gas Engines	3.20	S	
19a	Briggs & Stratton	Briggs and Stratton Repair Instructions II		S-H,A	G

SOURCE NUMBER	AUTHOR	TITLE, COPYRIGHT DATE AND NUMBER OF PAGES	APPROX. LIST COST	USE AND LEVEL	RATING
		Machinery Maintenance and Use			
70	Smith	Farm Machinery and Equipment, 1964, 520 pp.	9.50	R-H	F
66	Stone and Gulvin	Machines for Power Farming, 1957, 616 pp.	5.95	R	F
5	Allis Chalmers	Farm Practices, 1961, 334 pp.	Free	S-H	F
66	Bainer, Kepner, Barger	Principles of Farm Machinery, 1955, 571 pp.	7.50	R	
58	Hunt	Farm Power and Machinery Management, 1964, 190 pp.	4.50	S-J,H	G*
6	AAAE&VA	Selecting and Maintaining Field Mowers, 1966, 128 pp.	3.00	R-H,A	
		Painting			
88	Brown	How to paint With Brush and Spray, 1963, 160 pp.	2.50	S-H	G
46	Jervis	Painting and Decorating, 1964, 228 pp.	3.00	S-H	F
56	Crewdson	Spray Painting, 175 pp.	3.00	R	
		Plans, Projects, and Ideas			
61	James F. Lincoln Foundation	Farm Equipment Welding Plan, 1963, 456 pp.	2.00	S-H,A	F
118	Midwest Plan Service	Home Improvement Plans, 1962, 48 pp.	1.00	R	
		Beef Equipment Plans, 1963, 72 pp.	1.00	R	
		Dairy Equipment Plans, 1963, 72 pp.	1.00	R	
		Poultry Equipment Plans, 1962, 28 pp.	1.00	R	

SOURCE NUMBER	AUTHOR	TITLE, COPYRIGHT DATE AND NUMBER OF PAGES	APPROX. LIST COST	USE AND LEVEL	RATING
		Plans, Projects, and Ideas (Cont'd)			
		Sheep Equipment Plans, 1960, 40 pp.	1.00	R	
		Swine Equipment Plans, 1959, 56 pp.	1.00	R	
		Catalogue of Plans for Major Farm Buildings	Free		
6	AAAE&VA	Planning a Farm Shop Layout, 1956, 48 pp.	1.15	S	G*
		Filmstrip	5.50		
		Planning Farm Fences, 1960, 44 pp.	.50		
		Filmstrip	5.50		
		Planning the Machinery Storage and Shop Structure, 1957, 36 pp.	1.00	R	G
		Filmstrip	5.50		
		Planning a Machinery Storage Layout, 1956, 26 pp.	.60	R	F
		Filmstrip	5.50		
56	Cook	380 Things to Make, 1941, 325 pp.	3.60	R	F
		500 More Things to Make, 1944, 471 pp.	3.60	R	F
		600 More Things to Make, 1953, 470 pp.	3.60	R	F
56	Phipps and Jenne	Ideas for Farm Mechanics Projects and Activities, 444 pp.	4.45	R	
56	Johnson	Farm Shop Plans and Student Notebook, 1964, 350 pp.	3.25	S-H	F
		Plumbing			
6	AAAE&VA	Planning Water Systems for Farm and Home, 1964, 108 pp.	2.60	S-HA	Ex.*
		Filmstrip	16.50		
66	Wright	Rural Water Supply and Sanitation, 1956, 347 pp.	4.96		F

SOURCE NUMBER	AUTHOR	TITLE, COPYRIGHT DATE AND NUMBER OF PAGES	APPROX. LIST COST	USE AND LEVEL	RATING
		Shop Skills and Information			
32	Delta Power Tools	Getting the Most out of Your Drill Press, 1954, 118 pp.	1.00	R	
	"	Getting the Most Out of Your Radial Saw, 1956, 108 pp.	1.00	R	
	"	Getting the Most Out of Your Circular Saw and Jointer, 1954, 120 pp.	1.00	R	
	"	Getting the Most Out of Your Lathe, 1950, 128 pp.	1.00	R	
100	Gross	How to Work with Tools and Wood, 1955, 215 pp.	.35		
27	Hunt	Shop Tools: Care and Repair, 1958, 252 pp.	4.20	R	
20	Hjorth, Holtrop	Operation of Modern Woodworking Machines, 1958, 176 pp.(cloth)	2.80	R	
22	Cunningham, Holtrop	Woodshop Tool Maintenance, 1956 295 pp.	5.76	R	
	Delmar	Hand Processes, Sheet Metal Series, 146 pp.	1.95		
56	Farrall, Albrecht	Agricultural Engineering, A Dictionary and Handbook, 1965, 434 pp.	6.75	R	
72	Smith	Forging and Welding, 146 pp.	4.00		
69	Wakeman, McCoy	The Farm Shop, 1960, 577 pp.	5.96	S-H,A	G
56	Phipps, McColly, Scranton & Cook	Farm Mechanics Text and Handbook, 1959, 814 pp.	4.50	S-H,A	Ex.*
	Willoughby	General Drawing Handbook, 1957, 95 pp.	2.00		
12	Giachino	American Technical Society: Freehand Sketching, 94 pp.	1.65		
12	Bruce and Meyer	Sheet Metal Shop Practice, 251 pp.	4.00	R	

SOURCE NUMBER	AUTHOR	TITLE, COPYRIGHT DATE AND NUMBER OF PAGES	APPROX. LIST COST	USE AND LEVEL	RATING
		Shop Skills and Information (Cont'd)			
31	Kidd & Siy	Hand Woodworking Tools, 298 pp.	6.20		
31	McDonnell, Kid and Siy	Portable Power Tools, 1962, 292 pp.	4.20	R-H	G
		Soil and Water Management			
110	Vo-Ag Service	Farm Surveying, 1960, 16 pp.	.16	R-H,A	G
67	Beasley and Wooley	Farm Water Management for Erosion Control, 1957, 196 pp.	4.75	R	
66	Schwab, Frevert, Barnes, & Edminster	Elementary Soil and Water Conservation Engineering, 1960, 395 pp.	6.25	S-H,A	G
27	Israelson, Hansen	Irrigation Principles and Practices, 1962, 382 pp.	10.95	R-A	Ex.*
56	Rubey	Supplemental Irrigation for Eastern United States, 1954 209 pp.	3.00	R	
120	Chapman, Fitch and Betch	Conserving Soil Resources		S-J,H	
70	McColly & Martin	Introduction to Agricultural Engineering, 1955	9.50	R	
		Welding			
61	Sellon and Matthews	Arc Welding, 1958, 44 pp.	.50	R	
61	Kugler	Arc Welding Lessons for School and Farm Shops, 1959, 343 pp.	1.00	S-H,A	Ex.*
72	Jennings	Gas and A.C. Arch Welding and Cutting, 1956, 118 pp.	2.75	R	
61	Morford	Farm Arc Welding, 1958, 456 pp.	2.00	R	
70	Parker	Farm Welding, 1958, 252 pp.	5.60		
62	Linde Air Products	Welding and Cutting Manual, 1960, 208 pp.	1.80	S-H,A	F

SOURCE NUMBER	AUTHOR	TITLE, COPYRIGHT DATE AND NUMBER OF PAGES	APPROX. LIST COST	USE AND LEVEL	RATING
		Welding (Cont'd)			
61	Woods	Metals and How to Weld Them, 1963, 392 pp.	2.00	S-H	G *
12	Giachino, Weeks, Brune	Welding Skills and Practices, 1960	4.95	R	
62	Linde Air Products	The Oxy-Acetylene Handbook, 1960, 592 pp.	3.00	R-H,A	F
31	Griffin & Roden	Basic Oxy-Acetylene Welding			

SOURCE NUMBER	AUTHOR	TITLE, COPYRIGHT DATE AND NUMBER OF PAGES	APPROX. LIST COST	USE AND LEVEL	RATING
		ANIMAL SCIENCE			
		Beekeeping			
93	Root	ABC and XYZ of Bee Culture, 1962, 703 pp.	4.95	R	G
126	Agricultural Experiment Station	Manual 15: A Handbook in Beekeeping in California	.50	S	G*
69	Eckert, Shaw	Beekeeping, 1960, 451 pp.	12.50	R	
		Beef Cattle			
89	Diggins, Bundy	Beef Production, 1962, 341 pp.	6.16	S-H	F
56	Juergensen	Approved Practices in Beef Cattle Production, 1964, 353 pp.	3.37	S-H	F
66	Snapp	Beef Cattle, 1960, 641 pp.	8.75	R	G
56	Ensminger	Beef Cattle Science, 1960 ,822 pp.	6.07	R-H	G
		Dairy Science			
89	Diggins, Bundy	Dairy Production, 1961, 342 pp.	6.48	S-H	G
66	Yapp and Nevens	Dairy Cattle, 1955, 420 pp.	4.76	R	
56	Nordby, Lattig	Selecting, Fitting and Showing Dairy Cattle, 7th Edition, 1961, 117 pp.	1.25	S	
58	Coletti, Anthony	Handbook for Dairymen, 1963, 310 pp.	4.50		
89	Davis	Modern Dairy Cattle Management, 1962, 264 pp.	5.25	R-H,A	G
56	Juergensen, Mortenson	Approved Practices in Dairying, 1960, 299 pp.	3.25	S-J,H	G
66	Reaves, Henderson	Dairy Cattle Feeding and Management 1963, 448 pp.	9.95	S-H	G

SOURCE NUMBER	AUTHOR	TITLE, COPYRIGHT DATE AND NUMBER OF PAGES	APPROX. LIST COST	USE AND LEVEL	RATING
		Disease Control			
56	Dykstra	Animal Sanitation and Disease Control, 1961, 305 pp.	5.50	R-H,A	F
89	Haberman	The Farmer's Veterinary Handbook, 1953, 305 pp.	4.95	R	
56	Udall	The Practice of Veterinary Medicine, 1954, 810 pp.	8.50	R	
100	Seiden	Livestock Health Encyclopedia, 1961, 614 pp.	6.00	R-H,A	F
21	Schipper	Preventive Veterinary Medicine, 1962, 167 pp.	4.50	S-H,A	F
104	U.S.D.A.	Yearbook, Animal Diseases, 1950, 591 pp.	2.00		
		General Livestock Production			
89	Bundy & Diggins	Livestock and Poultry Production, 1961, 703 pp.	6.92	S	
56	Ensminger	Stockman's Handbook, 1965, 756 pp.	7.15	S-H, A	G*
69	Bogart	Improvement of Livestock, 1959, 436 pp.	3.75	R	
77	Morrison	Feeds and Feeding (Abridged), 1956, 630 pp.	4.75	S-H,A	
77	Morrison	Feeds and Feeding (23rd Edition), 1165 pp.	15.50	R-H,A	G*
70	Maynard and Loosli	Animal Nutrition, 1960, 600 pp.	9.50	R-H,A	G
56	Cassard	Approved Practices in Feeds and Feeding, 1963, 362 pp.	3.37	S-J,H,A	G
56	Nordby, Beeson, Fort	Livestock Judging Handbook, 1962, 398 pp.	4.95	R-J,H	G
56	Nordby, Lattig	Selecting, Fitting and Showing Livestock and Poultry, 1957, 103 pp.	6.00		
89	Youltz and Carlson	Judging Livestock, Dairy Cattle, Poultry and Crops, 1962, 288 pp.	5.80	S-H	F

SOURCE NUMBER	AUTHOR	TITLE, COPYRIGHT DATE AND NUMBER OF PAGES	APPROX. LIST COST	USE AND LEVEL	RATING
		General Livestock Production (Cont'd)			
69	Anderson, Kiser	Introductory Animal Husbandry, 1963, 800 pp.	9.50	R	
43	Cole	Introduction to Livestock Production, 1962, 766 pp.	8.75	R-H,A	G
56	Ensminger	Animal Science, 1963, 1158 pp.	7.15	R-H,A	G
89	Acker	Animal Science and Industry	7.95	R-H,A	F
56	Ensminger	Horses and Horesemanship, 1963, 583 pp.	5.75	R-H,A	G
56	Fowler	The Marketing of Livestock and Meat, 1961, 740 pp.	6.07	R-H	G
56	Ziegler	The Meat We Eat, 1964, 537 pp.	5.63	R-H	G
66	Snapp & Neumann	Beef Cattle, 1960, 683 pp.	8.75	S-H,A	G
69	Bogart	Improvement of Livestock, 1959, 436 pp.	7.95		
89	Lasley	Genetics of Livestock Improvement, 1963, 342 pp.	8.95	R	
70	Rice, Andrews, Warwick, Legates	Breeding and Improvement of Farm Animals, 1962, 517 pp.	9.95	R	F
84	Ashbrook	How to Raise Rabbits for Food and Fun, 1960		R	F
27	Ashbrook	Raising Small Animals for Pleasure and Profit, 1951	4.00		
27	Ashbrook	Butchering, Processing and Preservation of Meat	6.00		
		Poultry Science			
89	Bundy, Diggins	Poultry Production, 1960, 384 pp.	5.88	S-J,H	G
63	Winter, Funk	Poultry Science and Practice, (4th Edition), 1956, 662 pp.	5.50	R	

SOURCE NUMBER	AUTHOR	TITLE, COPYRIGHT DATE AND NUMBER OF PAGES	APPROX. LIST COST	USE AND LEVEL	RATING
		Poultry Science (Cont'd)			
56	American Poultry Association	Standards of Perfection, 571 pp., 1962	7.50	R	
56	Biddle and Juergenson	Approved Practices in Poultry Production, 1963, 328 pp.	3.37	S-J,H	G
64	Card	Poultry Production, 1961, 395 pp.	7.00		
89	Goodman, Tudor	Your Future in Poultry Farming, 1960, 412 pp.	6.50	S-H	F
66	Parnell	Profitable Poultry Production, 1957, 393 pp.	4.95		
56	Titus	The Scientific Feeding of Chickens, 1961, 297 pp.	3.15		
		Sheep			
56	Juergenson	Approved Practices in Sheep Production, 1963, 360 pp.	3.37	S-J,H	G
66	McKinney	The Sheep Book, 1959, 295 pp.	4.96	S	
56	Ensminger	Sheep Husbandry, 1955, 587 pp.	4.50	R	
89	Diggins, Bundy	Sheep Production, 1958, 384 pp.	6.48	S	
56	Ensminger	Sheep and Wool Science, 1964, 705 pp.	6.07	R-H	G
		Swine			
89	Bundy, Diggins	Swine Production, 1963, 438 pp.	6.20	S-J,H	G
63	Anderson	Swine Management, 1957, 531 pp.	4.40	S	
56	Ensminger	Swine Science, 1961, 542 pp.	6.25	S-H	G *

SOURCE NUMBER	AUTHOR	TITLE, COPYRIGHT DATE AND NUMBER OF PAGES	APPROX. LIST COST	USE AND LEVEL	RATING
		Swine (Cont'd)			
56	Cook, Ensminger	Approved Practices in Swine Production, 1962, 329 pp.	6.25	S-J,H	G
56	Fowler	Marketing Livestock and Meat, 1961, 500 pp.	5.57	S-H,A	G
56	Nordby, Lottig	Selecting, Fitting, Showing Swine, (6th Edition), 120 pp.	1.35	S-J,H	G
70	Carroll, Krider, and Andrews	Swine Production, 1962, 424 pp.	8.75	R-H,A	F

SOURCE NUMBER	AUTHOR	TITLE, COPYRIGHT DATE AND NUMBER OF PAGES	APPROX. LIST COST	USE AND LEVEL	RATING
		PLANT SCIENCE			
		Crops			
70	Preston	Developing Farm Woodlands, 1954, 386 pp.	5.50	R	
89	Delorit, Ahlgren	Crop Production, 1959, 672 pp.	6.92	R	
69	Hughes, Metcalfe, Johnson	Crop Production - Principles and Practices, 1957, 618 pp.	6.75	R	
89	Martin, Leonard	Principles of Field Crop Production, 1959, 1176 pp.	6.75		
56	McVicker	Approved Practices in Pasture Management, 1960, 300 pp.	2.50	S-H	G
69	Hughes, Henson	Crop Production, 1957, 620 pp.	7.95	R	
104	U.S.D.A.	Yearbook (Crops in War and Peace, 1950-51), 942 pp.	2.00	R	
56	Wilson, Richer	Producing Farm Crops, 1962, 336 pp.	4.05	S-H	F
66	Klingman	Weed Control, As a Science, 1961, 420 pp.	8.50	R-A	F
58	Hughes, Heath, Metcalfe	Forages, 1962, 683 pp.	7.50	R	
58	Isley	Weed Identification and Control, 1960, 386 pp.	5.95		
89	Donahue, Evans, Jones	Range and Pasture Book, 1956, 415 pp.	5.92	R-H,A	G
104	U.S.D.A.	Yearbook (Grass), 1948, 892 pp.	2.00	R	
70	Robbins, Crafts	Weed Control, 1962, 660 pp.	14.75	R	G

SOURCE NUMBER	AUTHOR	TITLE, COPYRIGHT DATE AND NUMBER OF PAGES	APPROX. LIST COST	USE AND LEVEL	RATING
		Fertilizers			
56	McVicker	Using Commercial Fertilizers, 1961, 286 pp.	3.95	R-H,A	G
98	McVicker, Bridger and Nelson	Fertilizer Technology and Usage, 1963, 464 pp.		R-A	G
71	Sprague	Hunger Signs in Crops, 1964, 461 pp.	15.00	R-H,A	Ex.*
69	Tisdale and Nelson	Soil Fertility and Fertilizers, 1956, 430 pp.	8.00	R	G
81	National Plant Food	The Fertilizer Handbook, 1964 450 pp.	3.00	S-H,A	G
		Horticulture			
89	Schneider, Scarborough	Fruit Growing, 1960, 323 pp.	6.72	R	
64	Talbert	Growing Fruits and Vegetable Crops, 1953, 150 pp.	4.50	R	
50	Childers	Modern Fruit Science, 1961, 894 pp.	5.50	R-H,A	F
66	Knott	Handbook for Vegetable Growers, 1957, 238 pp.	3.95	R	
66	Shoemaker, Tesky	Practical Horticulture, 1955, 374 pp.	4.20	R	
27	Wescott	Plant Disease Handbook, 1950, 746 pp.	7.50	R	
66	Peairs, Davidson	Insect Pest of Farm, Garden, and Orchard, 1956, 661 pp.	6.75	R	
66	Work, Carew	Vegetable Production and Marketing, 1956, 560 pp.	4.72		
63	Mack	Vegetable and Fruit Growing, 1956, 560 pp.	4.40	R	

SOURCE NUMBER	AUTHOR	TITLE, COPYRIGHT DATE AND NUMBER OF PAGES	APPROX. LIST COST	USE AND LEVEL	RATING
		Horticulture (Cont'd)			
66	Shoemaker, Tesky	Tree Fruit Production, 1959, 456 pp.	6.95	F	
64	Chandler	Deciduous Orchard, 1957, 492 pp.	7.50	R	
70	Edmond, Senn, Andrews	Fundamentals of Horticulture, 456 pp., 1963	8.95	R-A	G
56	Hoover	Approved Practices in Beautifying the Home Grounds, 1959, 271 pp.	3.50	R	
89	Hartman, Hudson, and Kester	Plant Propagation: Principles and Practices, 1961, 559 pp.	8.25	R	G*
56	Ware and McCollum	Raising Vegetables, 1965, 400 pp.	4.95	S	
71	Sprague, H. B.	Hunger Signs in Crops, 1964, 461 pp.	15.00	R-H,A	Ex *
43	Janick	Horticultural Science, 1963, 472 pp.	8.50	S-H,A	G
121	Ziegler, Wolf	Citrus Growing in Florida	6.00	S-H,A	Ex*
121	West, Arnold	Native Trees of Florida	4.00	S-J,H,A	
		Insects			
91	Borror and Delong	An Introduction to the Study of Insects, 1964, 762 pp.	14.50	R	G
36	Frost	Insect Life and Insect Natural History, 1959, 526 pp.	2.45	R	
70	Metcalf, Flint, Metcalf	Destructive and Useful Insects, 1962, 1120 pp.	17.50	R	G
35	Swain	The Insect Guide, 1948, 235 pp.	4.50		
104	U.S.D.A.	Yearbook, Insects, 1956, 780 pp.	2.00	R	

SOURCE NUMBER	AUTHOR	TITLE, COPYRIGHT DATE AND NUMBER OF PAGES	APPROX. LIST COST	USE AND LEVEL	RATING
		Plant Diseases			
70	Anderson	Diseases of Fruit Crops	11.00	R	
104	U.S.D.A.	Yearbook (Plant Diseases), 1953, 940 pp.	2.00	R	G
27	Wescott	Plant Diseases Handbook, 1960	15.00	R	G
70	Walker	Diseases of Vegetable Crops, 1952	10.50	R	
		Spraying and Chemicals			
47	Hanna	Handbook of Agricultural Chemicals, 1958, 494 pp.		R	G
69	Hough	Spraying, Dusting, and Fumigating Plants, 1951, 698 pp.	7.95	R	

SOURCE NUMBER	AUTHOR	TITLE, COPYRIGHT DATE AND NUMBER OF PAGES	APPROX. LIST COST	USE AND LEVEL	RATING
		SOIL SCIENCE			
		Soils			
56	McVicker	Using Commercial Fertilizers, 1961, 286 pp.	3.95	S-H	G
56	Donahue	Our Soils and Their Management, 1961, 568 pp.	5.25	S-H	G
66	Worthen, Aldrich	Farm Soils, 1956, 439 pp.	4.95	S	
56	Fosters	Approved Practices in Soil Conservation, 1964, 384 pp.	3.37	S-H	F
69	Buckman, Brody	The Nature and Property of Soils, 1960, 430 pp.	4.50	R	
89	Stallings	Soil, Use and Improvement, 1957, 403 pp.	4.50	R	
66	Sernis, Ahlgren	Grassland Farming, 1955, 146 pp.	2.96		
89	Knuti, Korpi Hide	Profitable Soil Management, 1962, 376 pp.	6.16	R-H	G
69	Berger	Introductory Soils, 1965, 384 pp.	5.95	R	G
66	Cook	Soil Management for Conservation and Production, 1962, 527 pp.	9.95		
89	Donahue	Soils and Introduction to Soils and Plant Growth, 1958, 349 pp.	7.50	R	G
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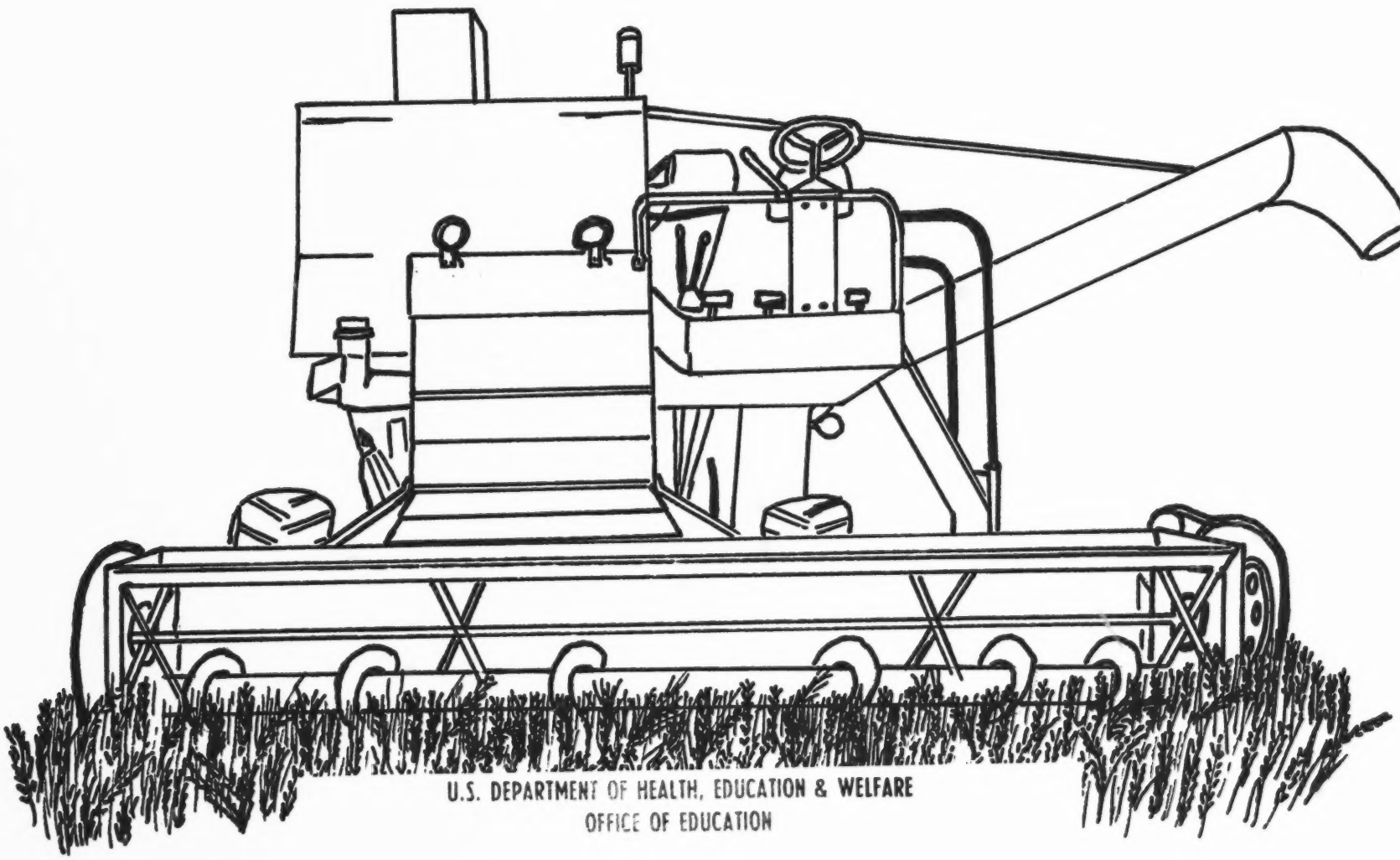

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APPLICATION OF THE UNIT

COMBINES AND COMBINING

The manual "Combines and Combining" has been developed by the Ohio Vocational Agriculture Instructional Materials Service to assist vocational agriculture students in gaining knowledge about this important harvesting machine. For most efficient use, each student should have a copy of the manual available during his study of the unit on combines. The manual suggests teaching procedures and student experiences that would be conducted in the classroom, the agricultural mechanics shop, and on field trips to farms and implement dealers.

The manual is not designed to be used as a workbook, although there are certain forms designed for recording information during the course of study that the teacher may wish to reproduce in quantities for student use. This may be accomplished by preparing spirit masters with an office copying machine for reproduction with a duplicating machine. The same office copying machine will usually prepare transparencies for use with the overhead projector.

For most effective work the students should have ready access to a combine to enable them to put their theory into practice. It is highly recommended that one or more combines be available in the agricultural mechanics shop during the course of study. Other combines may be studied during field trips to farms and to implement dealers.

Since the individual features of the different makes and models of combines cannot be included in one publication, it is also strongly recommended that the operator's manual for the combines being studied be made available. This manual refers to the manufactures operator's manual for specific recommendations and adjustments. If the operator's manual is not available locally, copies may be obtained from the manufacture's branch office.

SUPPLEMENTAL MATERIALS

A set of thirty 2 x 2" color slides has been selected from several hundred slides made available by Allis-Chalmers, J. I. Case, and The International Harvester Companies to illustrate the operation and design of the combine. The slides, with the accompanying script,may be purchased from the Vocational Agriculture Instructional Materials Service.

A sample 50-question examination and key has been prepared in accordance with the educational objectives that were followed in developing the manual. The examination contains the following type questions: true or false, multiple choice, matching, and mathematical problems. In addition to the 50 questions, the illustrations showing the combine cross section and the flow chart found on pages 22 and 24 respectively are included as part of the examination. Copies of the examination may be purchased from the Vo-Ag Instructional Materials Service.

EDUCATIONAL OBJECTIVES

Effective teaching has resulted when an evaluation indicates that students have attained desirable knowledge, skills, attitudes, and asperations in the subject being taught. The ability to think clearly in the subject matter area as well as the ability to perform manual operations is an important goal.

The following objectives, stated in terms of student needs and behavior, were used as a guide in developing the manual:

STUDENT NEEDS —

1. To appreciate the harvesting losses that may occur when the combine is improperly operated and adjusted.
2. To appreciate the economic loss that can occur.
   a. Through grain lost in the field.
   b. By marketing a damaged and contaminated product.
3. To understand the design and principles of operation of the combine.
4. To understand the principles of the various combine adjustments.
5. To be able to evaluate his need for a combine.
6. To be able to select a combine that will meet his needs.
7. To be able to understand practical and experimental knowledge concerning combine operation and desing.

DESIRED STUDENT BEHAVIOR —

1. The ability to recognize and determine the extent of combine harvesting losses.
   a. Field losses.
   b. Machine losses.
   c. Damaged grain loss.
   d. Losses due to foreign material in the grain.
2. To identify the basic operations of the combine.
   a. Cutting and feeding.
   b. Threshing.
   c. Separation.
   d. Cleaning.
3. To identify the cause of each kind of combine loss.
4. To make proper adjustments with the machine or method of operation to correct the losses.
5. To determine his need for a combine in his farming operation.
6. To select a combine that will meet his farming needs.
7. To make repairs on his combine.
8. To apply practical and experimental knowledge in solving combining problems.
9. To make use of the manufactures operator's manual in operating and repairing the machine.

ACKNOWLEDGEMENTS

The manual "Combines and Combining" was prepared by Harlan E. Ridenour of the Ohio Vocational Agriculture Instructional Materials Service. Many persons provided invaluable assistance in compiling and organizing the material presented in this manual. The manuscript has been reviewed by Mr. S. G. Huber, Department of Agricultural Engineering, Dr. G. S. Guiler, Department of Agricultural Education, The Ohio State University, and Dr. W. H. Johnson, the Ohio Agricultural Experiment Station, for both content and arrangement. Dr. Ralph J. Woodin of the Department of Agricultural Education provided assistance in determining the organization of the manual.

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The first printing of the manual "Combines and Combining" has been extensively reviewed by D. M. Byg, Extension Agricultural Engineer, Farm Machinery, of The Ohio State University. Mr. Byg has suggested certain changes and additions which have been included in the second printing. In addition, D. M. Byg, W. E. Gill and W. H. Johnson conducted a survey to determine the actual grain losses that farmers were experiencing with their corn harvesting equipment throughout the 1964 harvest season. Some of the findings resulting from this survey have been added to the manual.

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Instructional Materials Service

COMBINES AND COMBINING

I. WHAT IS THE VALUE OF DOING A GOOD JOB OF COMBINING?

The combine can be adapted to harvest any of our seed growing crops by use of the appropriate attachments and by making the proper adjustments on the machine for the kind of crop to be harvested. The principles of operation are the same for each of the crops even though different attachments may be used. In Ohio the combine is widely used in the harvesting of our grain crops. This means that we must understand how to operate the combine properly if we are to avoid large losses of grain at harves time.

The large investment the farmer has in grain crops makes it important to harvest all the high quality grain he can from his fields. A recent study shows that the cost per acre of raising the following crops was: corn - $58.85, soybeans- $44.25, and wheat - $47.30.[1]

Student exercise: Study your farming program or farm account records to find your cost of production per acre for the crops you will be harvesting with the combine. Does this make it seem important to save all the high quality grain you can?

A. WHAT KIND OF LOSSES DO WE HAVE BECAUSE OF POOR COMBINE OPERATION AND ADJUSTMENT?

1. Field losses of grain.

No matter how careful we are some grain will always be left in the field. Some will be lost on the ground before combining, some will be missed by the machine because of cutting too high or poor driving, while some will be lost through the machine because the heads are not completely threshed out or the kernels thrown out of the machine. These losses will be greater than necessary unless the combine is properly operated and adjusted.

The graph shown in Figure 1 may be used to show the dollars per acre loss with different possible rates of loss per acre with grain at different prices.

2. Marketing losses caused by poor quality grain.

Poor adjustment and operation of the combine may cause damaged

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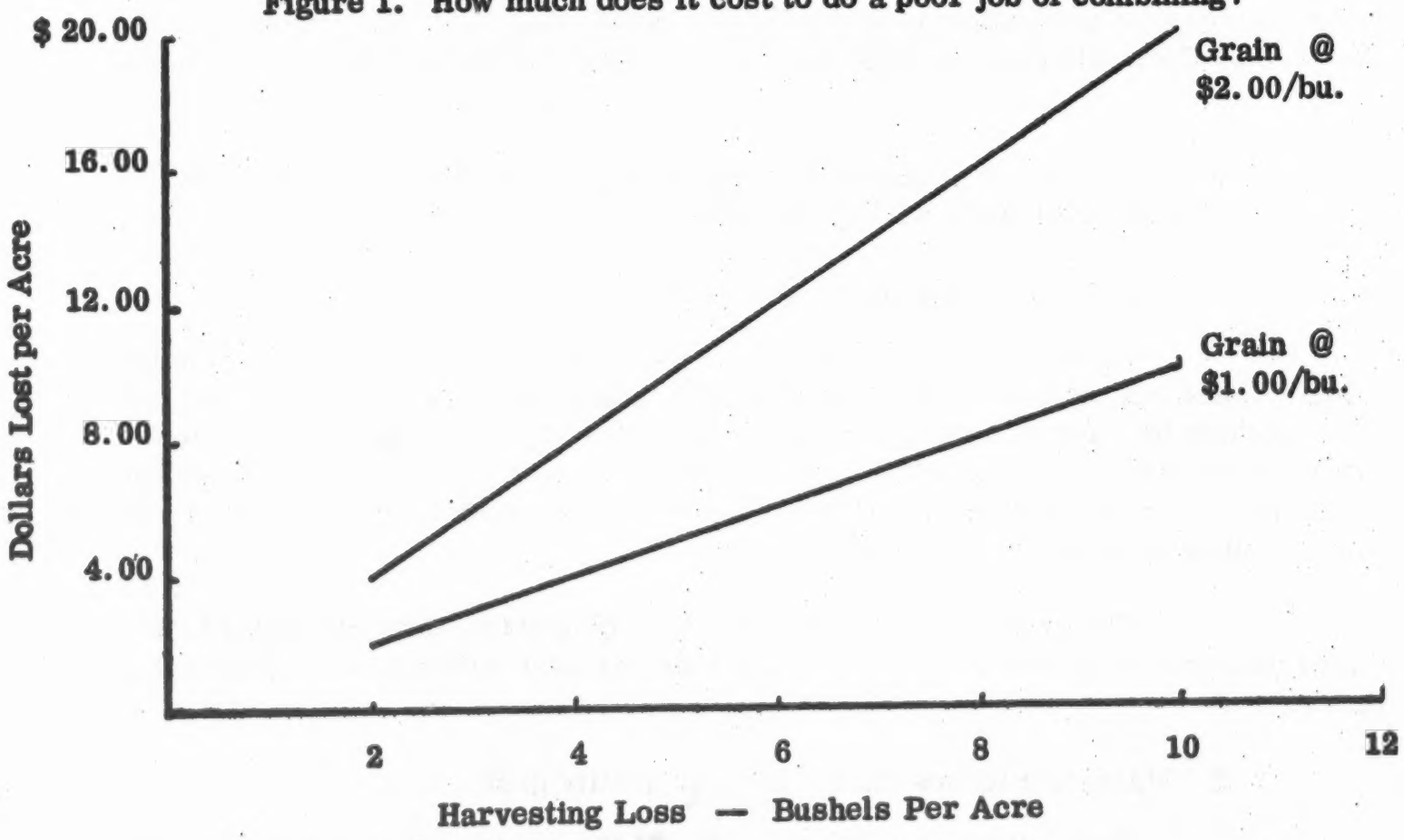
1. G. V. Vollmar and R. H. Blosser, Crop Economics for Ohio, Bulletin 423, The Ohio State University, Department of Agricultural Economics.

grain that will lower the sale price or storage quality. This will cause an economic loss to the farmer. By understanding the principles of operation of the combine these losses can be kept to a minimum.

Grain damage that will cause the price to be discounted include the following: low test weight per bushel, high moisture content, heat damage, foreign material, shrunken-broken kernels, and split grain in the case of soybeans. These losses can be kept to a minimum by proper timing of the combine operation and by having the machine in proper adjustment.

Figures 2, 3, and 4 prepared by Ross Milner, Extension Specialist, Grain Marketing, The Ohio State University, show the effect of the different kinds of grain damage and the approximate discounts that may be applied to the market price of the grain.

Figure 1. How much does it cost to do a poor job of combining?



In the example above the loss in dollars per acre has been plotted for grain prices at $1.00 and $2.00 per bushel for losses from 2 to 10 bushels per acre. You may substitute any crop at its current market value and plot the dollar loss for different harvesting losses.

FIGURE 2

SOFT RED WINTER AND WHITE WHEAT GRADES - PREMIUMS AND DISCOUNTS*

Grade Factors	Grade No. 2	Approximate Discounts by Processors and Terminals
Test Weight	Min. 58 lbs.	(1/2¢ each 1/2 lb. under 58 thru 56 lbs.) (1 ¢ each 1/2 lb. under 56 thru 54 lbs.) (1 1/2 ¢ each 1/2 lb. under 54)
Total Damage	Max. 4%	1¢ each 1% or fraction 4.1% thru 10%
Heat Damage	Max. 0.2%	negotiated in excess of 0.2%
Foreign Material	Max. 1%	1¢ each 1% or fraction 1.1% thru 5%
Shrunken & Broken	Max. 5%	negotiated in excess of 5%
Total Defects	Max. 5%	negotiated in excess of 5%
Wheat of Other Classes	Max. 5%	SRW with white 1/2¢ 5.1% thru 10%
Additional Grade Factors	(always SAMPLE GRADE when present)	
Inseparable Stones (7 or more)		negotiated
Musty or sour odors		10¢ per bushel
C.O.F.O. 1/		negotiated
Heating		negotiated
D.L.Q. 2/		negotiated or rejected

Special Grade, TOUGH, over 13 1/2% moisture. (14%, -1¢) (14.5%, -3¢) (15.0%, -5¢) (15.5%, -8¢) or dry and shrink.

FIGURE 3

CORN GRADES - PREMIUMS AND DISCOUNTS*

Grade Factors		Buying Grade No. 2	Approximate Discounts by Processors and Terminals
Test Weight	Min.	54 lbs.	1/2 to 1¢ each lb. or fraction under 54 lbs.
Moisture	Max.	15.5%	1 to 1/2¢ each 1/2% over 15 1/2%
Broken & F.M.	Max.	3 %	1¢ each 1% or fraction over 3%
Total Damage	Max.	5 %	1/2 to 1¢ each 1% or fraction over 5%
Heat Damaged	Max.	0.2%	1/2¢ each 1/10% over 2/10% to 3% then 1¢ each 1/10%
Additional Grade Factors	(Always SAMPLE GRADE when present)		
Inseparable Stones (over 7)			Subject to negotiation
Musty			5 to 10¢ or subject to negotiation
Sour			10¢ or subject to negotiation
Heating			5 to 10¢ or subject to negotiation
C.O.F.O. 1/			subject to negotiation
D.L.Q. 3/			subject to negotiation or rejection

FIGURE 4

SOYBEAN GRADES - PREMIUMS AND DISCOUNTS *

Grade Factors		Buying Grade No. 1	Buying Grade No. 2	Approximate Discounts by Processors and Terminals
Test Weight	Min. lbs.		54	1/2 cent each lb. or fraction under 54
Moisture	Max. %	13		2 to 2 1/2¢ each 1/2% or fraction over 13%
Splits	Max. %		20	1/4¢ to each 5% or fraction over 20%
Total Damage	Max. %	2		1¢ each 1% or fraction over 2%
Heat Damaged	Max. %		.5	1¢ each .5% or fraction over .5%
Foreign Material	Max. %	1		All over 1% deducted from weight
Other Colors 4/	Max. %	1		1/2¢ each 1% or fraction over 1%
Musty		Sample		negotiated
Sour		Sample		negotiated
Heating		Sample		negotiated
C.O.F.O. 1/		Sample		negotiated
Inseparable Stones (over 7)		Sample		negotiated
D.L.Q. 5/		Sample		negotiated
Purple Mottled or Stained 6/		Not higher than No. 3		negotiated
Materially Weathered		Not higher than No.4		negotiated

1/ C.O.F.O. - Commercially objectionable foreign odors -- includes skunk, smoke, burned decaying plants or animals, oil, etc.

2/ D.L.Q. Wheat - Distinctly low quality -- included three or more rat and mouse pellets, bird droppings, and treated pink wheat. Also large stones, glass, caster beans, Crotolaria seeds, foreign substances and other unusual conditions.

3/ D.L.Q. Corn - Distinctly low quality -- includes rodent excreta in excess of .2% based on 1 1/8 to 1 1/4 quarts of original sample, stones, pieces of glass and concrete too large to enter the probe, castor beans, cockleburs, Crotalaria more than 2 in 1000 grams and unknown foreign substances or commonly recognized harmful or toxic foreign substances. Also, other unusual conditions which adversely affect the quality and which cannot be properly graded by specified factors.

4/ Other Colors - mean brown, black and/or bi-colored soybeans in yellow or green soybeans. Color is a grading factor up to and including 10% of other colors. Above 10% class changes to "Mixed Soybeans."

5/ D.L.Q. Soybeans - Distinctly low quality -- large stones, glass, concrete too large to enter the probe, castor beans, more than 2 Crotalaria seeds/1000 grams, visible contamination by rodents, birds or other sources of filth, unknown foreign substance or a commonly recognized harmful or toxic foreign substance, and other unusual conditions which adversely affect the quality.

6/ Includes discoloration due to fungus growth, dirt or nontoxic inoculants and other nontoxic substances.

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* Ross Milner, Extension Specialist, Grain Marketing, The Ohio State University.

3. Operating the combine with improper adjustments or under poor conditions may require excessive amounts of power. This will increase the cost of harvesting the crop.

4. Operating the combine under poor conditions with improper adjustments will increase the wear on the machine. This will shorten the life of the combine and increase repair bills.

B. CHARACTERISTICS OF A GOOD JOB OF COMBINING.

A poor job of combining means that too much grain will be left in the field and that some will be damaged so much that the market grade will be lowered. Both of these losses mean that we will not receive as much for our work and investment as we would if we did a good job of combining. The cost of doing a good job is no more than for doing a poor job.

Let us see if we can tell what a good job of combining should be like. Where would you look?

The field.

1. Uncut grain left standing.
2. A few grains left in some of the heads.
3. Straw and heads are not excessively chewed up.

The machine.

1. Very few unthreshed heads at the rear of the machine.
2. Material spread evenly over the rack.
3. Little or no grain found coming from shoe or rack.
4. A small amount of material in the tailings auger.

The grain tank.

1. The grain is not cracked.
2. There is a small amount of chaff and other foreign matter in the grain.
3. The grain has a satisfactory moisture content for storage or marketing without excessive losses.

C. WHAT ARE THE THINGS THAT EFFECT THE KIND OF JOB OF COMBINING WE SHOULD DO?

1. The combine:

   a. The power needed to run the combine at constant r.p.m. (revolutions per minute.).
   b. The speed of forward travel.
   c. The adjustment of the combine.
   d. The skill of the operator.
   e. The width of the combine.

2. The natural conditions.

   a. The lay of the land. (Topography.)
   b. The condition of the crop for threshing.
   c. The stand of the crop.
   d. The amount of weeds in the field.
   e. The variety of the crop.

D. THERE ARE SEVERAL THINGS WE NEED TO KNOW ABOUT A COMBINE IF WE ARE TO BECOME EFFICIENT OPERATORS WITH THE ABILITY TO DO THE KIND OF JOB WE DESCRIBED.

Even if we hire our combining done we should be able to tell whether or not the custom operator is doing a good job for us.

Some of the things we need to know are listed here. They will be studied in more detail later in this manual.

1. To understand the functional design of the combine.
2. To understand the basic principles of operation of the combine.
3. To have the ability to identify combine losses.
4. To have the ability to make the proper adjustments on the combine to keep the losses as low as possible.
5. To have the ability to maintain the combine in efficient operating condition.
6. To have the ability to determine the need for a combine in the farming operation and to select the machine that would best meet the need.

II. THE BASIC DESIGN OF THE COMBINE:

In studying the design of the combine it is recommended that one or more combines be available in the school shop. These may be obtained from the students' home farms or from a local implement dealer. Copies of the operator's manual should also be provided for the combines being studied. Quantities for class use can usually be obtained by writing direct to the manufacturer. The use of the operator's manual will serve two purposes: (1) to help in identifying the parts of the combine, their function and necessary adjustments, and (2) to illustrate the importance of using the operator's manual when working with the combine.

A. TYPES OF COMBINES.

1. Width of cut is one way of classifying combines.
2. The way power is supplied is another classification.

   a. Pull type power take-off drive.
   b. Pull type with an auxilliary engine to supply cutting and threshing power.
   c. Self-propelled combines.

B. BASIC OPERATIONS PERFORMED BY THE COMBINE.

As the name implies the combine harvester performs several harvesting operations at the same time. The grain is cut, or picked in the case of corn, fed into a threshing unit where the grain is removed from the husk, the grain is then separated from the straw or husks, and finally the grain is cleaned and delivered into the grain tank.

A study of the cross section of the combine will help in understanding what takes place in the machine when it is operating and also will show the relationship of one part of the combine to another. (See figure 5.) To do a good job of combining the operator must understand the function of each unit of the combine, its adjustment, and the effect of each adjustment on the performance of the machine.

1. Cutting and feeding unit: Figures 6, 7, and 8.

The function of this section of the combine is to cut only as much of the crop as is necessary to get all the heads, lay the cut crop on the platform or auger, and then feed it uniformly into the threshing unit. Different makes and models of the combines will do this in somewhat different ways.

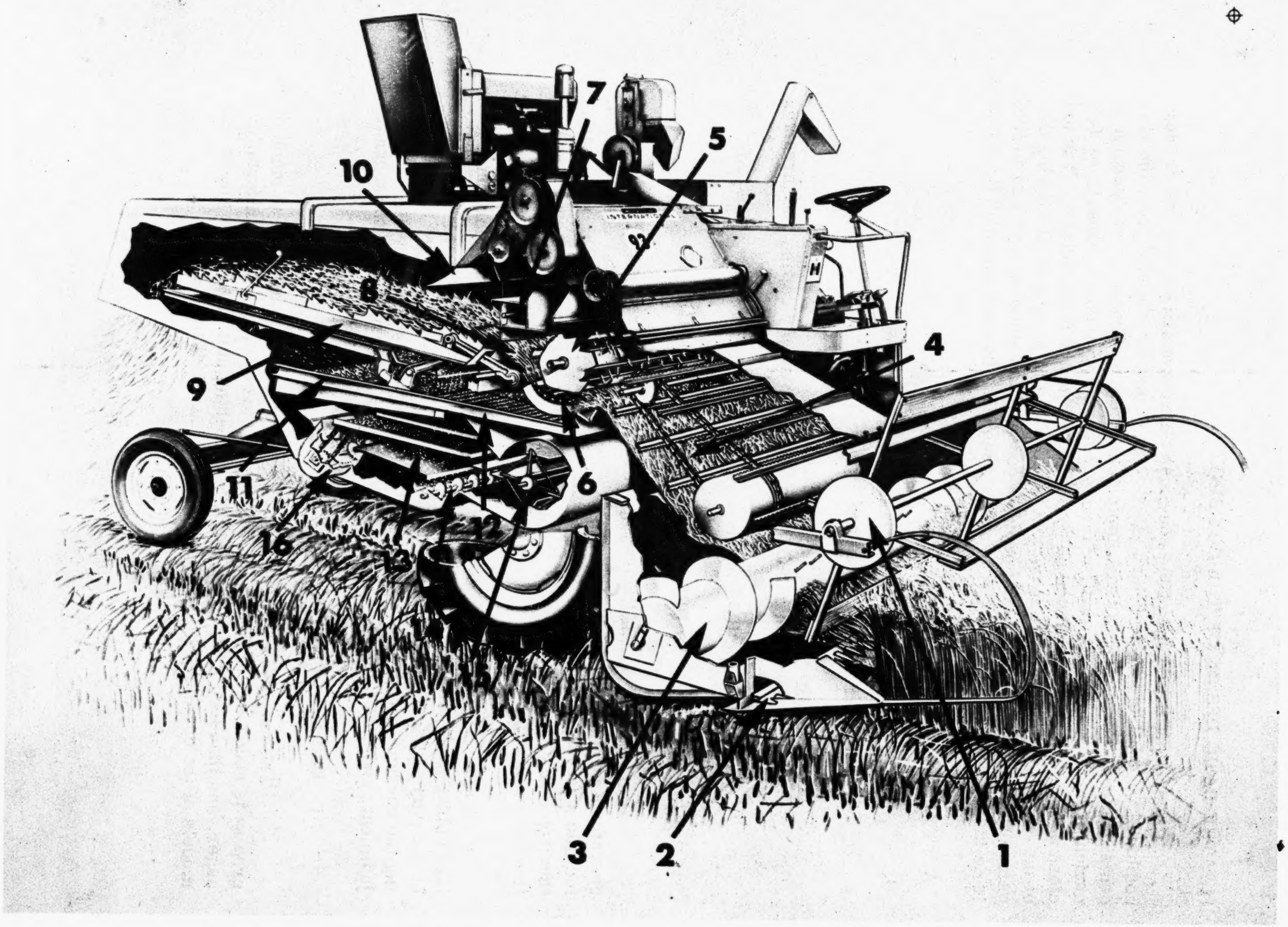


Figure 5. Combine Operating Cycle. Courtesy International Harvester Company.

The Combine Operating Cycle (Figure 5)

The reel (1) momentarily holds the crop against the guards until the knife (2) cuts the stems, and then it sweeps the cut material onto the platform. The platform auger (3) delivers the cut grain to the feeder (4) which carries the cut grain to the cylinder (5). The grain is rubbed out of the head between the rotating cylinder (5) and the concave grates (6). The cylinder beater (7) strips the cylinder, continues separating loose kernels of grain through the finger grate (8) then moves the material onto the straw rack (9) where final separation takes place. The adjustable cylinder beater check flap (10) regulates the flow of material over the racks. The grain pan (12) catches the grain separated at the concave, cylinder beater grate, and return from the straw racks and delivers it to the chaffer (11). The cleaning fan (15) supplies the wind blast which is the medium of separation. The shoe and sieve (13) operates in the direct oppostie tothe grain pan and chaffer which assures double action cleaning (as the grain pan and chaffer moves forward, the shoe and shoe sieve move towards the rear.) The shoe sieve (13) is where the final cleaning takes place. The threshed grain falls through the chaffer, and shoe sieve, and into the grain trough (14) where it is moved to the grain elevator by the grain auger. The grain elevator conveyor chain then delivers the clean grain to the grain tank. Unthreshed heads will move rearward across the chaffer and shoe sieve and drop into the tailings return auger trough (16). From this point, the unthreshed heads are returned by the tailings elevator to the cylinder for re-threshing.

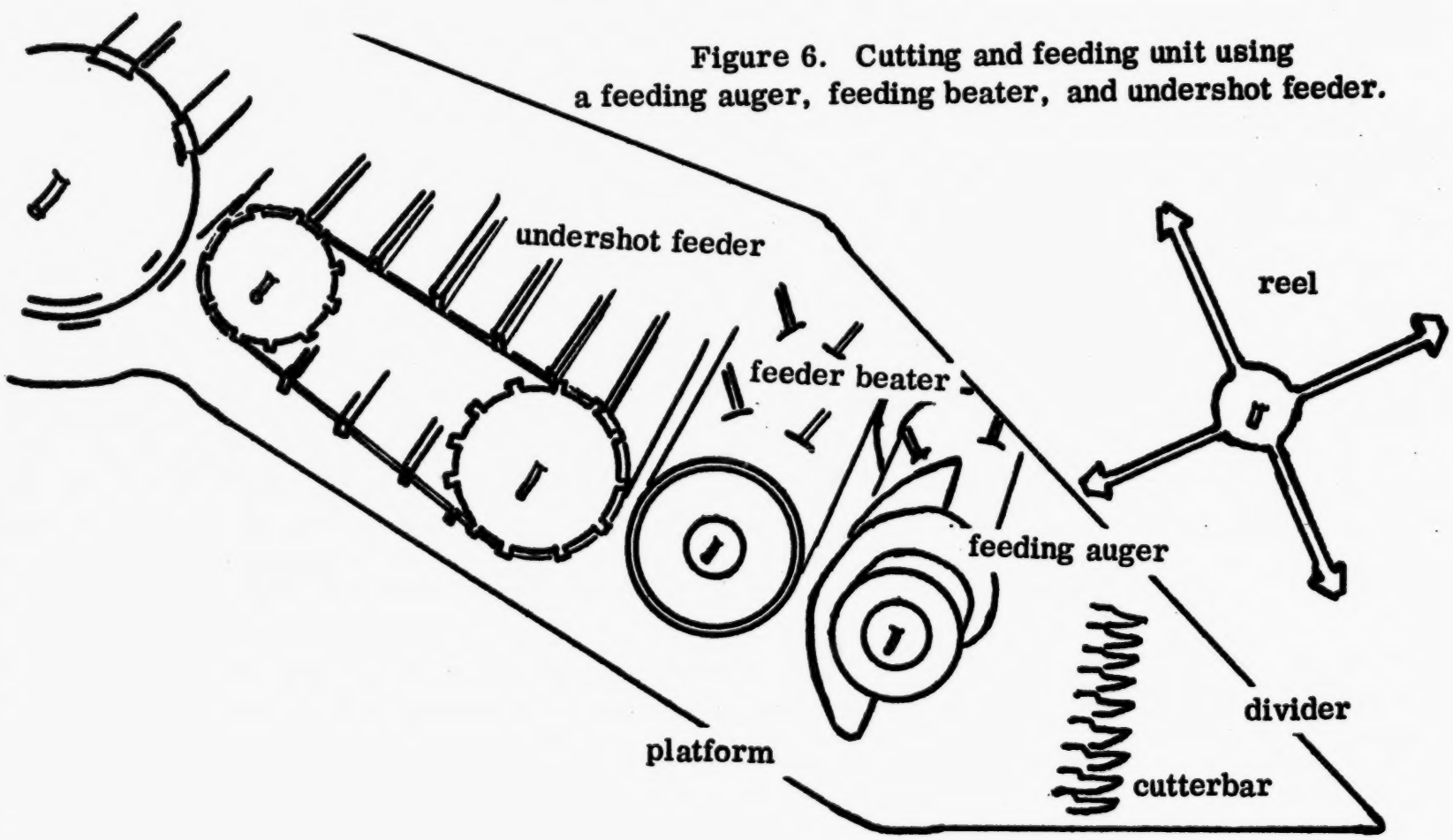


Figure 6. Cutting and feeding unit using a feeding auger, feeding beater, and undershot feeder.

Figure 7. Cutting and feeding unit using a feeding auger and feeding beater.

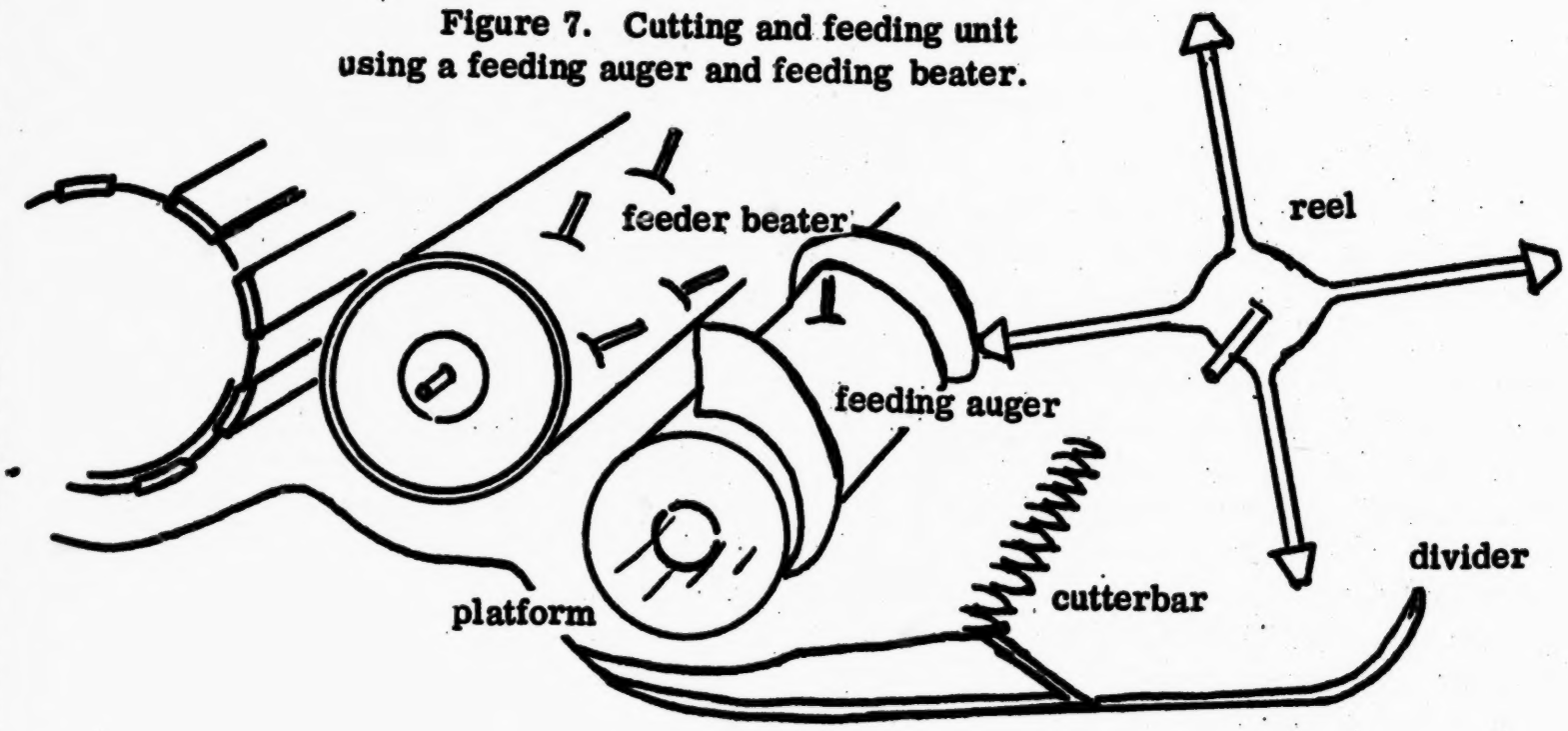
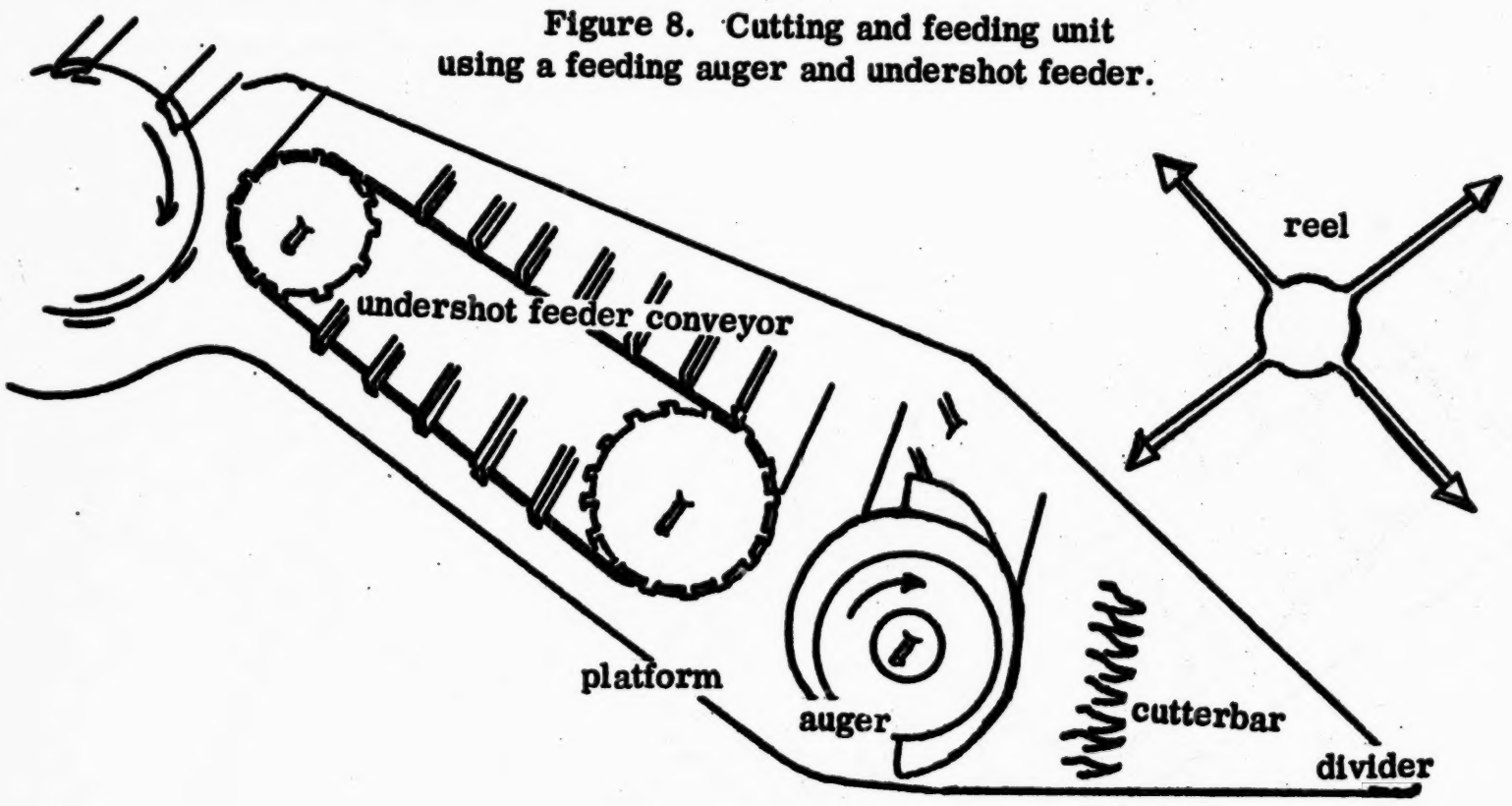


Figure 8. Cutting and feeding unit using a feeding auger and undershot feeder.



Not all combines will perform this operation in exactly the same way. How is your combine designed to take care of the cutting and feeding operation?

Figure 7. Cutting and feeding unit using a feeding auger and feeding beater.

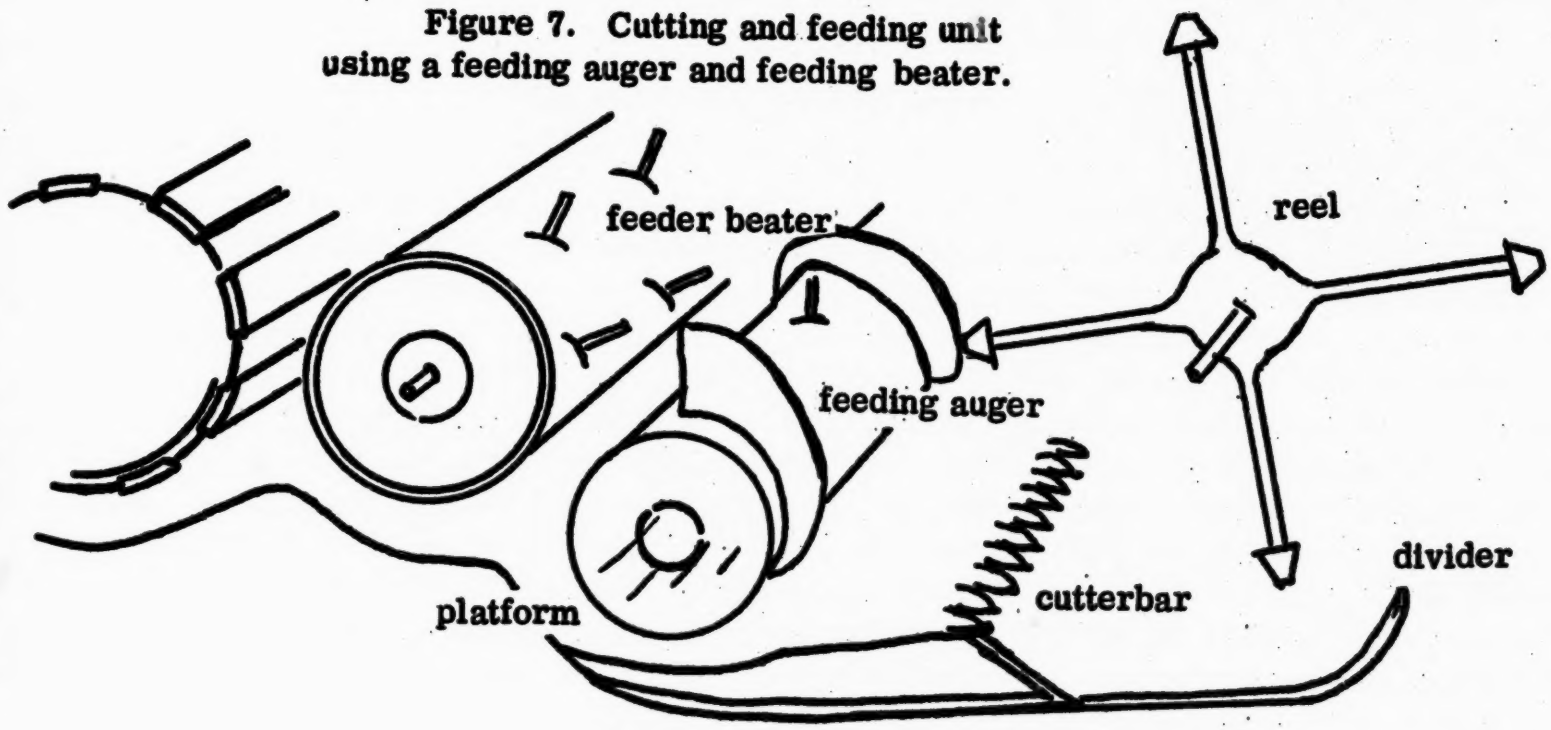
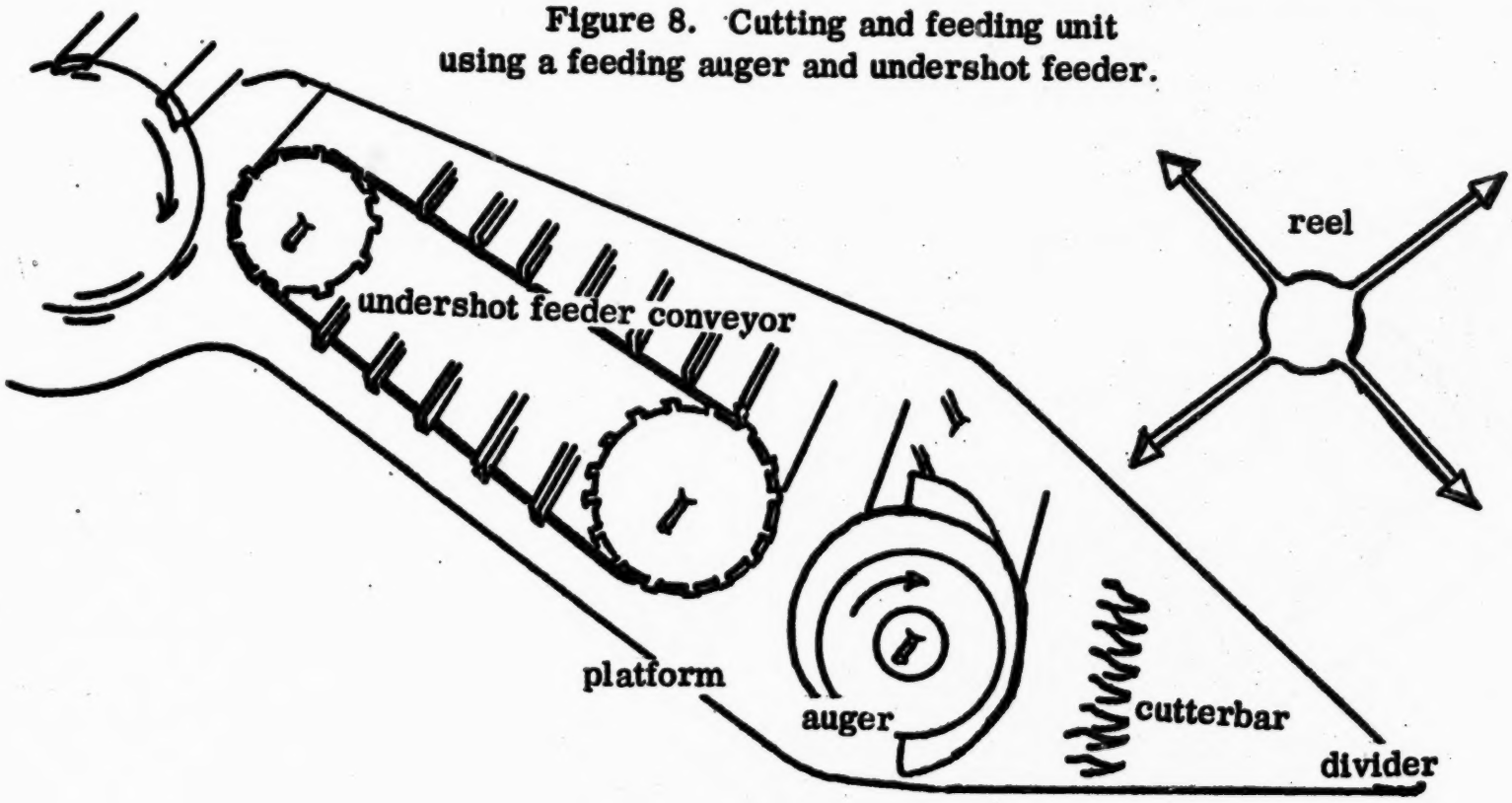


Figure 8. Cutting and feeding unit using a feeding auger and undershot feeder.



Not all combines will perform this operation in exactly the same way. How is your combine designed to take care of the cutting and feeding operation?

The main parts in the cutting and feeding area are:

a. Cutter bar: The cutter bar works like a series of shears running through the field to cut the grain. This is accomplished by knife sections reciprocating (working back and forth) over ledger plates which are held in place by guards. Hold down clamps, wearing plates, and shims are used to keep the knife flat on the ledger plates. Figure 45.

The sickle bar is usually driven by a pitman drive assembly. Figure 53.

Power will usually be supplied to the pitman crank by means of a series of belts and chains.

b. Reel: The reel slats gather in the crop, hold it until it has been cut by the knife, and then move it onto the platform. The reel must be square, level, and at the proper height and position to feed the grain uniformly and steadily. The reel may be ground driven or power driven.

c. Platform: The platform holds the cutter bar and feeding mechanisms.

d. Cutting platform auger: The cutting platform auger moves the cut grain to the center of the platform where the retractable auger fingers feed the grain into the feeder conveyor or the feeder beater depending on the design of the combine.

e. Retractable finger feeder beater: In some combines the cutting platform auger is followed by a retractable finger feeder beater which moves the grain into either the feeder conveyor or into the threshing unit. Figure 7.

f. Feeder conveyor: The feed conveyor or feed rake, as it is sometimes called, is designed to feed the grain in a steady even flow into the threshing unit. Proper feeding into the threshing unit will cause less clogging.

g. Feeder beater: Some models of combines will have a feeder beater which takes the grain from the feed conveyor and feeds it uniformly into the threshing unit.

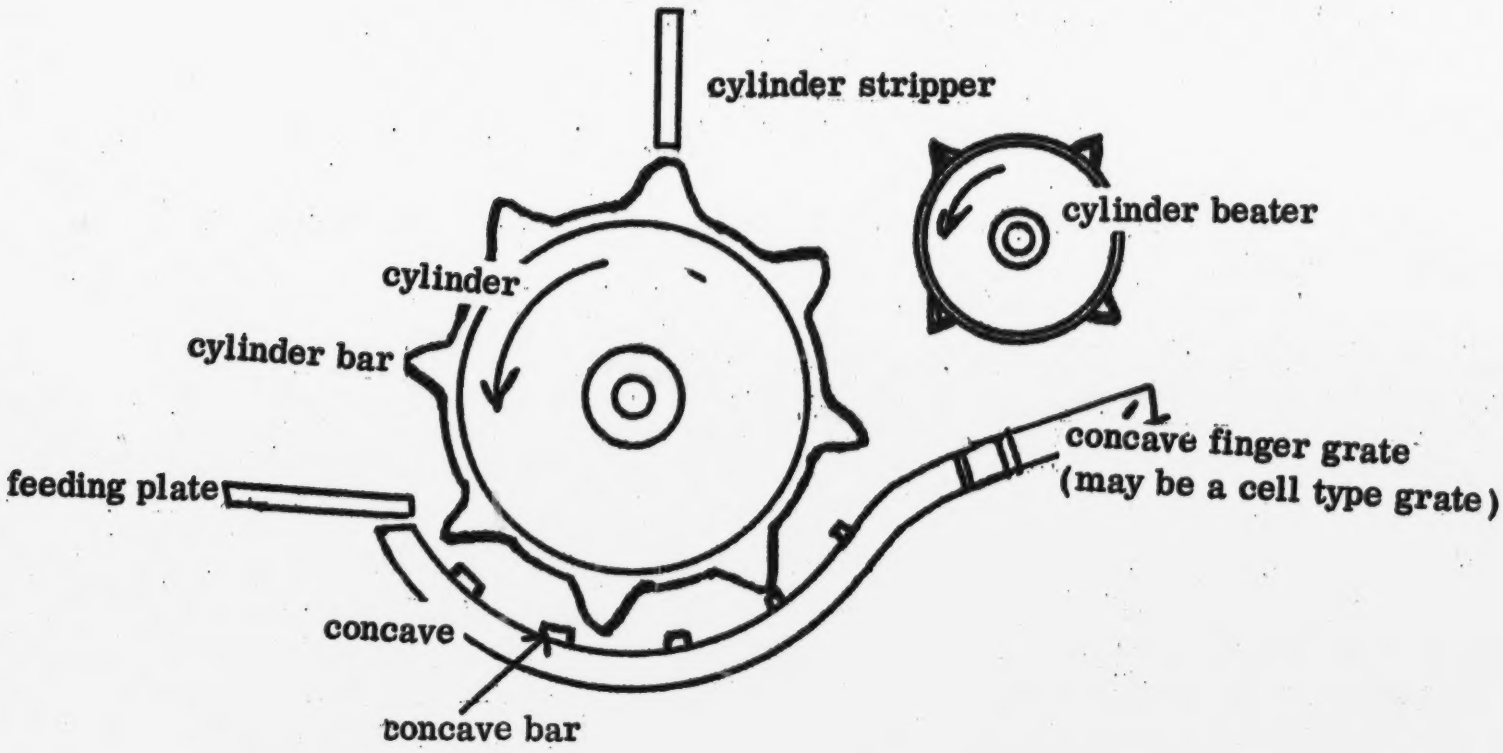
Student exercise: Study the combines you have in the school shop or at home, and make a schematic drawing of the cutting and feeding areas. Label all the parts and describe the flow of the grain. Use the operator's manual for the machine to help you.

2. Threshing Unit. Figure 9.

The function of this section of the combine is to thresh the grain from the heads. This is done by passing the grain between a rapidly revolving cylinder and a stationary surface underneath which is called the concave. The rubbing action on the grain caused by the bars on the cylinder passing over the concave channel bars causes the grain to be removed from the head.

The principle of threshing will be the same for all combines, but different makes and models will use different design and methods of making adjustments

Figure 9. THRESHING UNIT



The design of some of the parts shown on this schematic diagram may be different on your combine. Some combines will not have a separate shelling plate and may not have finger grates.

The main parts of the threshing unit are:

a. Cylinder: The cylinder will have either bars or spikes that will cause the rubbing of the grain against the concave.

(1). Rasp bar cylinder: The cylinder bars are rasp shaped as shown in the illustration. Figure 10.

(2). Rub bar cylinder: The cylinder bars are angle shaped and faced with rubber. Figure 11.

(3). Spiked tooth cylinder: The cylinder has spikes instead of bars. This type is not suited for corn harvesting. Figure 12.

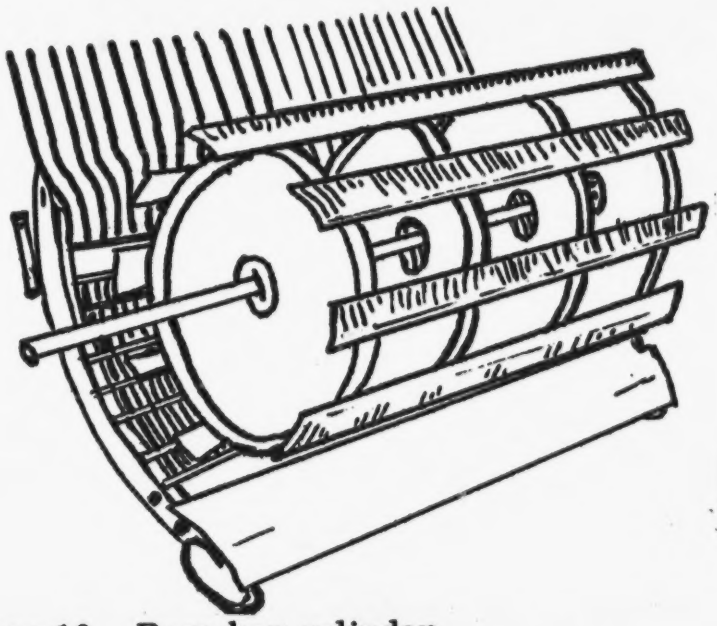


Figure 10. Rasp bar cylinder.

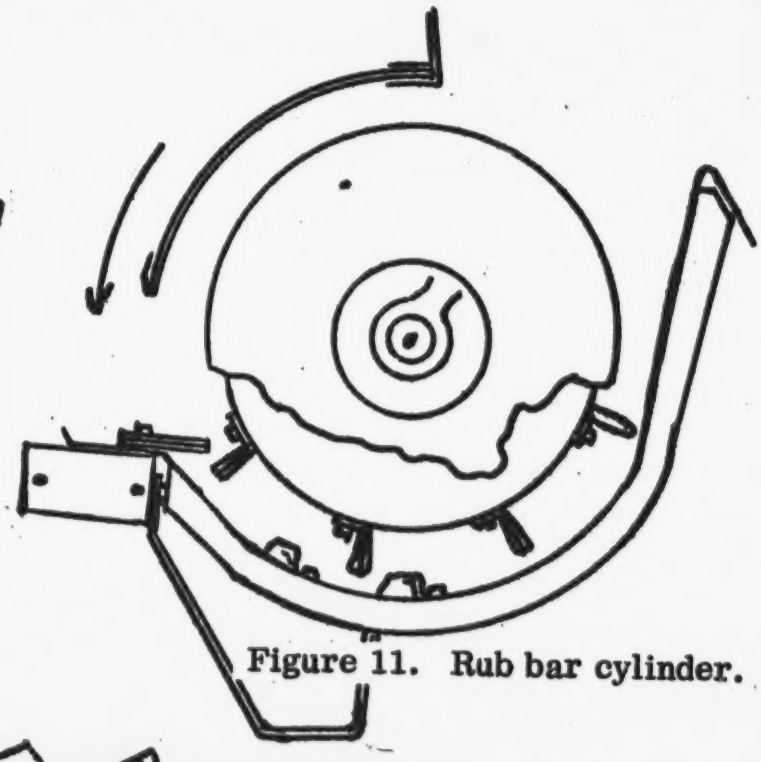


Figure 11. Rub bar cylinder.

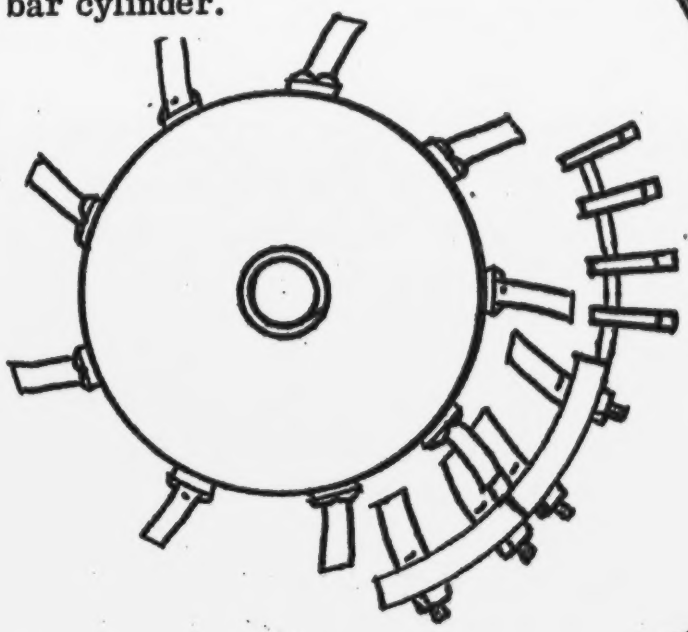


Figure 12. Spiked tooth cylinder.

b. Concave: The concave is the stationary part that the cylinder works against in the threshing action. It is the rubbing action between the cylinder bars and the concave bars that removes the seed from the head or pod. The concave is a grate composed of rods and bars or wires. (Figure 13.) It is at the concave grate and finger grate that as much as 90% of the grain is separated from the grain or husk. The separated grain falls through the grate onto the shoe pan where it is delivered to the cleaning unit. The straw and the remaining grain pass on into the separation unit. One make, the Gleaner combine, separates the grain from the straw by use of a raddle located behind the cylinder. Clean grain falls through the suspended straw and is conveyed to the cleaning shoe. (See figure 17.)

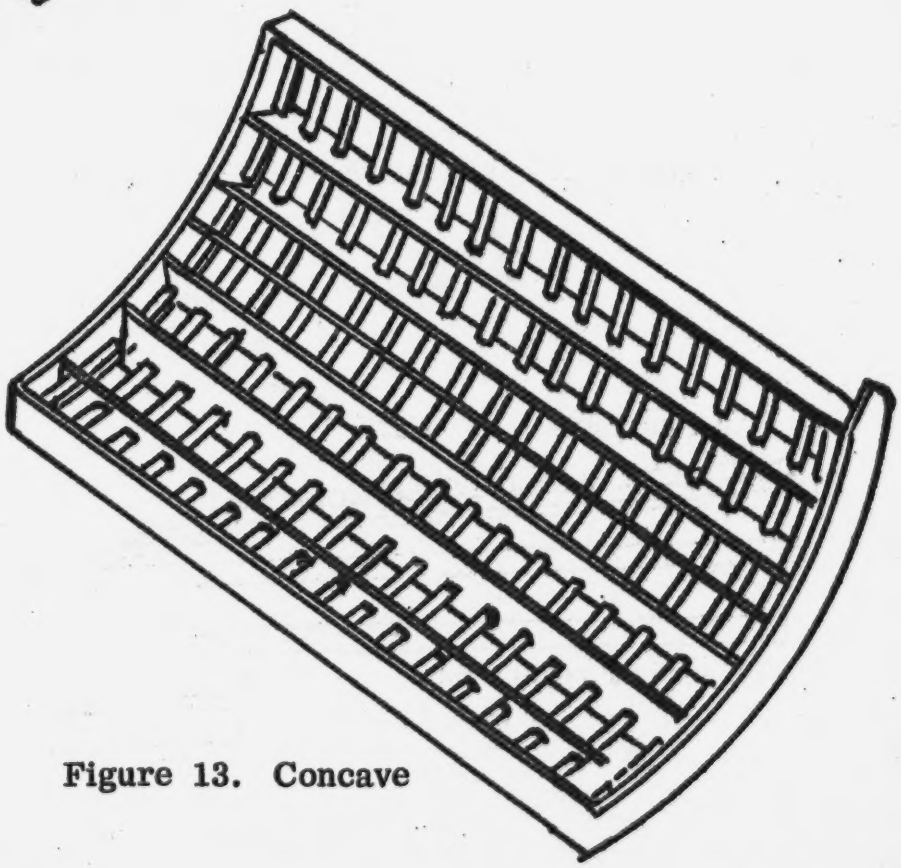


Figure 13. Concave

c. Cylinder beater: The beater behind the cylinder slows down the material coming from the cylinder, tears apart the straw, and delivers the material to the straw rack or the straw walker as it may be called. The beater helps in cleaning the straw from the cylinder thus preventing cylinder wrapping and feed back. Figure 9.

d. Feeding plate: The feeding plate (figure 9) is an adjustable plate located where the cut grain is fed into the cylinder concave unit. Much of the threshing can be done here.

e. Cylinder stripper: The cylinder stripper is set parallel to and above the cylinder and prevents back feeding.

3. Separating Unit.

The separating unit agitates the straw after it comes from the threshing unit. This shakes out the loose grain remaining in the straw and delivers it to the cleaning unit. Since the threshing unit separates up to 90% of the grain, only about 10% remains to be separated in this unit. The straw is carried out of the combine by the rack.

There are several designs used to collect the grain from the straw rack and concave grate. The schematic drawings in figures 14, 15, 16 and 17 show four possible methods of doing this.

Figure 14. Separating unit using straw rack return pan under the straw rack.

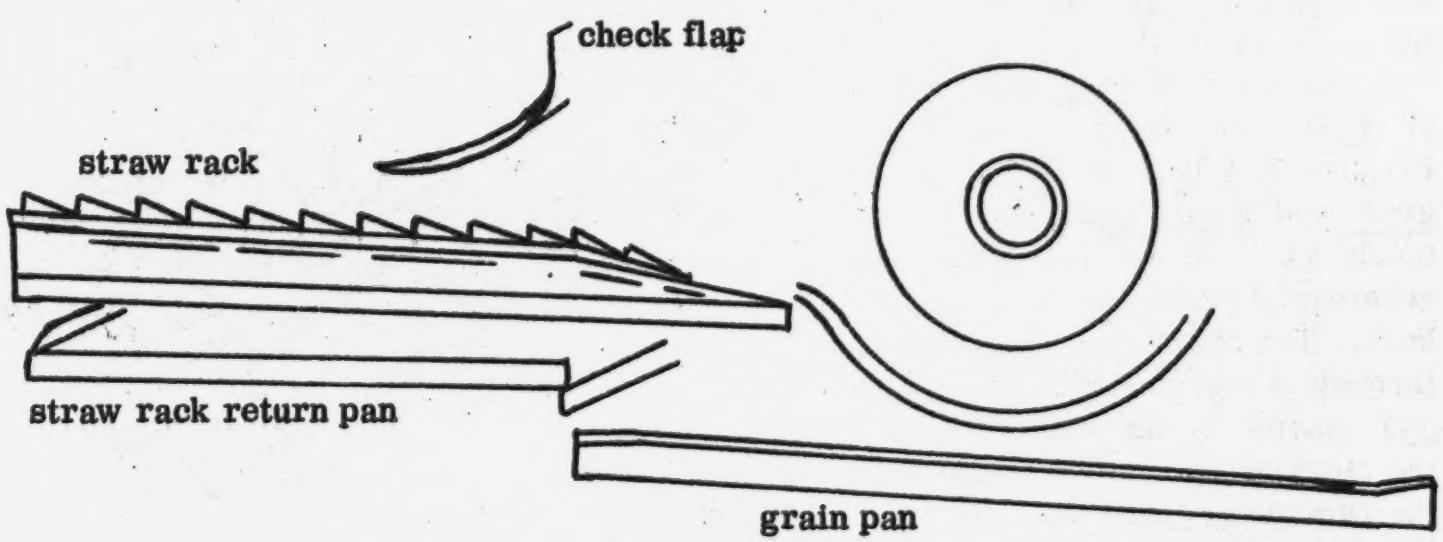


Figure 15. Separating unit using straw rack return pan and grain conveyor.

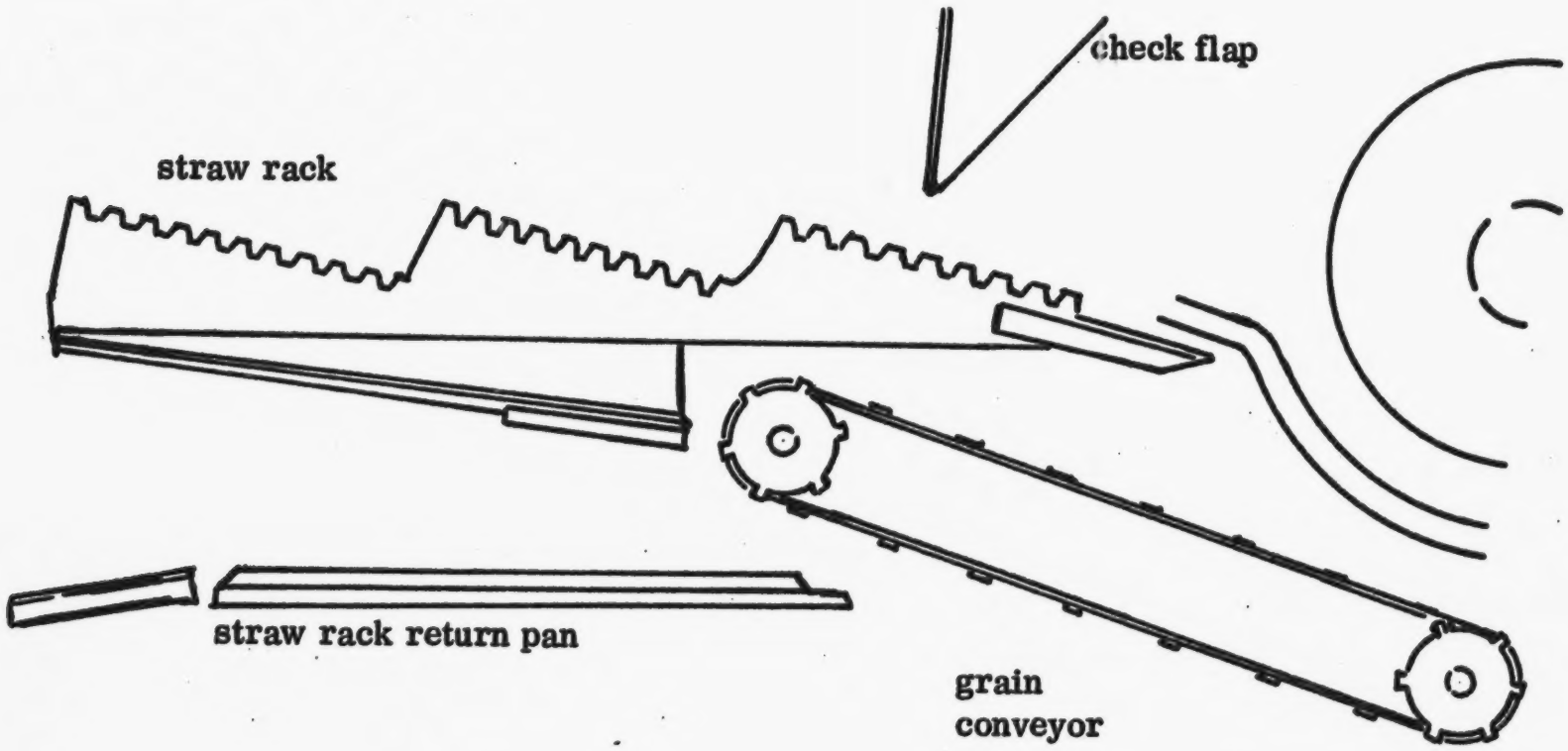


Figure 16. Separating unit using grain return conveyor under the straw rack.

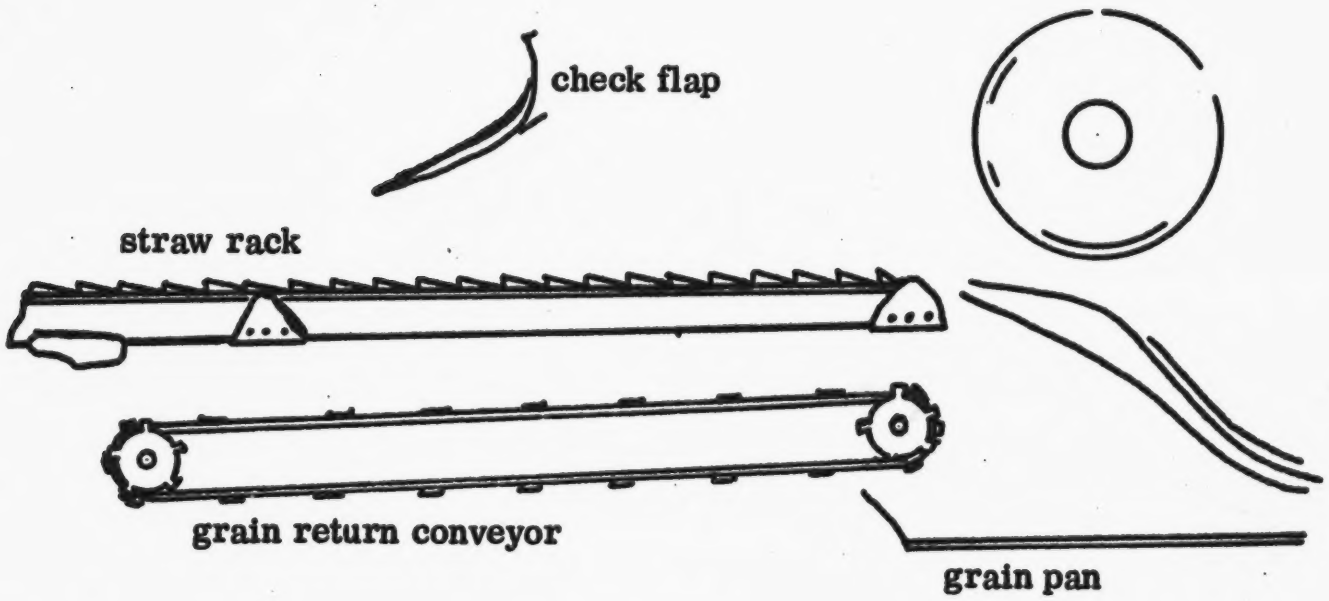
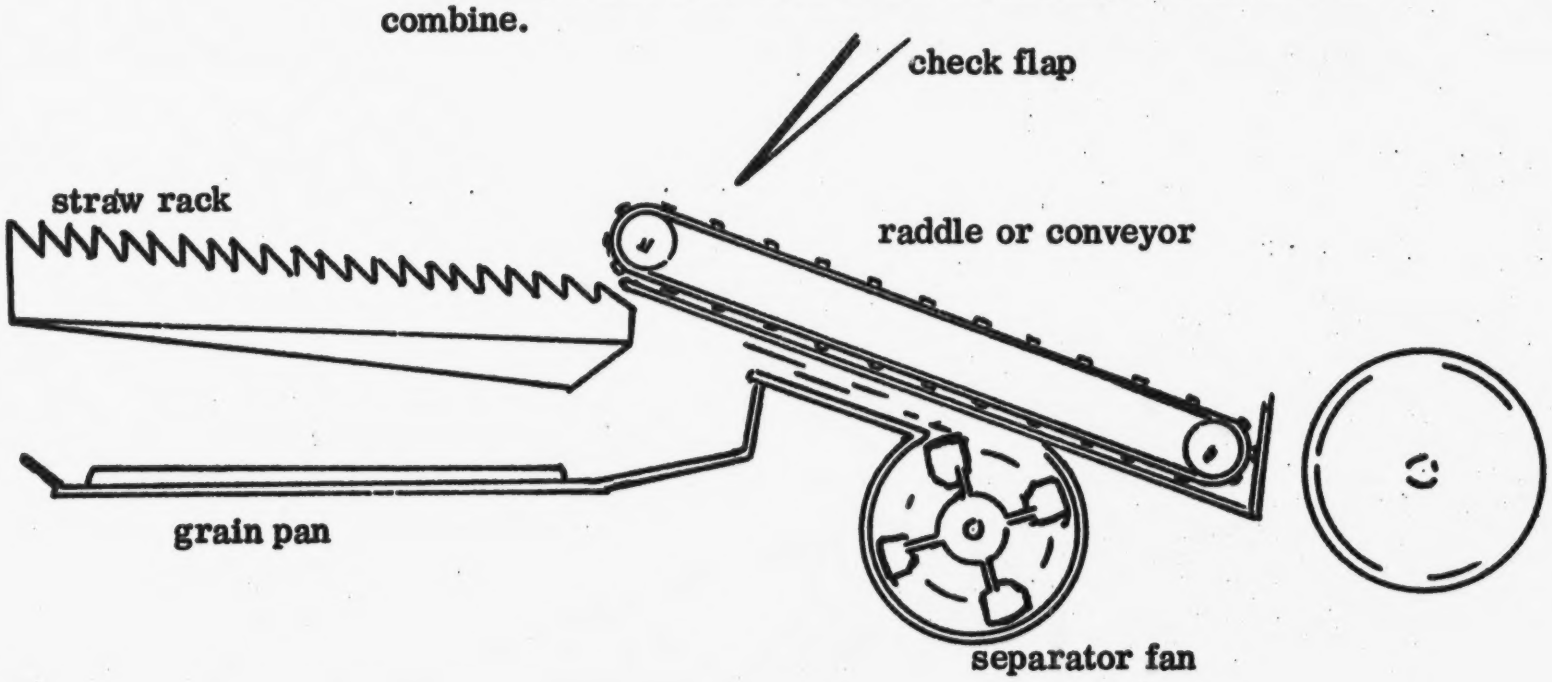


Figure 17. Separating unit using a grain return pan under the straw rack. A cleaning fan is also used in the separating section of this combine.

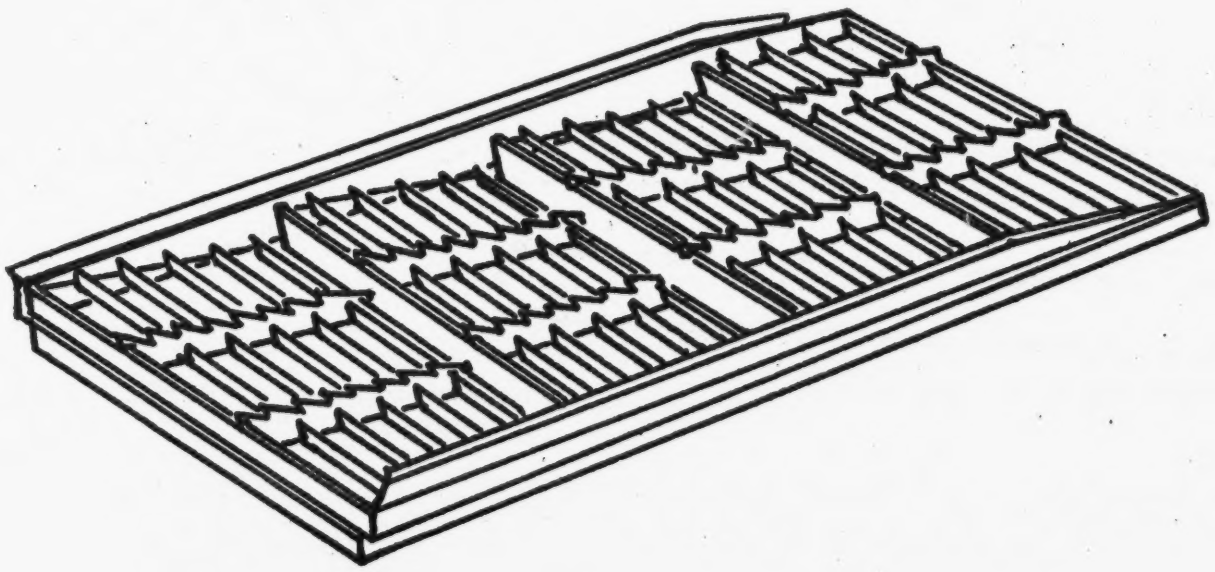


The main parts of the separating area are:

a. Concave grate and finger or cell grate which has been described in the threshing unit.

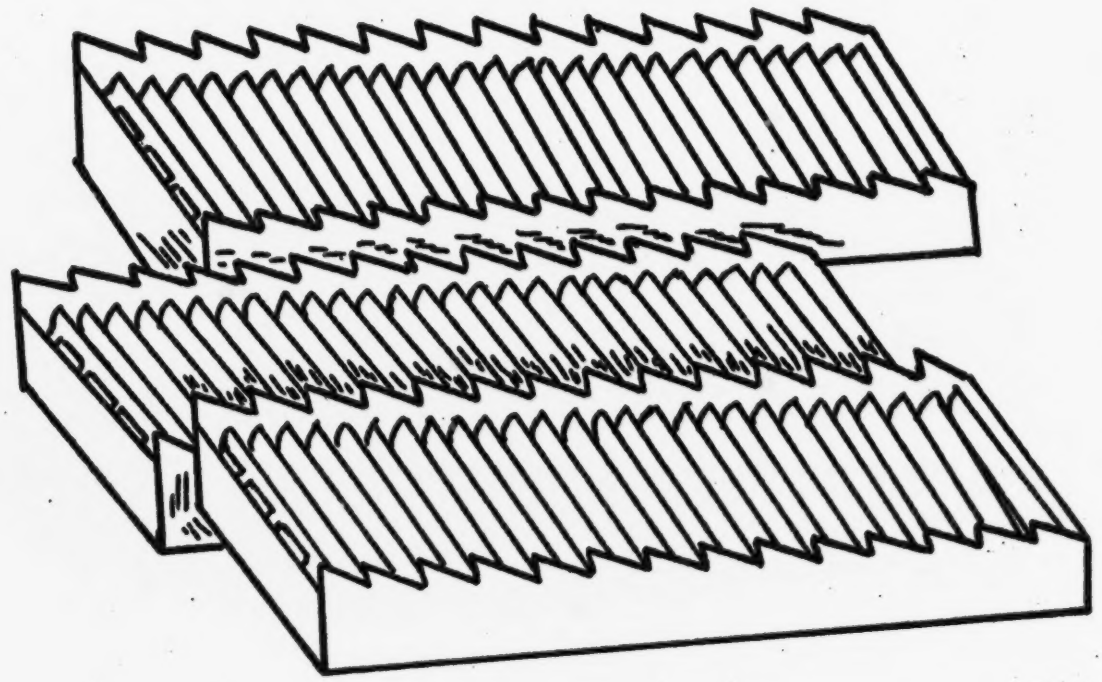
b. One piece straw rack: The straw rack is a one piece unit with risers pointed toward the rear of the combine. Figure 18. The straw rack is mounted on cranks located at the front and rear which give it an oscillating motion. As the rack moves rearward and upward the straw is tossed up and to the rear. As the rack returns forward and downward the straw stays in mid air for a short time and then falls onto a section of the rack nearer the end of the combine. In this way the straw moves step by step out of the combine. This tossing action causes the grain to be separated from the straw.

Figure 18. One piece straw rack.



c. Walker type straw rack: Some large combines may use a walker type straw rack which operates on the same principle as the rack. The straw walker has three or more narrow sections placed side by side. Each section is mounted on multiple throw cranks located at the front and rear. The crank throws for each section are equally spaced around the circle of rotation thus the sections do not operate as a unit as the rack does. Figure 19.

Figure 19. Walker type straw rack.



d. Grain return pan: The grain return pan is located under the straw rack. It catches the grain as it falls through the rack and moves forward to the grain pan. The straw walker usually has a return pan under each unit. Figures 14 and 15.

e. Grain return conveyor: In place of the grain return pan some combines will use a conveyor to catch the grain and move it forward. Figure 16.

f. Grain pan: The grain pan is usually located under the forward part of the straw rack behind and below the cylinder. Its function is to catch the grain from the concave and cylinder grates and from the grain return pan or conveyor for delivery to the cleaning unit. Figures 14 and 16.

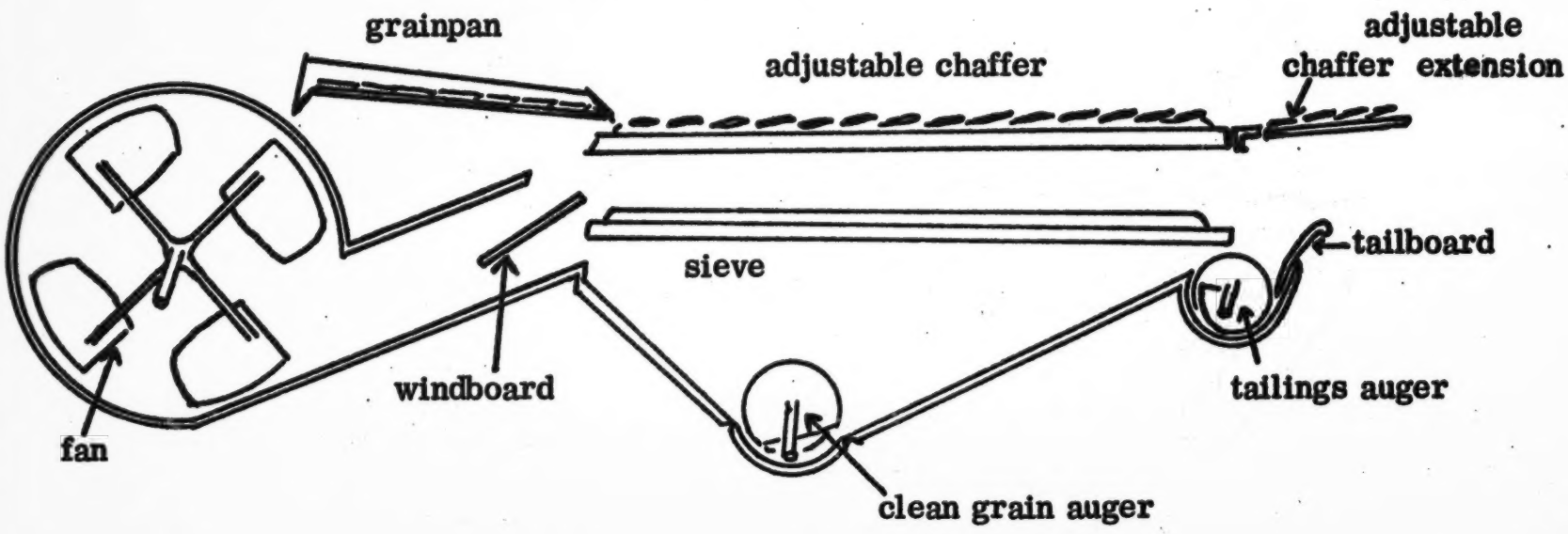
g. Grain conveyor: Some combines will use a conveyor in place of the grain pan to collect and deliver grain to the cleaning unit. Figure 15.

h. Check flaps or curtains: The check flaps or curtains deflect the straw and grain onto the rack as the full length of the rack is used for separation. They should not be in the way of the straw as the rack moves it to the rear.

Student exercise: The basic principles of separation are the same in all combines. However, different makes and models will have different designs. Prepare a schematic diagram of the separating unit of your combine after studying both the combine and the operator's manual. Explain the basic principles of separation.

4. Cleaning unit: The function of this unit is to separate the clean grain and send it to the grain tank, return the tailings (partially threshed heads) to the cylinder for rethreshing, and move the remaining material out of the combine. This is accomplished by means of gravity and air blast. Figure 20.

Figure 20. Cleaning unit.



a. Adjustable chaffer: The adjustable chaffer acts as a sieve. It is made up of a series of cross pieces mounted on rods and fastened together so they can be moved at the same time to adjust the size of the openings. Figures 20 & 21.

Figure 21. Side and flat views of the chaffer showing how the lips may be adjusted to control the amount and kind of materials passing through.

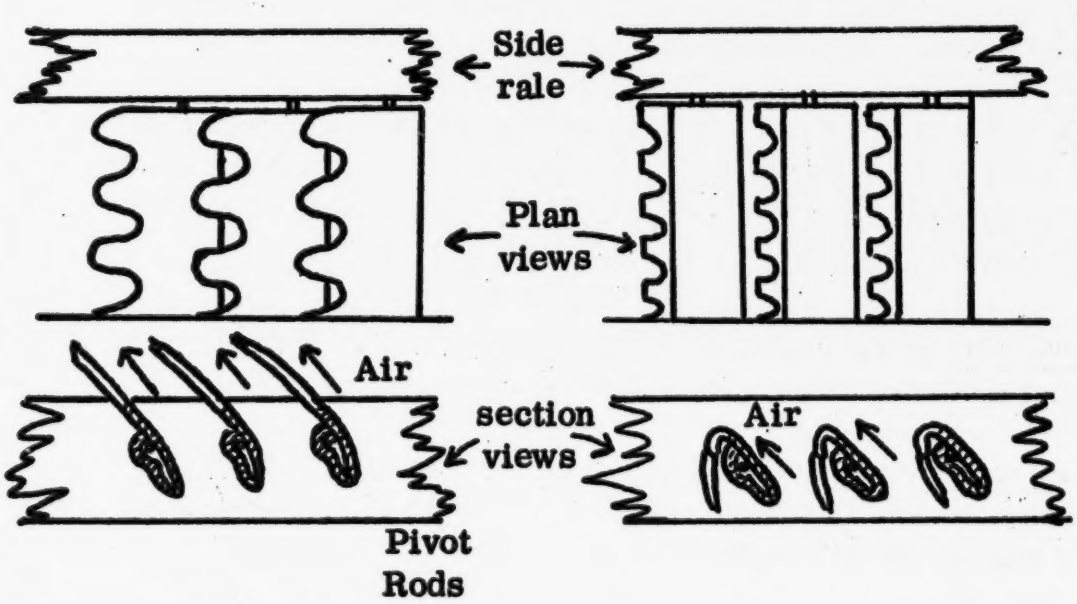


Figure 21. Partial views of two types of adjustable chaffer sieves.

b. Chaffer extension: As the name suggests this is an extension of the chaffer. In addition to having adjustable lips the chaffer extension will also swing up and down on the end of the chaffer. The unthreshed portions of grain heads fall through the chaffer extension into the tailings auger. The bulky material passes over the chaffer extension and out of the combine. Figure 22.

c. Sieve: The sieve is like the chaffer except that the lips and openings are smaller. The final job of cleaning is done here. The material that is too large to pass through the sieve is carried over the the tailings auger and returned to the cylinder for rethreshing. Figure 22.

d. Special chaffer and sieve equipment: Many combines will have special screens available for some crops that are difficult to clean.

e. Cleaning fan: The fan furnishes a blast of air. The strength of the air blast is controlled by the speed of the fan and by shutters in the air intake. The direction of the air blast is controlled by windboards. The function of the air blast is to keep the material "alive" on the chaffer and sieve. The air blast should be strong enough to lift the chaff slightly off the chaffer and sieve, but not strong enough to blow grain out of the combine.

f. Clean grain auger and clean grain elevator: The clean grain auger collects the cleaned grain and augers it to the clean grain elevator which delivers the clean grain to the grain tank.

g. Tailings auger and tailings elevator: The tailings auger collects all of the material which comes off the lower sieve plus any material which falls through the extension chaffer.

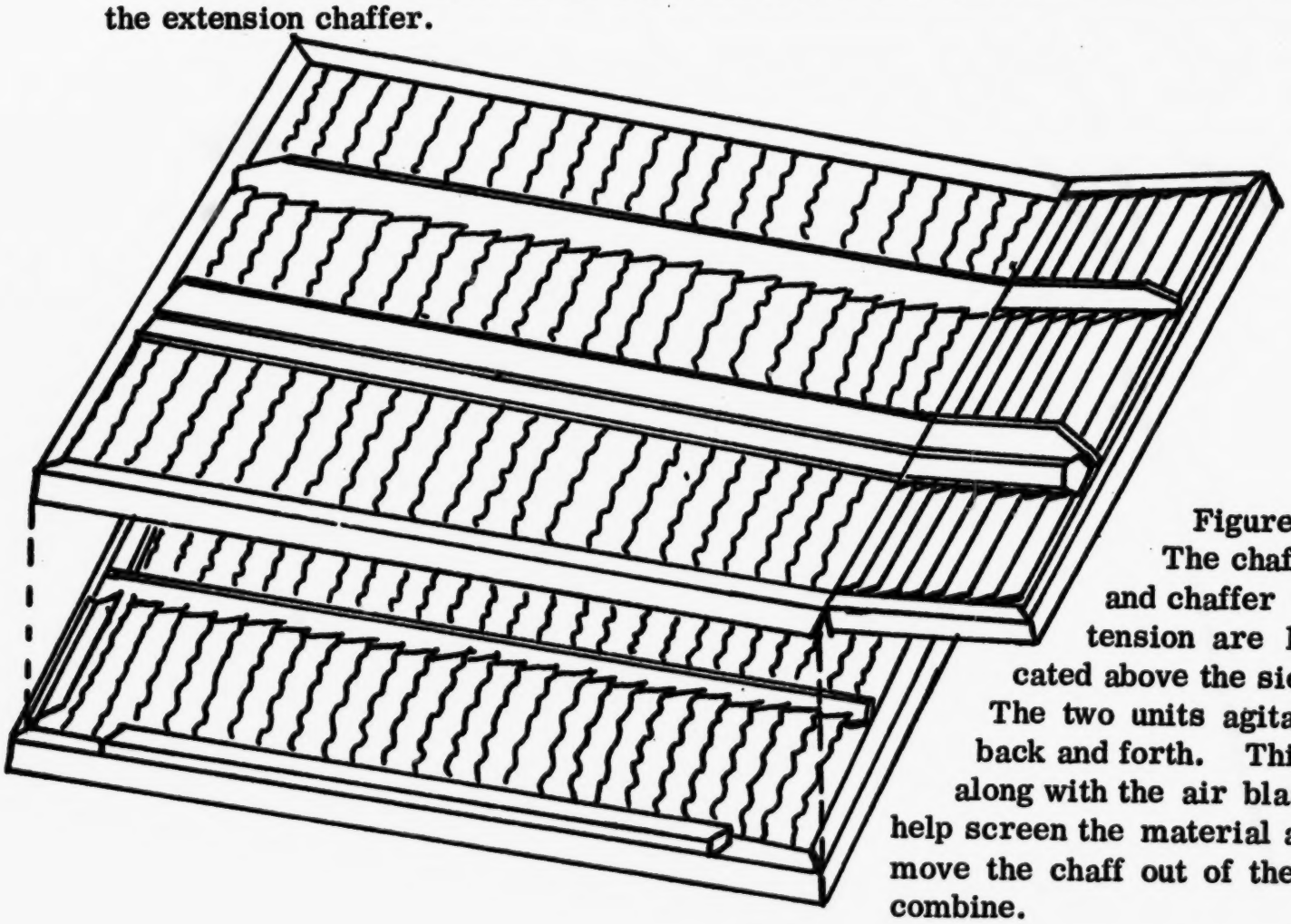


Figure 22. The chaffer and chaffer extension are located above the sieve. The two units agitate back and forth. This along with the air blast help screen the material and move the chaff out of the combine.

h. Tailboard: The tailboard keeps the unthreshed material from being carried out of the rear of the combine while still allowing the chaff to be blown out. It may be raised or lowered as needed.

Student exercise: Prepare a schematic diagram of the cleaning unit on your combine showing the basic parts of the cleaning section on your combine. What are the basic principles of the cleaning operation?

5. How do the four areas of the combine work together?

The four areas of the combine must work together if the machine is to be expected to do an efficient job of harvesting. The way one section is operated and adjusted will affect the efficiency of the remaining areas. The following laboratory exercise will help you to understand how the combine areas work together.

Student exercise: Now that you have completed the study of the four basic areas of the combine — cutting and feeding, threshing, separating, and cleaning — turn to figure 23 and see how the material flows from one area of the combine to the next. Keep in mind that all combines will have each of these basic areas but may use different mechanical design to carry out the necessary work. After becoming familiar with the principal parts and their functions turn to figure 24, and see if you can name them. (Do not write in this book unless your teacher tells you to.)

Do you know how the material moves through the combine and the process that takes place in each of the sections? Turn to figure 25 and study the flow chart to see how the material moves through the machine. A look back to figure 5 (combine cross section) may help you. Next see of you can trace the flow of material through a combine in the school shop or at home. Use the blank flow chart in figure 26 while doing this.

Figure 23. FLOW OF MATERIALS THROUGH THE COMBINE.
Courtesy Massey-Ferguson Co.

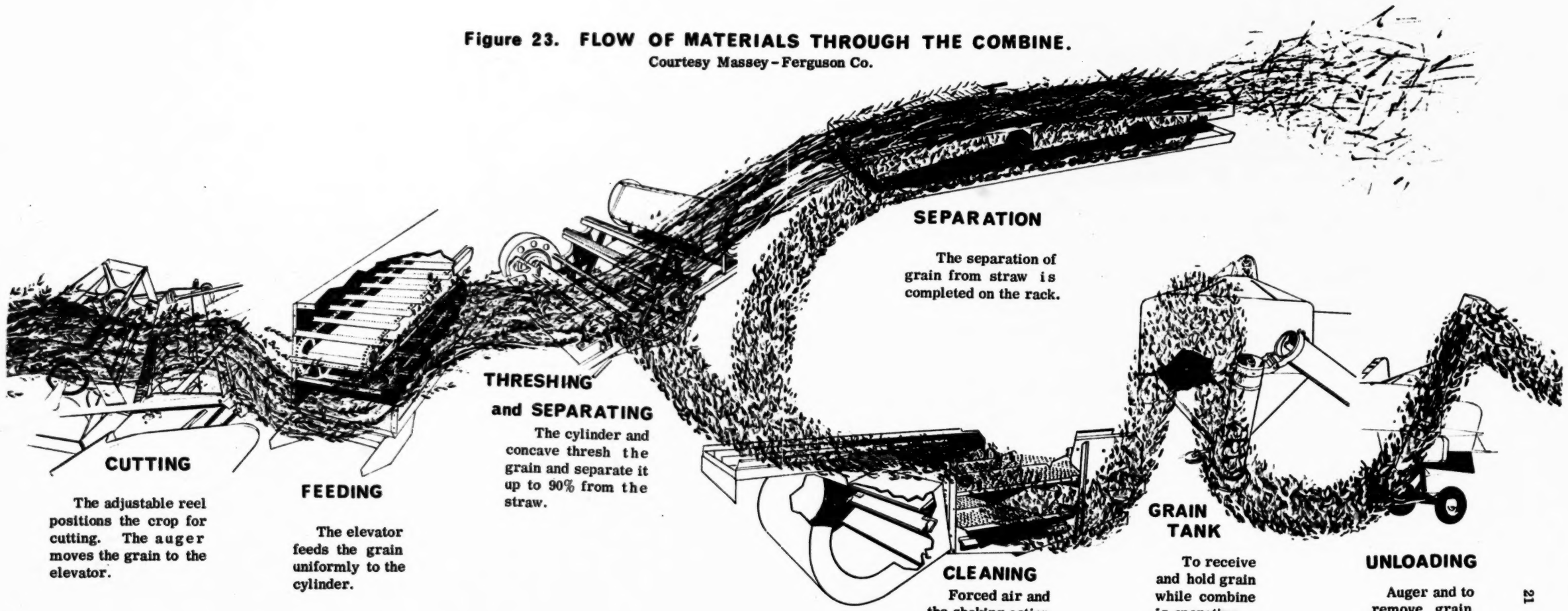
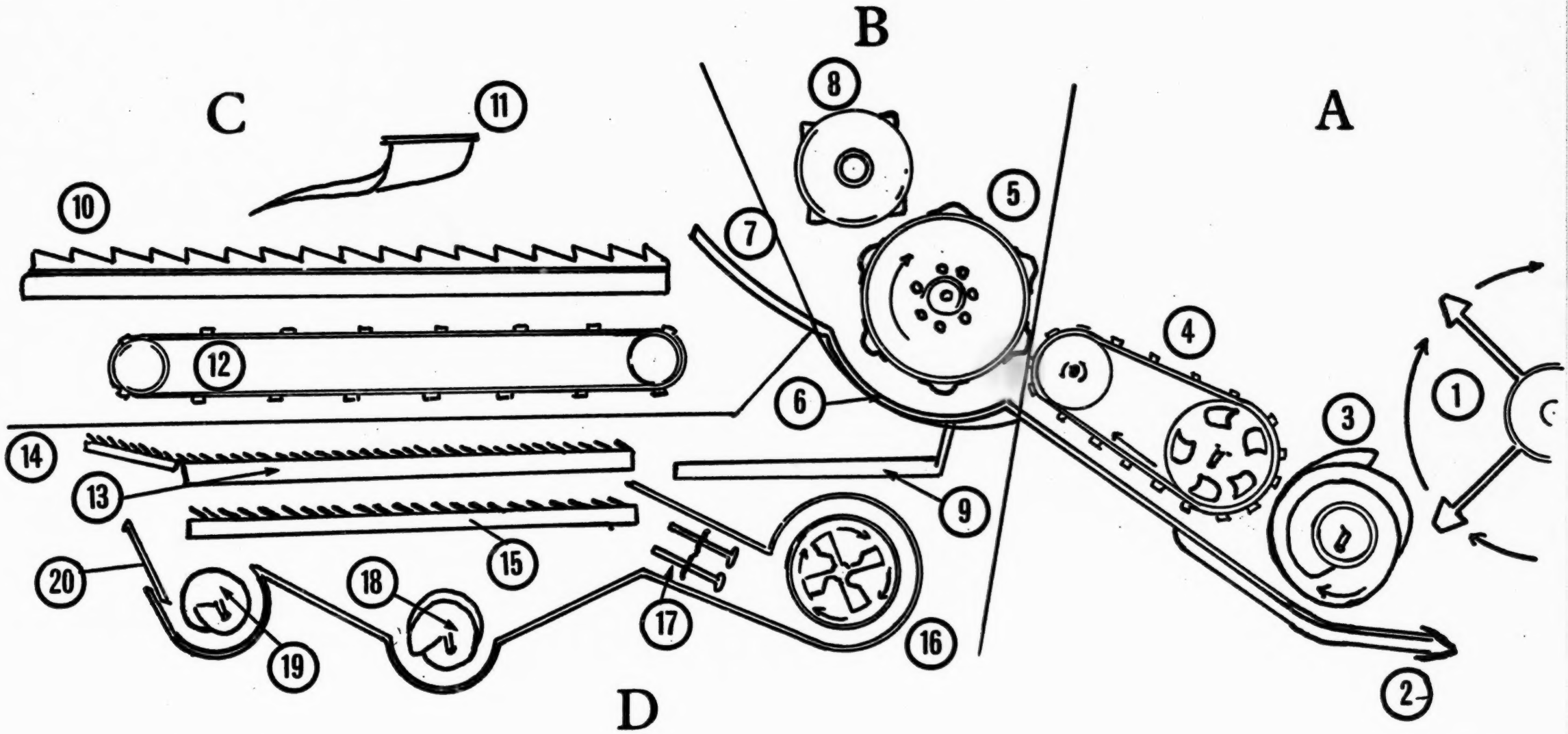


Figure 24. COMBINE CROSS SECTION

Write in the names of the parts of the combine that are indicated by the numbers on the drawing of the combine. Use the blanks below the drawing.



Sections of a Combine: A_____; B_____; C_____; D_____

	Section		Section		Section		Section
1	____	6	____	11	____	16	____
2	____	7	____	12	____	17	____
3	____	8	____	13	____	18	____
4	____	9	____	14	____	19	____
5	____	10	____	15	____	20	____

FIGURE 25 COMBINE FLOW CHART

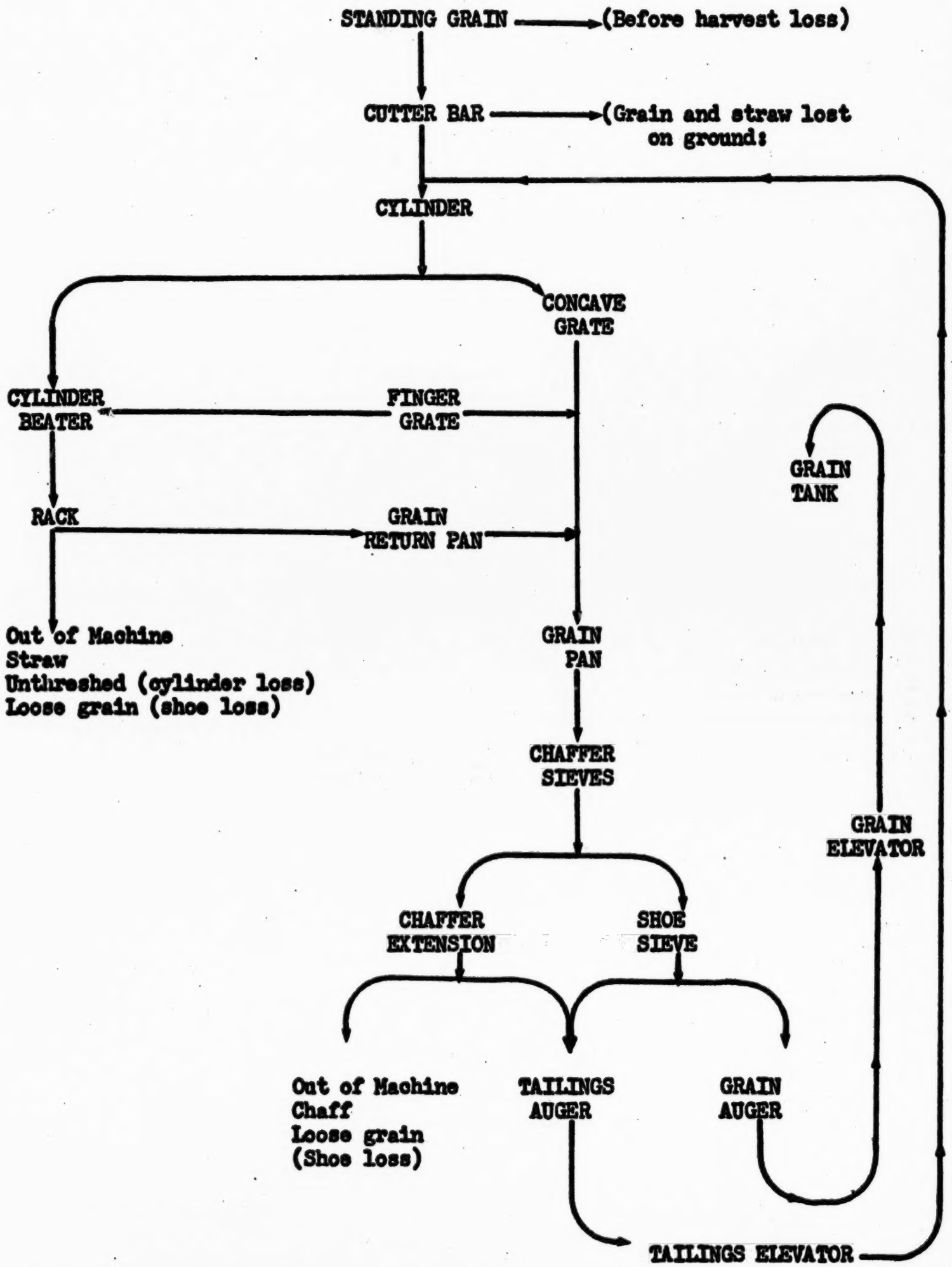


FIGURE 26 COMBINE FLOW CHART

SKETCH THE PATH OF MATERIAL THROUGH YOUR COMBINE

Name_____

STANDING GRAIN

CUTTER BAR

CYLINDER

CONCAVE
GRATE

CYLINDER
BEATER

FINGER
GRATE

GRAIN
TANK

RACK

GRAIN
RETURN PAN

Out of Machine
1. _____
2. _____
3. _____

GRAIN
PAN

CHAFFER
SIEVES

GRAIN
ELEVATOR

CHAFFER
EXTENSION

SHOE
SIEVE

Out of Machine
1. _____
2. _____

TAILINGS
AUGER

GRAIN
AUGER

TAILINGS ELEVATOR

III. OPERATION OF THE COMBINE.

If you are operating or intend to operate a combine it will be important for you to understand the sources and causes of grain loss and the adjustments that should be made to correct these losses. The quality of the job of combining you will be able to do will depend on your understanding of these adjustments and your ability to make the proper adjustments in the field when you are operating your combine.

This section of the manual should help you become familiar with the basic principles of some of the common adjustments to meet different operation conditions. You should also have a copy of the manufacutrer's operator's manual to use with the combine you are studying in this exercise. It will give you the specific adjustments for the machine you are working with.

A. SOURCES OF GRAIN LOSS FROM THE COMBINE.

Each of the four separate areas of the combine - cutting and feeding, threshing, separating, and cleaning - can be a source of loss. The losses in these areas are usually known as the cutter bar, cylinder, rack, and shoe losses.

1. Cutter bar loss: Any or all of the following items may cause cutter bar loss.

   a. Heads of grain missed by the cutter bar.
   b. Grain shattered out of the head as the knife cuts the straw.
   c. Grain cut and dropped to the ground before reaching the feeding platform.
   d. Grain shattered out when the reel strikes the standing grain.
   e. Heads of grain thrown out by the reel.

The grain that has been shattered onto the ground ahead of the combine should not be included with the cutter bar loss.

2. Cylinder loss: The cylinder can cause loss in two ways. They can be identified as follows:

   a. Unshelled grain left in the heads and carried to the rear of the combine by the rack.
   b. Cracked grain in the grain tank caused by the cylinder running too fast or the concave cylinder clearance being too close.

3. Rack loss: The rack loss is the loose grain which has not been separated from the straw as it passes over the rack and is carried out of the machine with the straw.

4. Shoe loss: The shoe loss is the grain that is carried over the rear of the sieves with the chaff or blown out of the combine with the fan.

The four losses taken together will show how good a job of combining you are doing.

5. How much loss can be expected: Losses, with the best combine adjustment, will vary greatly depending upon the type, variety, and the condition of the crop. Total losses in clean crops of wheat, oats, barley, and rye will vary from approximately 1% to 4% of the total yield. Under good harvesting conditions the total loss should not be more than one and one-half percent.

a. Small grain losses: Under average conditions the following range of losses might be expected when small grain crops are harvested.

(1) Cutter bar loss .5% to 2%. When the combine is properly adjusted this will usually be higher than for the other parts of the combine.
(2) Cylinder loss .5% to 1%. It is usually best not to reduce cylinder loss below .5% because rack shoe losses will increase rapidly if the straw is over threshed.
(3) Rack loss .2% to .4%.
(4) Shoe loss .2% to .4%.

b. Soybeans: Researchers at the Ohio Agricultural Experiment Station ran tests on farmer operated combines, under typical harvesting conditions, for a period of seven years. These tests show that the following results might be expected.

(1) Cutter bar loss 12.6%. This loss included the following:

(a) Beans shattered onto the ground.
(b) Beans remaining in pods on the stubble.
(c) Beans remaining in pods on stalks which had been cut off but not fed into the machine.
(d) Beans in pods on lodged stalks.

(2) Cylinder loss .96%. Nearly all of the beans are threshed out by the cylinder.
(3) Rack and shoe 1.0%. The separating and cleaning area did not have serious losses.

The total loss for the seven year test ranged from 8.8% to 19.3% of the total crop.

c. Corn: Research at the Ohio Agricultural Experiment Station shows that the following losses might be expected when harvesting corn.

(1) Gathering Unit
Lost ears 1% - 20%
Snapping roll loss 1% - 5%
(2) Cylinder loss 0 - 5%
(3) Rack and shoe .5% - 5%
(4) Cracked kernels .5% - 4%
(5) Invisible loss 0% - 5%

B. HOW COMBINE LOSSES CAN BE MEASURED.

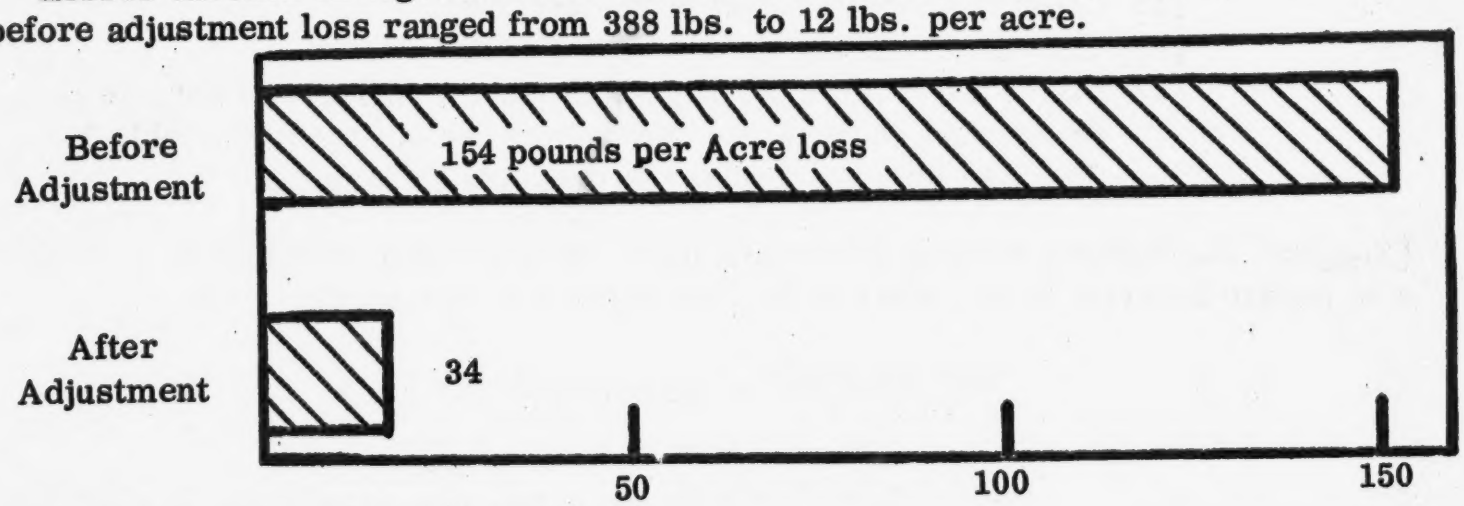
Each of the four areas of the combine - cutting and feeding, threshing, separating, and cleaning - has its own adjustments. The first step in finding out what machine adjustments are needed to improve your job of combining is to measure the amount of loss from each of the combine areas. This can be done accurately on most crops except grasses and legumes by the method used by the Ohio Agricultural Experiment Station.[2] A simpler, although less accurate, method is described in this manual.

1. Will it be worthwhile for you to check your combine losses to find the adjustments you should make to correct them?

The Ohio Agricultural Experiment Station conducted tests with combines being operated by farmers to harvest wheat. Each of these machines was out of adjustment in some way. The harvesting losses were checked on the machines as they were being run by the operators. The needed adjustments were made,and the harvesting losses were checked again. A summary of these tests is shown in figure 27. It should be mentioned that another machine being operated by a farmer was only loosing two pounds of wheat per acre.

FIGURE 27. ADJUSTING COMBINES REDUCES GRAIN LOSSES

Losses checked on eight combines before and after making adjustments. The before adjustment loss ranged from 388 lbs. to 12 lbs. per acre.



Grain losses in pounds per acre.

From Ohio Agricultural Experiment Station

2. G. W. McCuen and E. A. Silver, Combine Harvester Investigations, Bulletin 643, The Ohio Agricultural Experiment Station.

2. Figuring the harvesting loss per acre.

The bushels of grain lost per acre can be estimated by collecting the number of kernels lost in a measured test area. The test area should contain about 50 square feet for small combines and about 100 square feet for large combines. Smaller areas may be used by increasing the number of samples to maintain accuracy.

The test areas can be set up as follows: Measure the distance on the ground that the combine will need to travel in cutting the desired number of square feet. Mark this distance by setting stakes beside the standing grain. Example: a 12 foot combine will travel 8 feet 4 inches in cutting 100 square feet of grain. (Figure 28.) The material can be collected in a box or on canvas as the combine passes through this area and the kernels of grain separate from the chaff and straw. If the combine has a straw spreader it will need to be disconnected during the test.

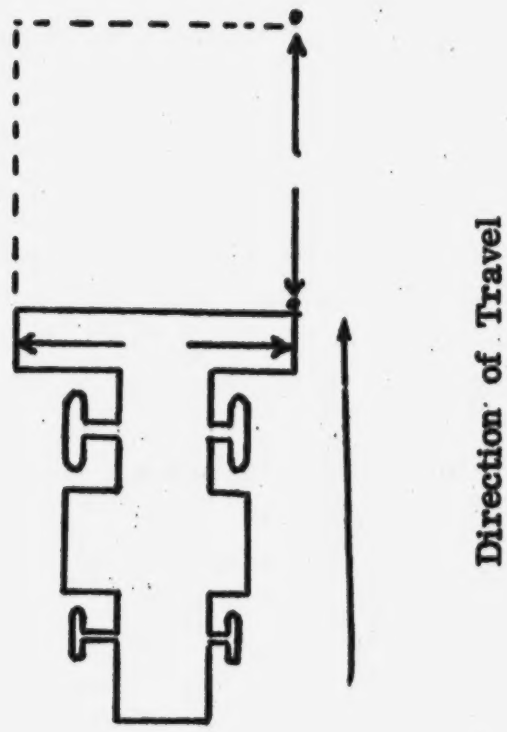


Figure 28. Measuring the test area for checking combine harvesting loss.

The kernels collected in the test area can be changed to bushels per acre by one of the following methods:

a. Counting the kernels.

(1) Count the kernels found in the test area.
(2) Find the number of kernels per square foot.
(3) Divide the kernels per square foot by the number of kernels per square foot equal to one bushel loss per acre found in table 1. This will give you the loss in bushels per acre.

Example: In checking soybean harvesting loss, 400 soybeans were picked up from a 20 square foot test area. What is the loss in bushels per acre?

$$\frac{400 \text{ soybeans}}{20 \text{ sq. ft.}} = 20 \text{ soybeans per sq. ft.}$$

$$\frac{20 \text{ soybeans per sq. ft.}}{5 \text{ kernels per sq. ft.}} = 4 \text{ bu. per acre loss.}$$

Table 1. Approximate Number of Kernels Per Square Foot to Equal One Bushel Loss Per Acre

Crop	Approximate Number of Kernels Per Square Foot
Wheat	18 - 20
Oats	10 - 12
Soybeans	4 - 5
Barley	13 - 15
Rye	21 - 24
Corn	2

The Ohio State University, Department of Agricultural Engineering.

If losses are high you must count large numbers of kernels which would require too much time. You may want to use the following method.

b. Measuring the kernels: Calibrated plastic tubes may be used to change the volume of kernels collected from the test area to loss in bushels per acre. Glue one end of a clear plastic tube to a block of wood. (See figure 29.) The position of the calibration marks will depend on the square feet of ground in the test area and the inside diameter of the plastic tube. Table 2 shows the volume required to equal one bushel loss per acre from a given test area.

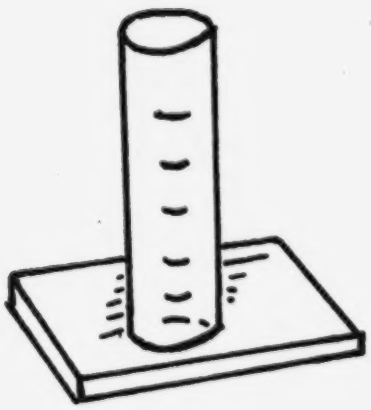


Figure 29. Calibrated plastic tube for measuring bushel per acre grain loss.

Table 2. Cubic Inches Required to Equal One Bushel Grain Loss Per Acre With Different Size Test Areas

Square feet of ground in test area	Volume in tube equal to 1 bu. per acre cubic inches
20	1
50	2 1/2
100	5

Example: If you have a plastic tube one inch in diameter how far apart will the calibration markings be to equal one cubic inch of volume in the tube.

Formula: Volume of a cylinder $= \pi r^2 h$

$$1 \text{ cu. in.} = 3.1416 \times (.5'')^2 \times X \text{ (height)}$$

$$1 \text{ cu. in.} = .7854\, X$$

$$X = 1.27''$$

When a one inch inside diameter tube is used each 1.27 inches of height will equal one cubic inch of volume in the tube.

Problem: If you are using a 1 1/2 inch inside diameter tube what will be the inches in height required to equal 1 cubic inch of volume in the tube?

3. Finding the loss from each combine area: The following procedures may be used to find the loss from each of the four areas of the combine. The location and the kind of loss you find will show you the kind of adjustment that needs to be made to improve the efficiency of your combine.

a. Finding the cutter bar loss: Stop the combine and count the kernels of grain found on one square foot of ground under the machine including the kernels in unthreshed heads. Subtract from this the shattered kernels and grain in heads of grain on one square foot of ground in the standing grain in front of the cutter bar. The difference will be the cutter bar loss. For more accuracy use several square foot areas in each location. The loss per acre can be figured from Table 1.

Example: If fifteen kernels of wheat per square foot are found under the machine and five per square foot are found ahead of the cutter bar the cutter bar loss is 10 kernels per square foot or 1/2 bushel per acre. (Table 1.)

b. Finding the cylinder loss: The following steps may be used in finding the cylinder loss:

(1) Select the size test area you want to use and mark it off on the ground. (Follow the instructions given earlier in this section.)
(2) Catch all the material coming from the rear of the combine.
(3) Collect the heads that are all or partly unthreshed. Thresh these out and measure the approximate loss in bushel per acre by one of the methods described.
(4) Examine the material for an excessive amount of chaff and short lengths of straw. Look in the grain tank for cracked kernels.

c. Finding the rack loss: The rack loss may be found as follows:

(1). Measure and mark with stakes the distance necessary to travel in cutting the test area.
(2). Catch all the material coming from the straw rack in a box or canvas.
(3). Collect the loose kernels and measure the loss in bushels per acre by one of the methods described.

Check the condition and the amount of straw as it comes from the rack to check the kind of job of combining you are doing. Has the straw been broken up by the cylinder?

d. Finding the shoe loss: On some combines this can be done by catching the material as it comes from the shoe and follow the same procedure used in finding the rack loss.

If it is not possible to catch the material as it comes from the shoe you will need to catch all the material coming from the rear of the combine. Collect the kernels which will represent both the rack and shoe loss. Subtract the rack loss from this and the remainder will be the shoe loss.

Examine the material in the tailings for excessive amounts of chaff and other debris. Look in the grain tank for dirt.

Student exercise: A field trip for the purpose of checking combine losses is recommended if combines are in operation at the time of this lesson. Otherwise, students should be encouraged to put this knowledge into practice at the first opportunity. The form "Record for Checking Losses" may be used to record the results of the tests.

RECORD FOR CHECKING COMBINE LOSSES

Name of farmer_____ Crop_____

Condition of Crop (weedy, lodged, wet, etc.)_____

_____

Width of cut ____ ft. x distance traveled ____ ft. = ____ft. sq. ft of test area.

Source of Loss	When kernels are counted		When kernels are measured	Loss in Bu. / A.
	Total No. Kernels	Kernels per sq. ft.	Cubic inches of Kernels	
1				
2				
3				
4				
5				
6				
7				

Observations:

Condition of straw as it leaves the rack:_____

_____

Amount of chaff and other debris in tailings:_____

_____

Are unthreshed heads going over the chaffer extension?_____

_____

Condition of threshed grain in the tank (damaged kernels or extensive dirt):

_____

C. HOW COMBINE LOSSES MAY BE REDUCED.

What information did your combine test give to you? If the grain loss was low there may be no need to make adjustments in the machine. However, if the grain loss was high the results of your test will help you in deciding on the adjustments you should make.

Refer to your record of combine losses as you study this section on combine adjustments. Tests conducted by agricultural engineers show that adjustments should be made in the following order.[1]

1. Machine speed. Check the machine speed to see that the combine is operating at the recommended revolutions per minute (r.p.m.). Steady, smooth power is very important. Any changes in engine speed will change the speed of the separator. Uneven speed will cause loss of grain, poor threshing, and sometimes complete plugging of the machine. You should be sure your combine is operating at the proper machine speed before going into the field. The manufactures' operator's manual will give the basic speed of the machine. This may be given as beater shaft speed, engine speed at full throttle, separator shaft speed, etc. Some service men will call this the "key shaft" since the operating speed of the entire machine depends on this shaft operating at the recommended speed. Adjust the engine governor so that the basic speed is 3 to 5% above normal when the combine is running empty. A revolution counter, figure 30 should be used to measure power take off and straw rack speeds since most tachometers cannot be read accurately enough at low speeds.

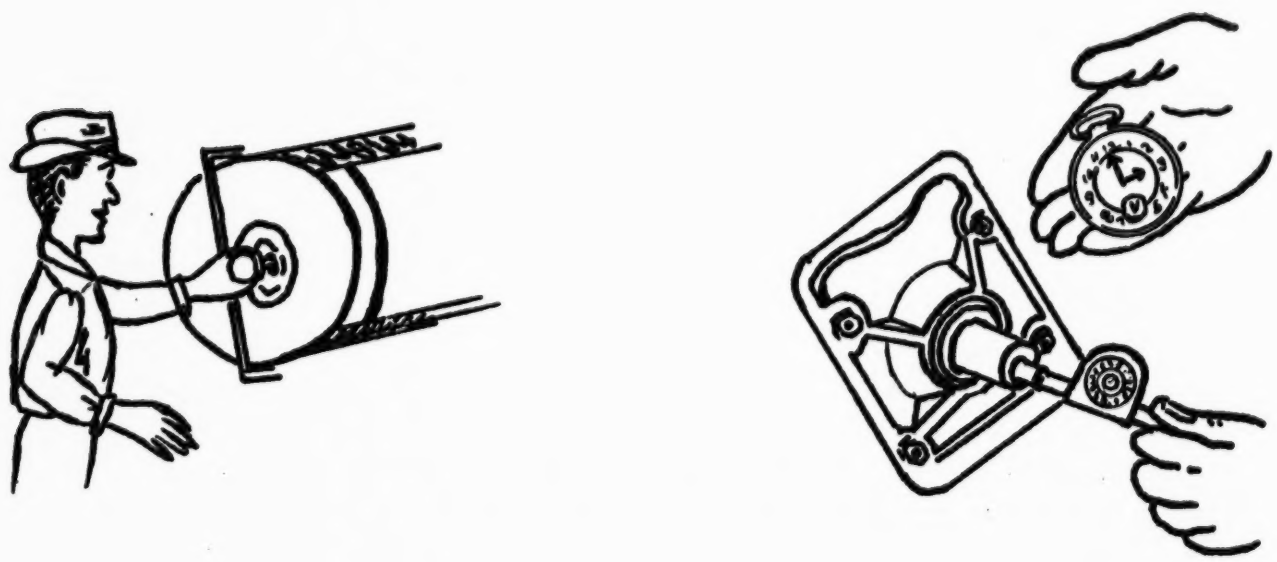


Figure 30. Check the machine speed by using a speed indicator on the "key" shaft.

1. S. G. Huber, Harvesting With Combines, The Ohio State University.

Student exercise: Check the operating speed of the combine you are working on in the shop.

Speed adjustments on the combine. Some parts of the combine are driven by belts running on pulleys or adjustable sheaves while other parts are run by chains and sprockets. Sometimes it is necessary to change the operating speed of a part such as the reel or the cylinder. This can be done as follows:

a. Pulleys. Power is supplied by one of the pulleys called the driver. This power is then transmitted by means of a belt to another pulley called the driven. Figure 33.

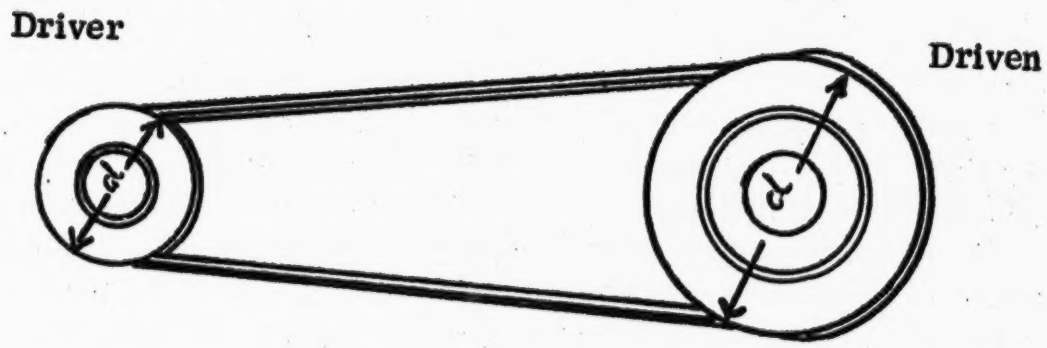


Figure 33. Pulley Speeds

If the driven pulley is to operate at the proper speed or r.p.m. (revolutions per minute) there must be a proper relationship between the size of the driver and the driven. The r.p.m. of the driver will usually not change because its power is supplied by the combine or tractor motor which should be run at full throttle all the time. This means that the speed of the driven can be changed by changing the size of one or both of the pulleys. The formula for this relationship is as follows:

Speed is measured by r.p.m.
Size of pulley is measured by diameter or d.
d of driver x r.p.m. driver = d of driven x r.p.m. of driven.

Example 1: If the driver pulley is 5 inches in diameter and is operating at 100 r.p.m., what will be the r.p.m of a 10 inch diameter driven pulley?

5" driver x 100 r.p.m. driver = 10" driven x X r.p.m. driven

$$500 = 10X$$

$$X = 50 \text{ r.p.m. of driven}$$

Example 2. If the driven pulley is 4 inches in diameter and operating at 500 r.p.m., what would the diameter of the driven pulley be to operate at 800 r.p.m?

$$4'' \times 500 \text{ r.p.m.} = X \times 800 \text{ r.p.m.}$$

$$800\,X = 2000$$

$$X = 2.5'' \text{ diameter}$$

b. Sprockets. When sprockets and chain are used to transmit power from the driver to the driven the same principles of proportion are used except the size of the sprockets is measured by the number of teeth instead of using the diameter as with pulleys.

Example 3. If a driver sprocket has 5 teeth and is operating at 100 r.p.m. what will be the r.p.m. of a 10 tooth driven sprocket?

$$5 \text{ teeth} \times 100 \text{ r.p.m.} = 10 \text{ teeth} \times X \text{ r.p.m.}$$

$$500 = 10X$$

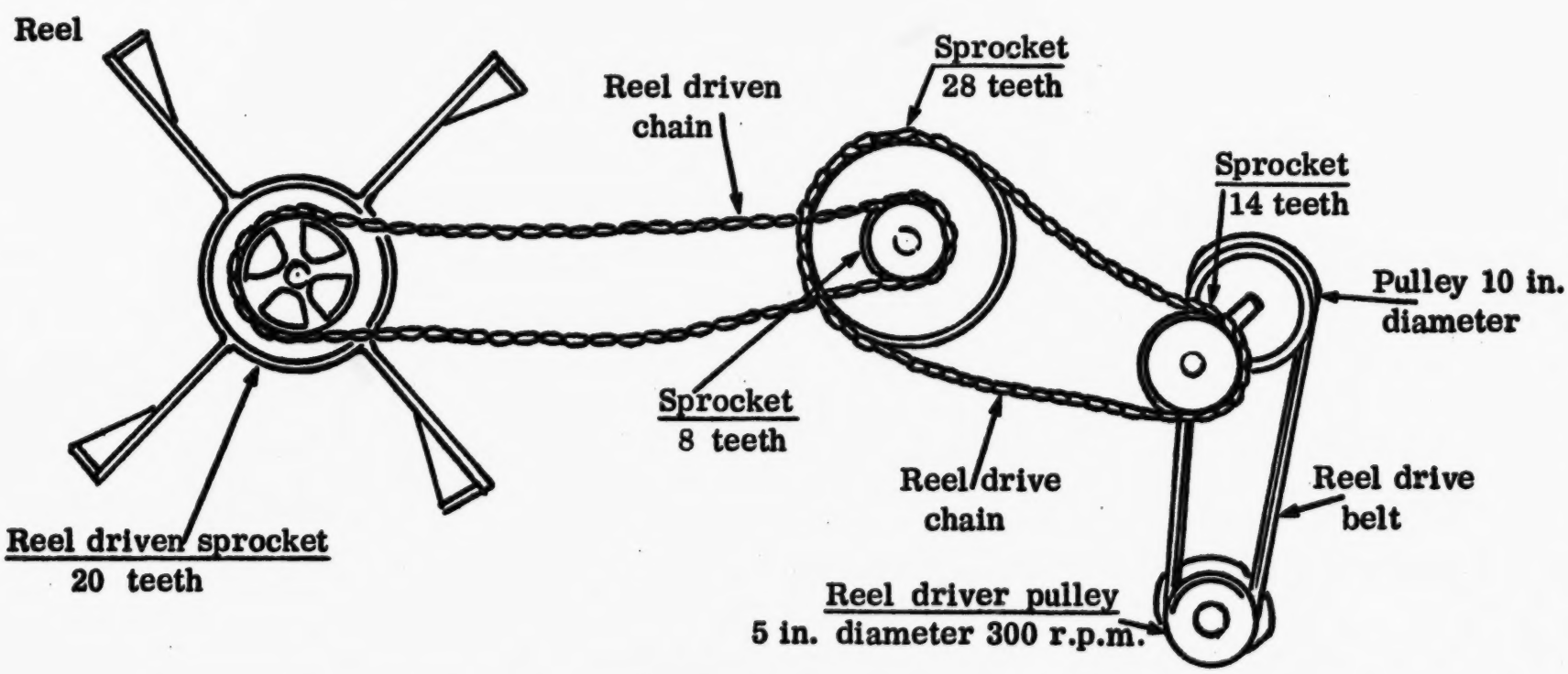
$$X = 50 \text{ r.p.m. of driven}$$

Notice that the answer is the same as in the first example with the pulleys since the proportions were the same.

Problem 1. If the sheave that drives the cleaning fan is 5 inches in diameter and operates at 750 r.p.m., what would the diameter of the driven sheave need to be to operate the fan at 900 r.p.m. ? (Figure to the nearest tenth of an inch.)

Problem 2. If the sprocket that dirves the cylinder has 32 teeth and operates at 650 r.p.m. and the cylinder driven sprocket has 19 teeth, what will te the speed of the cylinder in r.p.m. ? (Figure to the nearest whole number.)

Problem 3. In the illustration below at what r.p.m. is the reel traveling if the driver pulley is 5 inches in diameter and running at 300 r.p.m. ?



Schematic drawing of a reel driving power train.

Turn to the operator's manual for the combine you are working on and fill in the following information.

Table 4. Recommended Machine Operating Speeds.

Make and model of machine. _____

Part of combine to be checked for recommended speed.	recommended speed (r.p.m.)

2. Adjust the cylinder concave clearance and the cylinder speed. The cylinder loss is usually the lowest, but the cylinder - concave clearance and cylinder speed adjustments have a great affect on the rack and shoe losses in the combine. Poor adjustments in the threshing area will show up as follows:

Too little threshing action. (1) Unthreshed heads.

Too much threshing action. (1) Chopped up straw on the rack.
(2) Excessive tailings.
(3) Cracked grain.

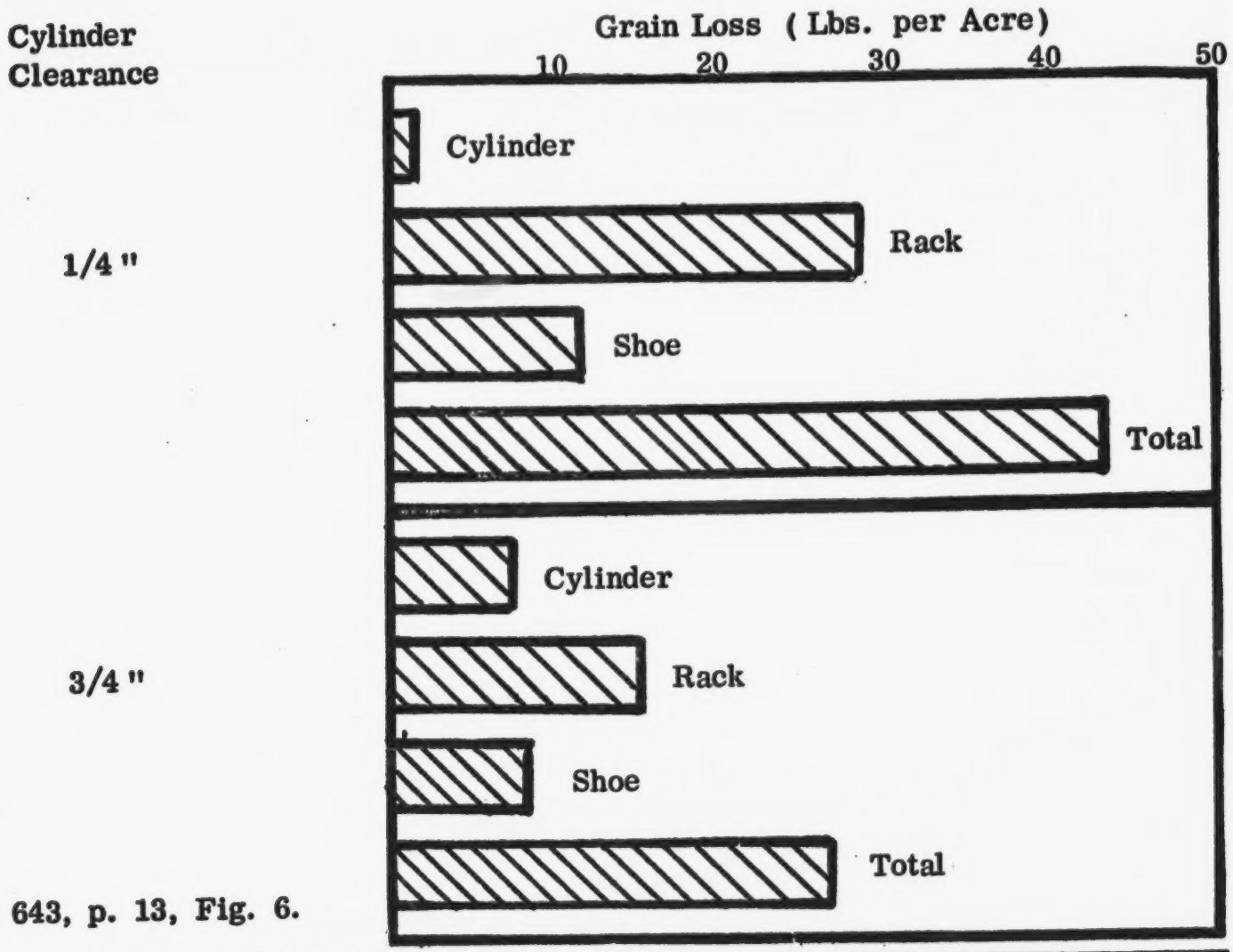
The threshing action may be changed as follows:

To increase—Increase the cylinder speed. Decrease the concave - cylinder clearance.

To decrease—Decrease the cylinder speed. Increase the concave - cylinder clearance.

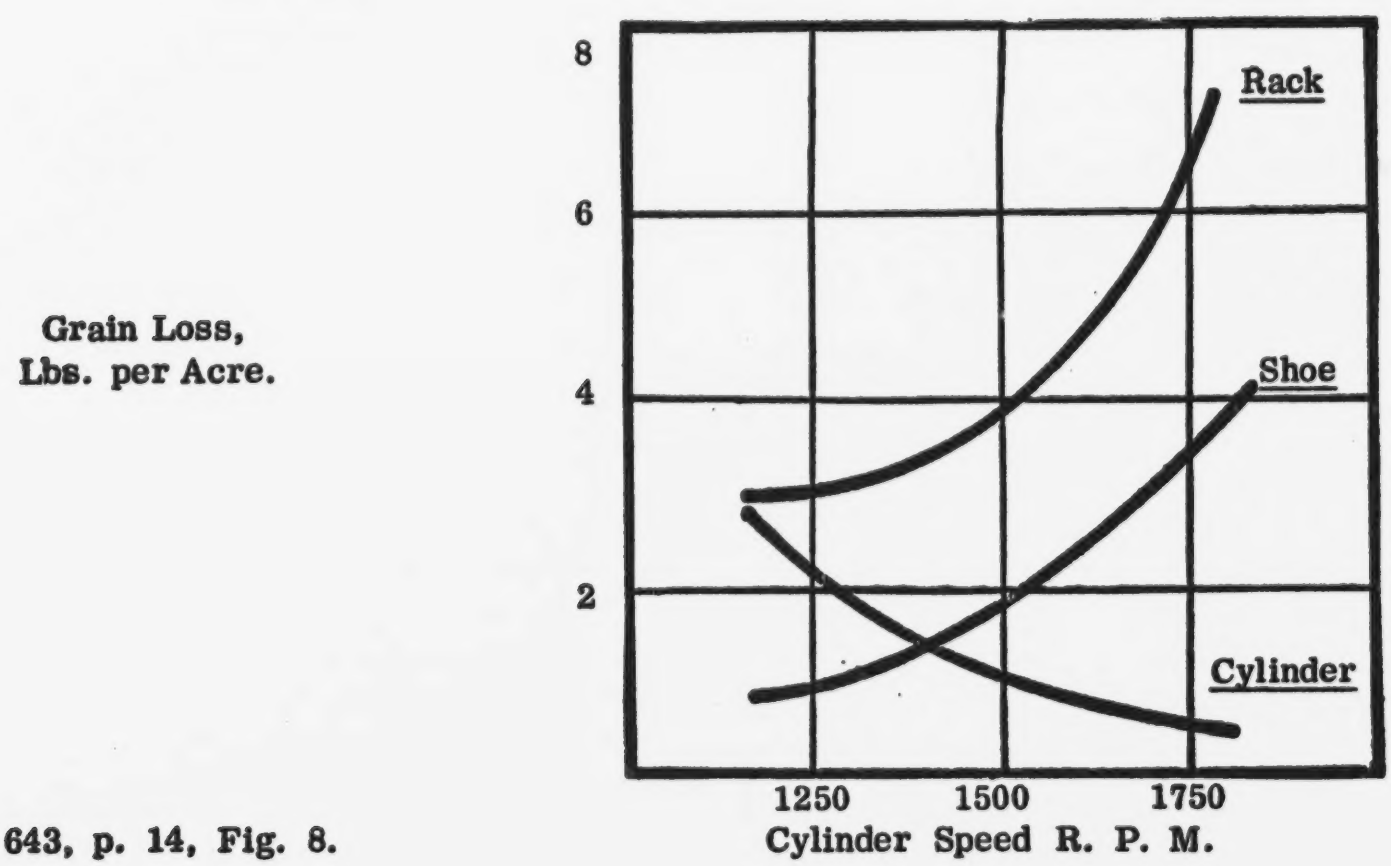
The most effecient job of separating and cleaning will be done by operating the machine with the least amount of threshing action required to remove the most of the kernels from the head. Over threshing breaks up the straw and causes the rack and shoe to be over loaded. Under threshing lets the heads go by unthreshed.

Figure 31. Small Cylinder Concave Clearance Reduces Cylinder Loss but Increases Total Loss.



OAES 643, p. 13, Fig. 6.

Figure 32. As Cylinder Speed Increases Cylinder Loss Decreases, but Rack and Shoe Losses Increase.



OAES 643, p. 14, Fig. 8.

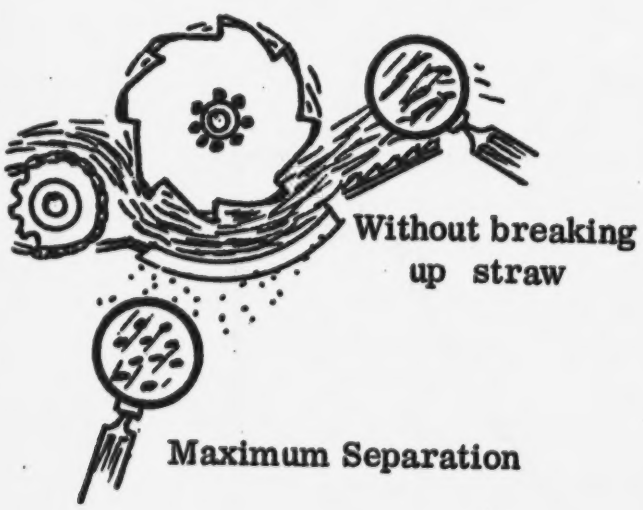
Figure 31 shows that a small cylinder clearance reduced the cylinder loss but increased the total loss. Increasing the cylinder clearance increased the cylinder loss slightly but decreased the rack and shoe loss making the total loss much less.

Figure 32 shows that high cylinder speeds reduce cylinder losses but increase rack and shoe losses. Decreasing the cylinder speed increased the cylinder loss slightly but reduced the rack and shoe losses greatly making the total loss less.

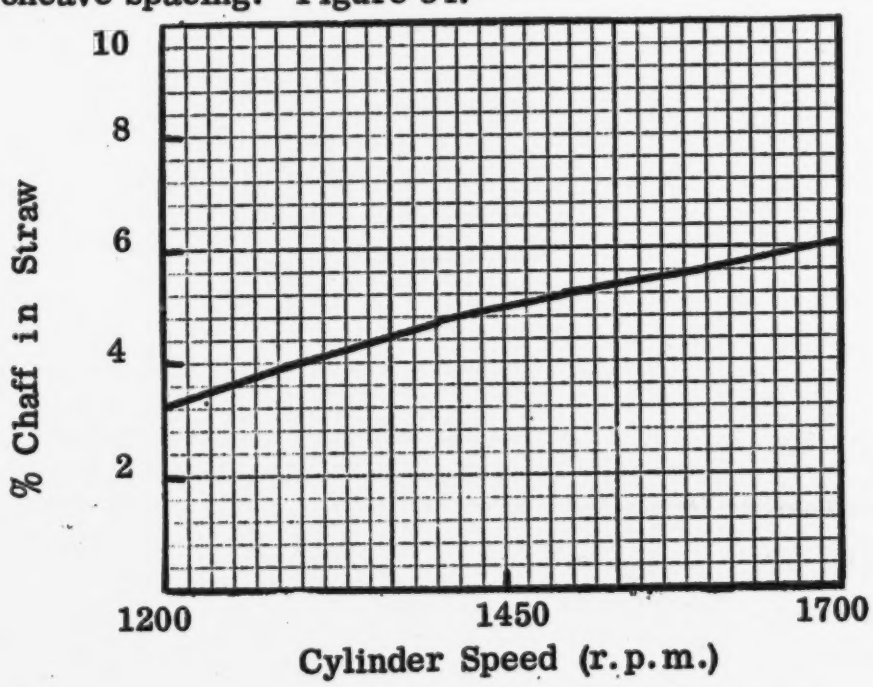
Many things will influence the proper cylinder speed and cylinder-concave clearance that will bring about the most efficient job of combining possible for your conditions. Increasing the cylinder speed seems to cause less over threshing than does decreasing the cylinder-concave spacing. Figure 34.

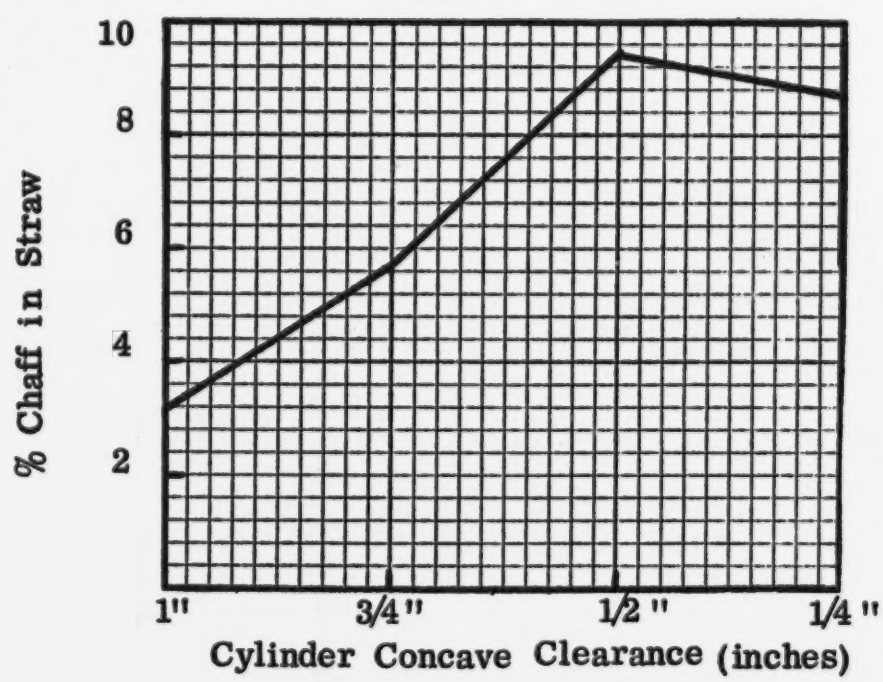
Figure 34.

The percentage of chaff in the straw increases as the cylinder speed increases and as the cylinder concave clearance



Cylinder and Concave Setting Speed





The first step is to study the operator's manual to determine the settings recommended for the crop you are harvesting.

Student exercise: Find this information for your combine and fill in table 5.

Table 5. Manufacturers recommendations for cylinder speed and cylinder - concave clearance.

Crop being harvested_____

Condition of crop_____

Adjustment	Recommendations	How adjustment is made
Cylinder speed (r.p.m.)		
Cylinder - concave clearance. (inches)		

These adjustments will be satisfactory for a trial run, but as one manufacturer says in his operator's manual, " The correct cylinder adjustment for any kind of grain must be determined by trial." [1]

The cylinder speed recommendations for threshing some crops will be given as peripheral speed which is the feet per minute a given point on the circumference of the cylinder would travel (sometimes called surface feet per min.)

Example: If the recommended peripheral speed of the cylinder is 4500 ft. per minute and the diameter of the cylinder is 24 inches, at what r.p.m. should the cylinder run to maintain this peripheral speed?

You will first need to know the circumference of the cylinder to know how far a point on the cylinder must travel to complete one revolution. The number of times the circumference is contained in the recommended peripheral speed will give the required r.p.m. of the cylinder.

$$\text{Circumference} = \text{diameter} \times \text{pi } (\pi)$$
$$C = 2 \text{ ft.} \times 3.1416$$
$$C = 6.2832 \text{ ft.}$$
$$\frac{4500 \text{ ft./ min.}}{6.2832 \text{ ft.}} = 716 \text{ r.p.m.}$$

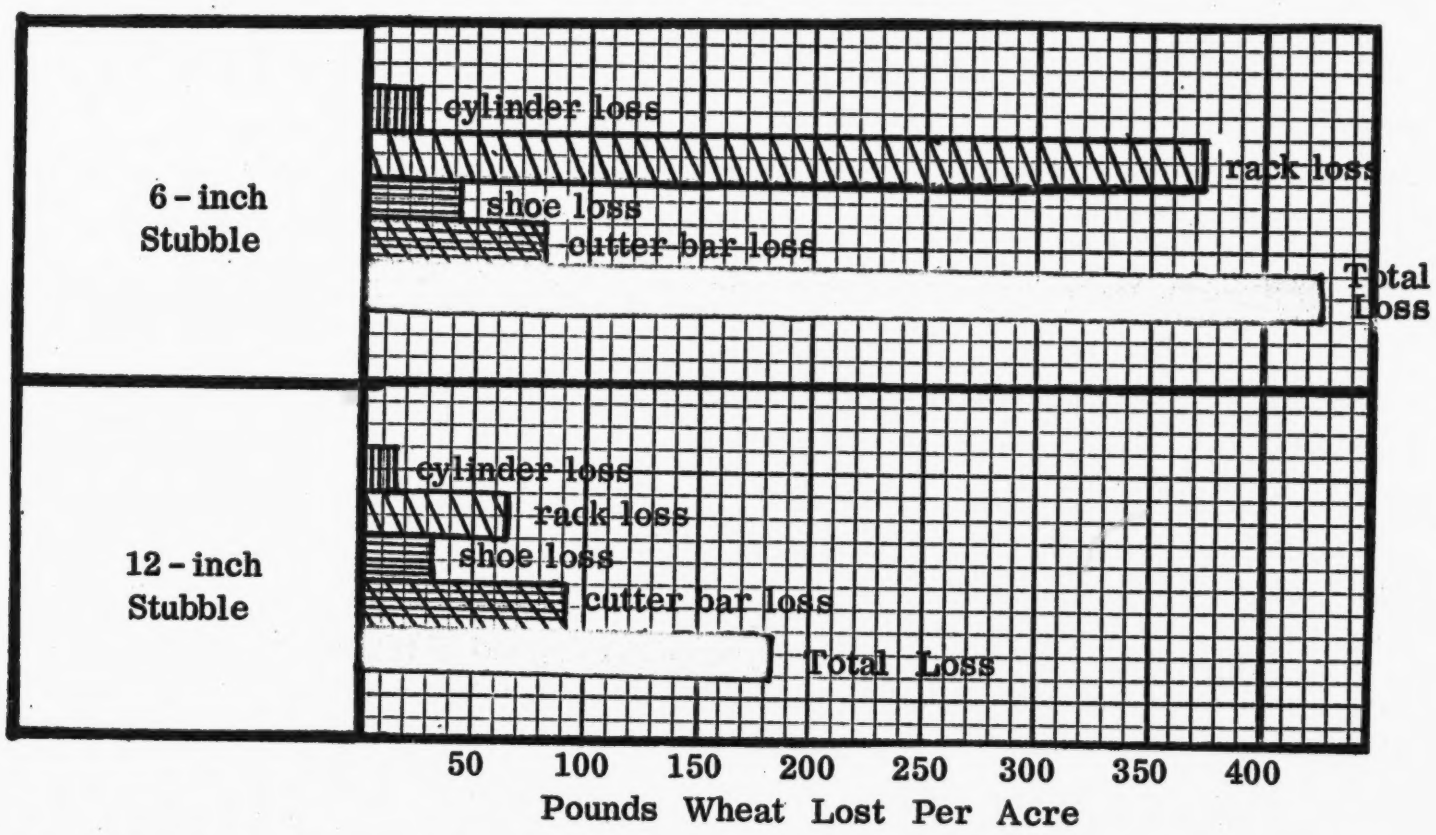
Problem: You are preparing to combine alfalfa seed. You want the cylinder to have a peripheral speed of 5000 ft. per minute. Your cylinder is 18" in diameter. At what r.p.m. should it operate to give you the desired peripheral speed?

1. Operator's Manual, IHC COMBINE.

3. Adjust the cutter bar height. The cutter bar area usually has highest loss of the four areas of the combine. The height of cut should not be lower than required to get all or most of the heads off the grain. Figure 35. Height of cut losses will show up as follows:

Too high: Heads or pods of grain will be left in the field.
Too low: Too much material will be run through the combine and will over load the rack causing this loss to increase more than it should. Figure 36.

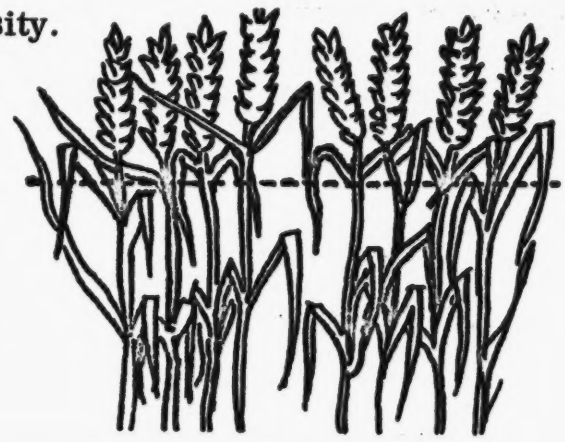
Figure 35. Increasing the height of cut decreases the total loss. (Wheat) Due to over loading the combine.*



*Harvesting With Combines, The Ohio State University.

Figure 36.

Cut just low enough to get all the heads.



Raising the height of cut increased the cutter bar loss slightly but greatly reduced the rack loss of the machine. The soybean plant is low growing and when ripe, the beans shatter easily. Because of this, over 80% of the combine loss takes place in the cutting and feeding area.

Student exercise: Study your operator's manual, your combine, and the condition of the crop being harvested to find the information for table 6.

Table 6. Recommendations for height of cut.

Crop being harvested _____

Condition of crop _____

Adjustment	Recommendations	How adjustment is made
Height of Cut		

4. Adjustable reel. A poorly adjusted reel will cause some of the loss in the cutter bar area of the combine. The reel may be adjusted for speed, height, and forward or rearward. Reel losses will show up as follows:

Reel too fast:
(1) The bats strike the grain with such force that grain will be shattered and lost.
(2) Grain carried over top of reel.

Reel too slow:
(1) The cut grain may fall to the ground and be lost.
(2) The cut grain may fall on the cutter bar causing the grain to be cut up or the knife to choke.
(3) Down, tangled grain or short straw may not be moved onto the platform.

Reel too low:
(1) The grain may tend to wrap around the bats.

Reel too high:
(1) The grain will not be moved onto the platform.

Reel too far forward:
(1) The grain will not be moved onto the platform.

Reel too far back:
(1) The grain may not be fed uniformly into the combine.

The adjustment of the reel will depend on the condition and the nature of the crop being harvested. Manufacturers give the following recommendations for the reel setting:

a. Reel speed: The speed of the reel depends on the condition of the crop. It should be as high as possible without shattering the grain or throwing grain from the feeder. The reel should travel slightly faster than the forward travel of the combine.

b. Reel height: Usually the reel should be set so the bats, when in their lowest position, will strike just below the lowest heads of grain. Figure 37. This will keep the bats from beating the grain from the heads.

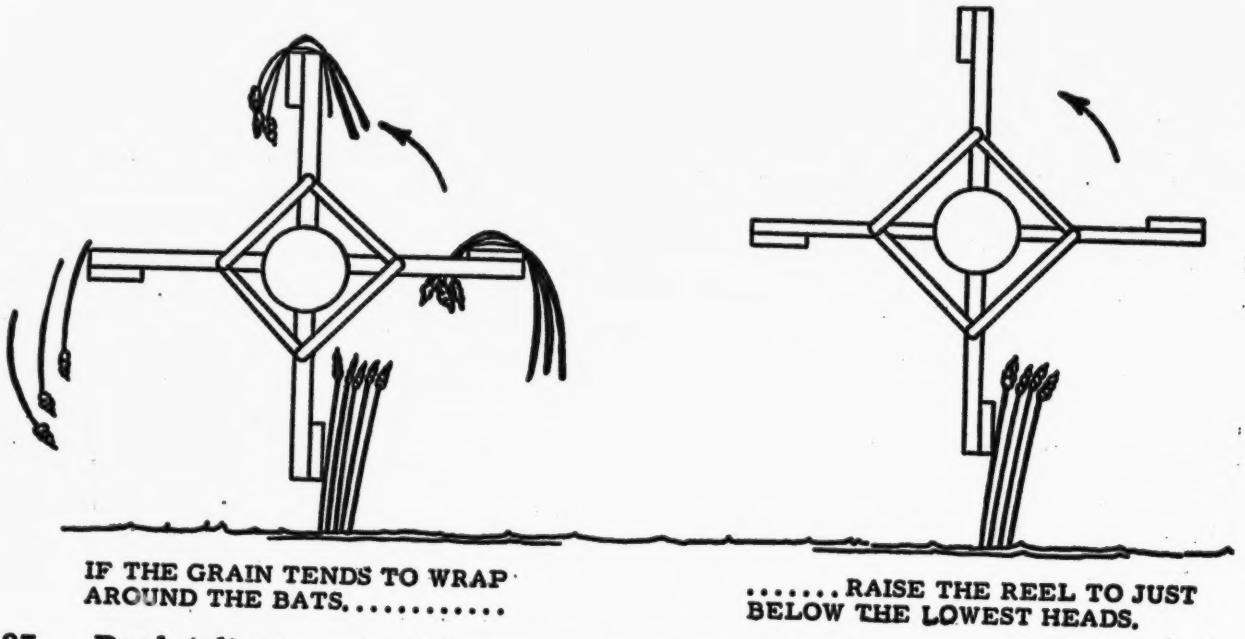


Figure 37. Reel Adjustment. (Courtesy J. I. Case Company.)

c. For different crop conditions:

(1) For medium and short crops, adjust the reel approximately four inches above the cutter bar and far enough forward so that the bats do not leave the grain until it is cut.

(2) For taller crops, set the reel back and raised so the bats run close to the top of the grain.

(3) For down crops, adjust the reel to a low and forward position with reel bats set flat.

Student exercise: Study your operator's manual and the condition of the crop to be harvested to find the information for table 7.

Table 7. Recommended Reel Adjustments

Crop being harvested_____

Condition of crop_____

Adjustment	Recommendations	How adjustment is made
Reel Speed (r.p.m.)		
Reel Height		
Position forward or rearward		

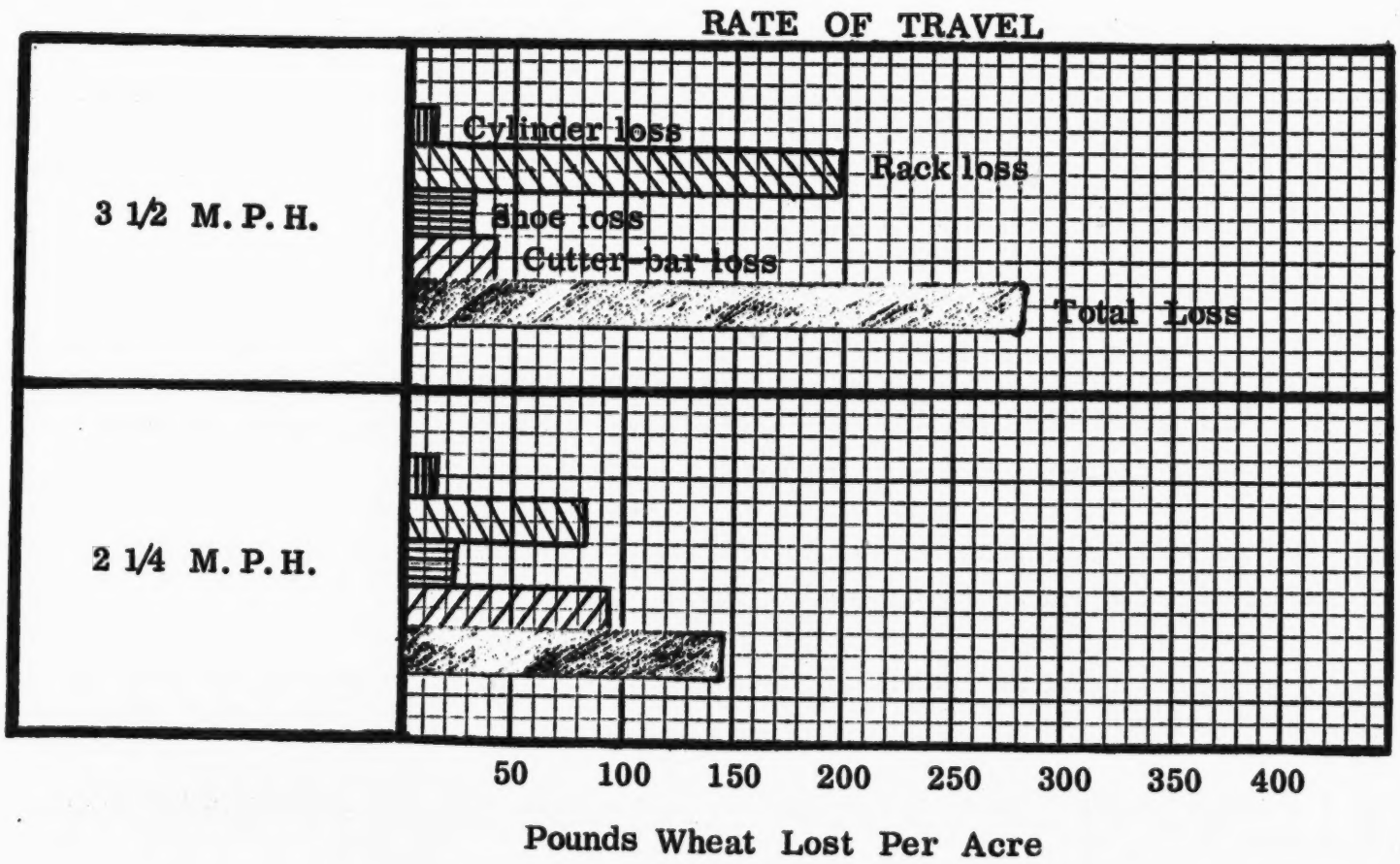
5. Speed of forward travel: Figure 38. Driving too fast will overload the combine causing excessive rack loss.

Overloading the combine by driving too fast or setting the cutterbar too low is the most common cause of high rack loss. Figures 35 and 39 show the effects of overloading on machine losses. Although these charts were made from studies in combining wheat, the same principles apply to combining other crops. The only way to find out if the machine is overloaded is to measure rack loss. The straw rack usually overloads before other parts of the machine.

Overloading is one of the big problems in harvesting legume seed. A very low rate of travel is advisable.

Figure 38. Fast driving overloads the combine.

Figure 39. Driving too fast increases total losses due to overloading the combine.



Ground speed should not be changed by using the throttle. The engine should always be run at full throttle to keep the machine speed up to recommended levels. (See section C. 1.) Forward travel speed should be adjusted by shifting transmission gears and, also, on self-propelled combines, by changing the selective ground speed drive adjustment.

Student exercise: Study your operator's manual, the condition of the crop to be harvested, and the kind of ground you have to cover to determine your recommended speed of forward travel. Place your recommendations in Table 8.

Table 8. Speed of Forward Travel

Recommended Speed m.p.h.	Transmission gear to use	Selective ground speed lever adjustives for self propelled machines

6. Adjust the cleaning sieves and fan blast.

Some of the losses in the cleaning area are caused by poor adjustments in other sections of the combine and can only be reduced by making the proper changes in these areas. These causes are as follows:

Overthreshing causing chopped up straw and excessive chaff which over loads the chaffer and sieve. (See section C-2.)

Overloading the combine by cutting lower than necessary to harvest the grain. (See section C-3.)

Overloading the combine by driving too fast for the condition of the crop. (See section C-5.)

Poor adjustments in the cleaning area of the combine will also cause grain loss. These adjustments and the operating loss or trouble they will cause are as follows:

a. Chaffer opening adjustment.

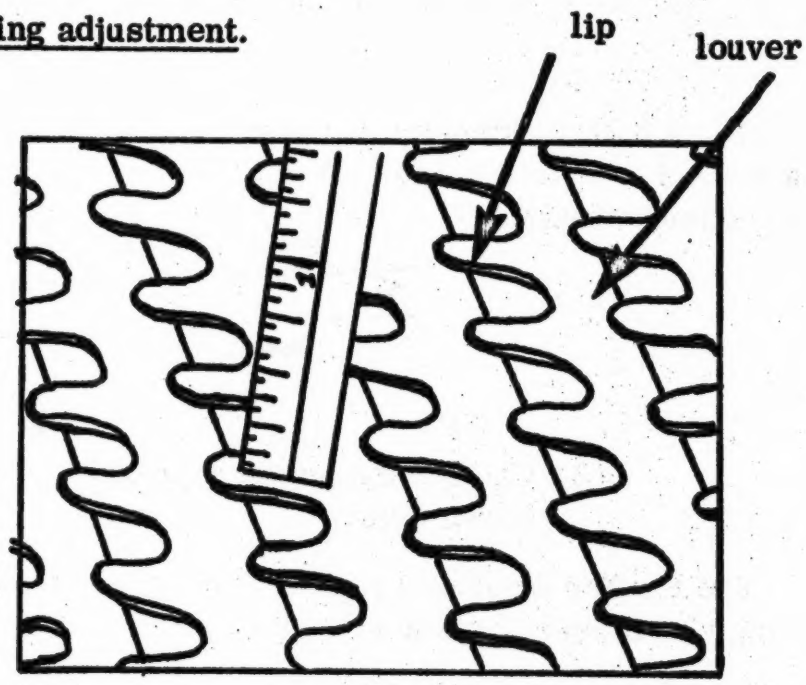


Figure 40

Chaffer Opening Adjustment

The lips may be raised or lowered to regulate the size of openings on the chaffer.

(1) Chaffer openings too large allowing too much chaff and other trash to fall through the chaffer onto the sieve.
(2) Chaffer openings too small allowing the grain to be carried over the chaffer in a blanket of material.

The chaffer openings should be large enough to allow the grain to work through the chaffer before it passes over two thirds of its length. At the same time chaff, weed stems, straw joints, and other coarse materials should be floated onto the chaffer extension.

b. Chaffer height adjustment. On some combines the rear of the chaffer can be raised causing the material to move up hill thus keeping it on the chaffer longer and increasing the cleaning action. When this is done the chaffer openings must be made smaller. This adjustment is used when light seeds, such as clover, are being harvested.

c. Chaffer extension opening adjustment.

(1) Chaffer extension openings too large, allowing too many weed stems, straw joints, and other coarse material to pass through into the tailings. This material is returned to the cylinder and will cause overloading in that area.

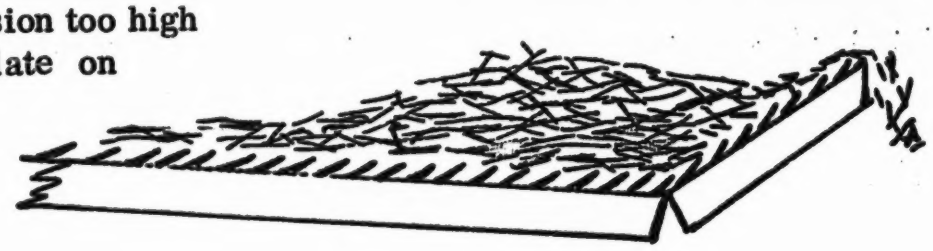
(2) Chaffer extension openings too small, allowing unthreshed portions of the heads to pass out of the combine.

The chaffer extension openings should be large enough to allow the unthreshed portions of the heads to pass through into the tailings trough to be returned to the cylinder for rethreshing. At the same time the coarse materials should be carried out of the machine.

d. Chaffer extension height adjustment.

(1) Chaffer extension adjusted too high causing choking at the rear of the chaffer sieve. Figure 41.

Figure 41. Chaffer extension too high causing material to accumulate on chaffer causing choking.



(2) Chaffer extension adjusted too low allowing light grain to be blown over.

The chaffer extension should be just high enough to prevent light grain from being blown over and low enough to prevent clogging at the rear of the chaffer.

e. The shoe sieve opening adjustment.

(1) Shoe sieve openings too large allowing an excessive amount of trash to fall into the clean grain auger. This trash will show up in the grain tank.

(2) Shoe sieve openings too small causing the grain to be carried over the sieve into the tailings auger where it is returned to the cylinder. This overloads the cylinder and increases the amount of damaged kernels.

The shoe sieve openings should be small enough to allow only threshed grain to pass through into the grain auger. White caps, straw joints, and pieces of unthreshed heads should be floated over into the tailings auger.

f. Shoe sieve height adjustment. On some combines the rear of the sieve can be raised causing the material on the sieve to be retarded, thus keeping the material on the sieve longer and giving the grain a better chance to pass through to the clean grain auger.

g. Special shoe sieve. Round or elongated hole sieves are available for cleaning special crops. See your operator's manual for recommendations.

h. The cleaning fan. The air blast from the fan is directed upward and to the rear through the sieves agitating or floating the material on the chaffer to aid in separation of the seed as the material moves to the rear. The air blast also blows out most of the light, chaffy material as the seeds fall through the openings of the chaffer sieve and then through the smaller openings of the shoe sieve.

i. Force of cleaning fan air blast. The force of the cleaning fan air blast may be controlled by regulating the speed of the fan or by controlling the amount of air coming into the fan.

(1) Fan speed.

(a) If the fan speed is too high the force of the air blast will blow the grain over the sieves.

(b) If the fan speed is too low the material will form a mat on the sieves keeping the grain from falling through.

(2) Fan wind regulators control the amount of air that enters the fan which in turn helps to regulate the strength of the air blast.

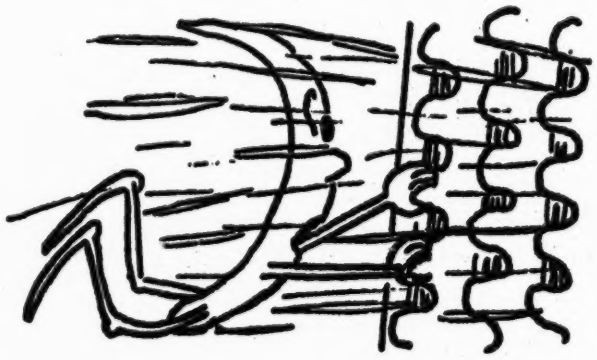
(a) Opening the wind regulators too much will increase the air blast and blow the grain over as in (a) above.

(b) Closing the wind regulators too much will decrease the air blast allowing the material to form a mat on the sieves keeping the grain from falling through as in (b) above.

The force of the cleaning fan air blast needed to do a satisfactory job of cleaning is determined by the size and weight of the seed, plus the amount of chaff going over the sieves. In general, the smaller the seed the less the force of the air blast should be and the larger the seed the greater the force of the air blast should be. Dirty crops usually require a stronger air blast than do clean crops. Figure 42.

Figure 42

Use Proper Amount of Blast



j. Direction of the air blast. The direction of the air blast is controlled by a fan wind deflector, wind boards, or air valves as they may be called.

(1) Air blast directed too far back on sieves will cause grain to be carried over with the chaff.

The deflector must be set to suit crop conditions. If grain is being carried over with the chaff, after the chaffer and shoe sieve are properly adjusted, set the deflector in a position to direct the air upward to the front of the chaffer and shoe sieve.

k. Tailboard. The tailboard can be raised and lowered as necessary to prevent unthreshed material from being carried out of the rear of the separator while still allowing for the chaff to be blown out.

Threshing

SERVICE HINTS / PROBLEMS	CORRECTIONS: adjust auger fingers	adjust concave or cylinder	adjust cylinder cut off bar	adjust cylinder speed	adjust drive belt (flat)	adjust elevator chains	adjust fan mill speed	adjust feeder chain	adjust reel speed	check "key" shaft or drive	adjust sieves	adjust slip clutches	adjust table auger speed	adjust table auger	adjust upper sieve extension	adjust rack speed	adjust rack drive belt	adjust windboards	check curtain in body	check for plugged concave	check space between walkers	check front beater speed	close shutters on fan mill	crop too green	ground speed too fast	install filler plates	knife not centering	knife sections need replacing	ledger plates dull	machine running too slow			
back feeding		X	X	X	X			X		X						X	X					X											
cracked grain		X		X		X																											
cylinder plugging		X	X	X																													
excess chaff				X			X			X	X																						
excess gleanings		X		X			X			X	X				X			X															
elevator to cylinder plugging			X					X				X	X																				
elevators stopping						X						X												X									
grain bunching in front of auger	X												X	X										X									
loss of grain over shoe		X		X	X		X			X	X																						
loss of grass seed over shoe		X		X	X		X			X	X												X		X	X							
loss from table	X				X				X				X																				
loss over walkers		X		X												X			X	X	X												
overthreshing		X		X																													
ragged stubble																									X		X	X	X	X			
straw gathers on windscreen	X								X				X																				
straw spreader spreads unevenly										X							X																
unthreshed heads		X		X																						X							

Figure 43. Threshing Problems Service Hints.
Courtesy, Massey - Ferguson Limited.

Courtesy, Massey - Ferguson Limited.

Mechanical

SERVICE HINTS / PROBLEMS	CORRECTIONS	adjust table balance springs	adjust table lift arms	adjust and lubricate drag links	adjust unloader belt	adjust belt clearance at motor pulley	belt not adjusted at transmission pulleys	clean radiator screen and core	check oil level in hydraulic pump	check pump drive belt for non slippage	control arm on speed valve not adjusted	check speed yoke for straightness	check for hydraulic oil leaks	check timing at distributor	check rear tire pressure	check to see that shoe does not hit body	damaged hydraulic lines or fittings	dealer service required	fill fuel tank	fill radiator	gears damaged in vari speed valve	no harm to pump (characteristic)	"O" ring on speed cylinder damaged	recharge battery	refer to operator's manual	remove stalks from sieves	restrictor valve in speed cylinder	spring can on transmission pulley weak	tighten fan belt	turn on ignition switch	turn on fuel at tank
belt slipping on traction drive						X	X																					X			
combine not coming to a complete stop						X					X																				
cylinder chain adjustment																									X						
engine overheating								X						X						X									X		
engine will not start														X					X					X						X	X
cears clash when selecting gears						X					X																				
grain unloading belt slipping					X																										
ground speed uneven									X			X									X		X								
knocking in pump (Bendix)																						X									
machine hard to steer				X											X										X						
machine hard to steer (hydraulic)				X					X	X			X		X		X								X						
sieves being damaged																X									X	X					
table will not lift		X	X						X	X			X					X													
table will not lower		X	X						X	X								X													
vari-speed will not move machine									X	X	X		X					X			X						X				

Figure 44. Mechanical Problems Service Hints.

Student exercise: The condition of the crop being harvested will determine the adjustments needed in the cleaning area of the combine. Study your operator's manual and the combine in the shop to determine the adjustments that are recommended for this area of the combine. Place the information in table 9.

Table 9. Recommended adjustments in the cleaning area of the combine. (Not all of the adjustments are on each make of the combine.)

Crop being harvested _____

Condition of crop _____

Adjustment	Recommendations	How adjustment is made
Chaffer Opening		
Chaffer Height		
Chaffer Extension Opening		
Chaffer Extension Height		
Shoe Sieve Height		
Special Shoe Sieves		
Fan Speed		
Fan Wind Regulator		
Fan Wind Deflector		
Tailboard		

7. Cutter bar adjustment. The cutter bar provides the support for the guards and sickle. The cutting is accomplished by the shearing action caused as the knife section slides over the guard. To cut properly, the knife must run smoothly in the cutter bar and every knife section must rest on the guard in position to make a shear cut. This means the guards, wearing plates, and knife clips must be in good condition and properly set. (Figure 45.) If these parts become loose or worn, the knife will chew and tear the crop instead of cutting it. This will also cause excessive shattering of ripe crops.

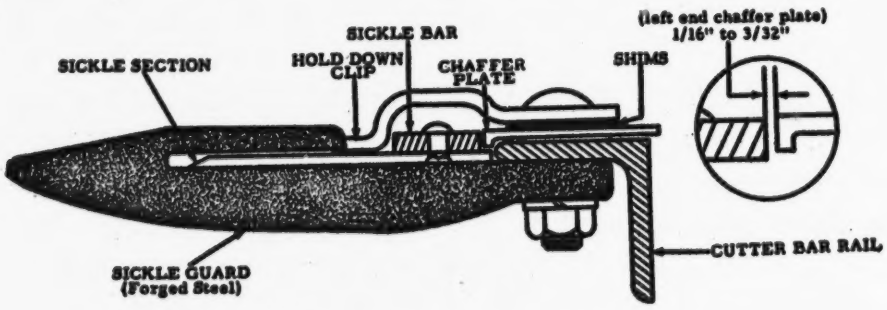


Figure 45. Cutter Bar Adjustment. (Courtesy, J. I. Case Company)

a. Guard alignment. Set each guard up or down as necessary to obtain a shear cut between the knife section and the guard. Tighten the bolt as each guard is aligned. (Figures 46 and 47.)

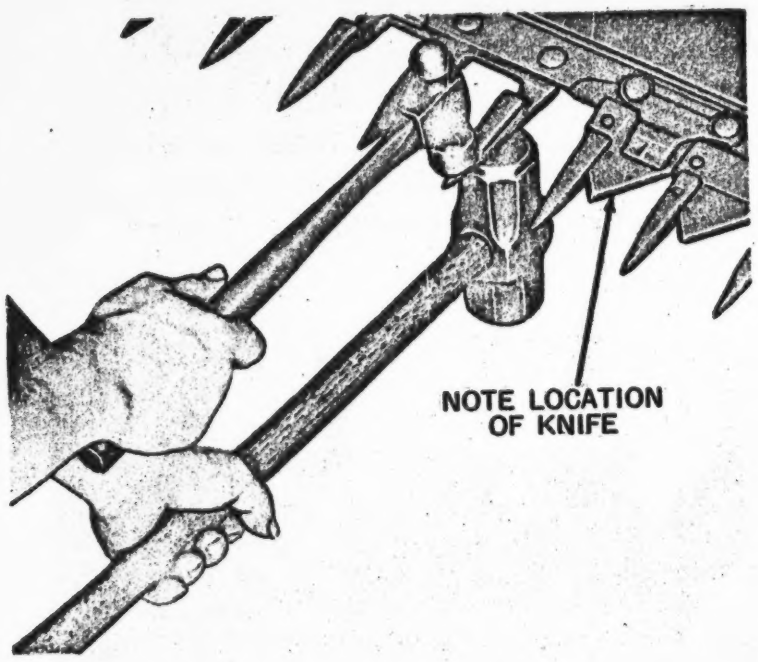


Figure 46. Setting Guard Down. (Courtesy, John Deere)

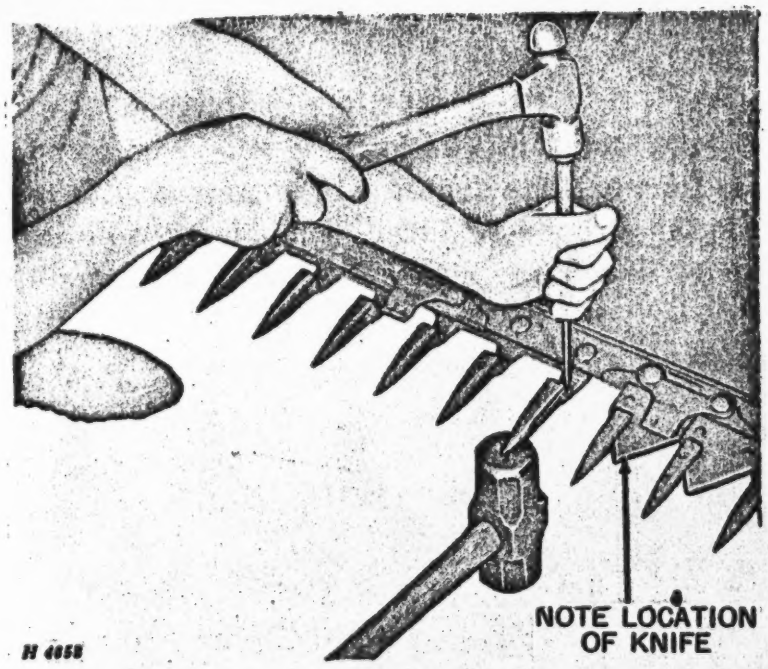


Figure 47. Setting Guard Up. (Courtesy, John Deere)

b. Knife clips. The knife clips must keep the knife sections from lifting off guards and permit the knife to slide without binding. Set the knife clips after guards are aligned. Never bend a knife clip down when the knife is under it. See figures 48 and 49 for instructions. Some models use shims under the knife clips so they may be adjusted up or down by adding or removing shims. (Fig. 48)

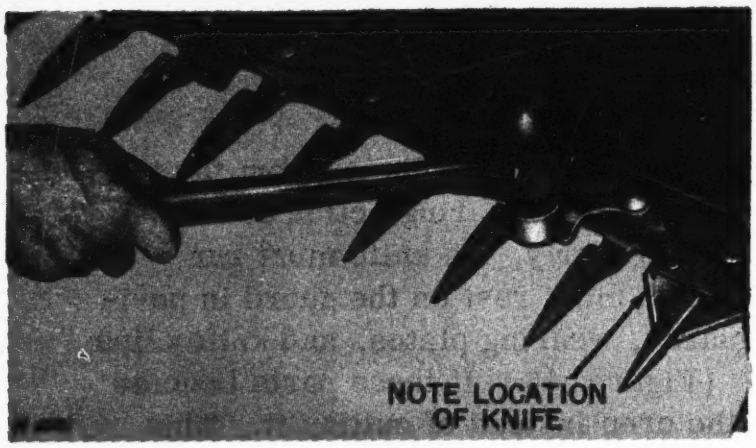


Figure 48. Setting Knife Clip Down
(Courtesy, John Deere)

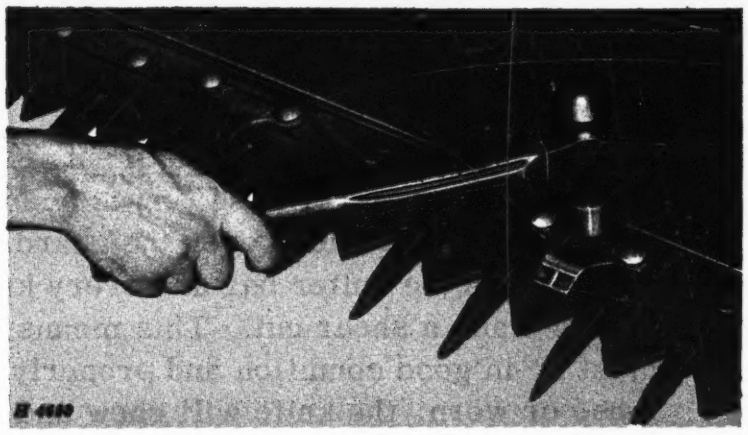
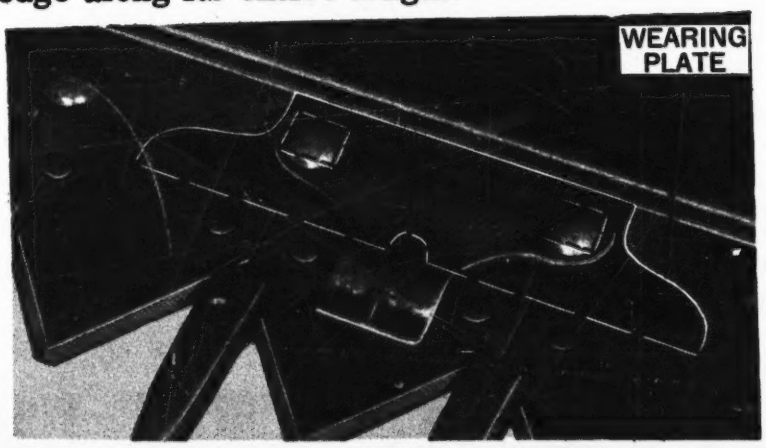


Figure 49. Setting Knife Clip Up
(Courtesy, John Deere)

c. Wearing plates. Wearing plates are located along the entire length of the knife back and may be moved back and forth to take care of wear on the knife back. The turned down edges of the wearing plates must line up with each other to give the knife back a straight bearing edge along its entire length.

Figure 50

Wearing Plate Adjustment



d. Sickle register. With each revolution of the pitman sickle drive, the sickel moves to the left and to the right. The sickle is in proper register when the sections center on the guards with the sickle at the end of its strike. Figure 51, proper register, provides good shearing action by the sickle section. Figure 52 shows the sickle sections out of register.

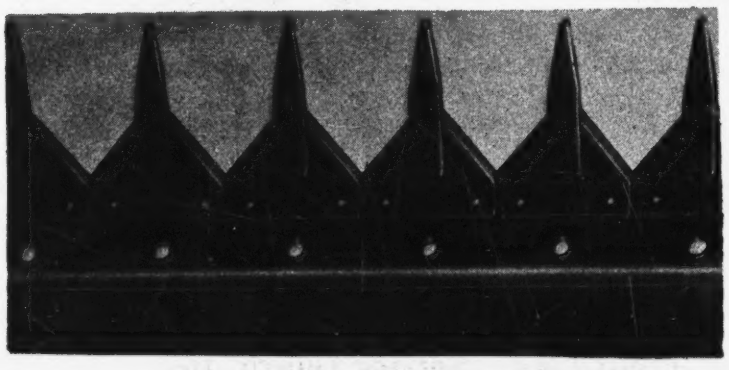


Figure 51. Proper Sickle Register
(Courtesy, John Deere)

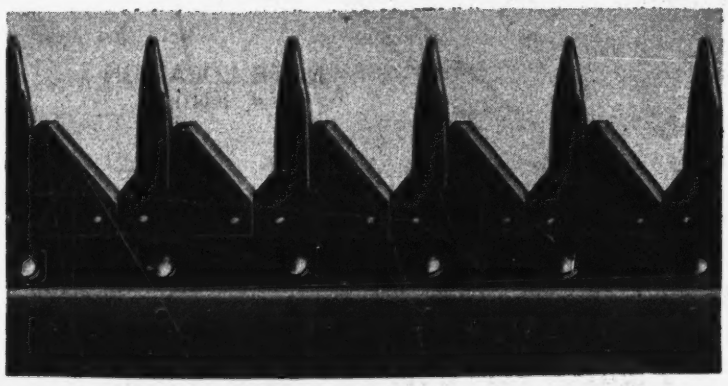


Figure 52. Improper Sickle Register
(Courtesy, John Deere)

The sickle register is usually adjusted by lengthening or shortening the pitman arm. (Figure 53.) Check your operaotrs manual for the instructions on your combine.

e. The sickle may develop an excessive amount of vertical or lateral play caused by wear and loose parts. Follow your operator's manual in making the adjustments to correct this condition. The sickle may also develop back lash because of wear in the sickle drive mechanism. Your operator's manual will tell you how to correct this. After making the above adjustments be sure the sickle moves freely throughout its normal stroke. If any of the parts are adjusted too tightly heating and excessive wear will take place.

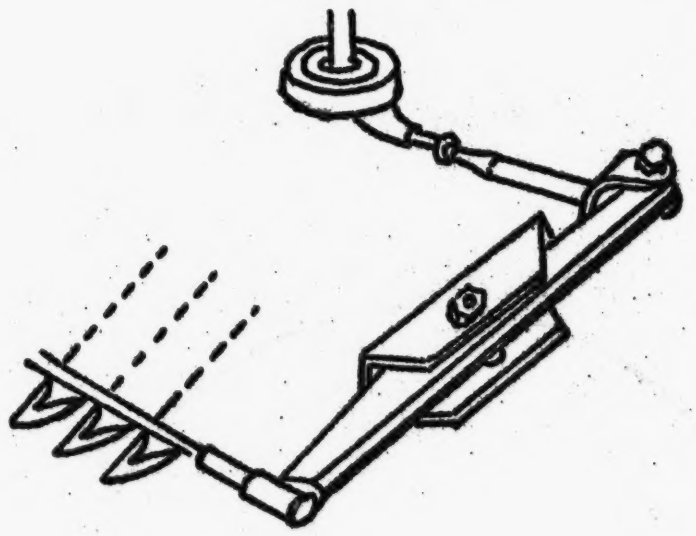


Figure 53. Sickle drive assembly.

8. Factors affecting combine efficiency. Adjustments must be made frequantly to meet changing crop conditions. Harvesting characteristics of grain will change from hour to hour, day to day, and field to field.

a. Varieties. Different varieties of grain may require considerable change in machine adjustment. Always check machine adjustment when starting to harvest a different variety.

b. Effect of weeds. Weeds, or other green material, increase losses in combining (Figure 54) and also increase the moisture content of the harvested grain. The losses increase because of the heavy mat of green material which forms on the straw rack, chaffer and sieves. Some things that may be done to reduce losses and the amount of moisture added to the grain are as follows:

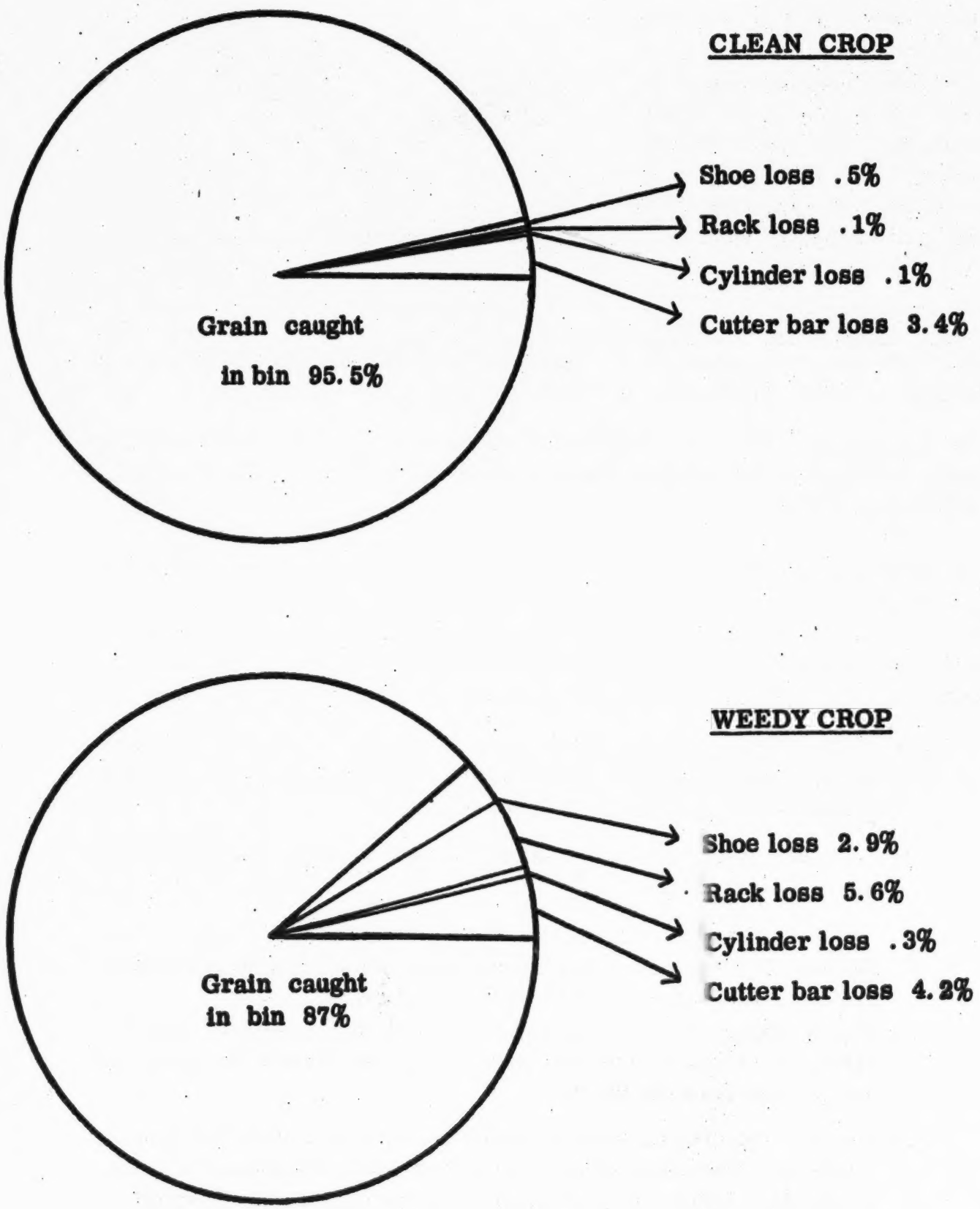
(1) Reduce the amount of green material taken into the machine by cutting around patches of weeds or raising the cutter bar if the green material is not as tall as the crop.

(2) If green material must be taken into the machine the following steps may be taken:

First, reduce the rate of travel or take a narrower cut.
Second, increase the cylinder-concave clearance so the green material is broken up as little as possible.
Third, change the direction of the fan blast forward so that a strong air blast is present where the grain leaves the grain pan and passes onto the chaffer.

(3) Windrowing may be used to avoid taking green material into the machine. The crop should be cut and windrowed about a week to ten days before a clean crop would be combined. Two or three good drying days are required for the windrow to reach threshing condition. The windrow should be loose and fluffy and resting on stubble.

Figure 54. WEEDS INCREASE COMBINE LOSS



(OAES 643, pg. 19)

9. Stone ejector: Under some harvesting conditions it is desirable to operate the cutter bar or corn head, as the case may be, as close to the ground as possible. If stones or other foreign objects are on the surface of the ground they may be picked up and fed into the cylinder causing a great amount of damage to this part of the combine. To safeguard against this happening some combines are equipped with a stone rejector which permits stones to be thrown out before they have the opportunity to damage the cylinder and concave. Figure 55 shows the safety concave door on the Gleaner combine.

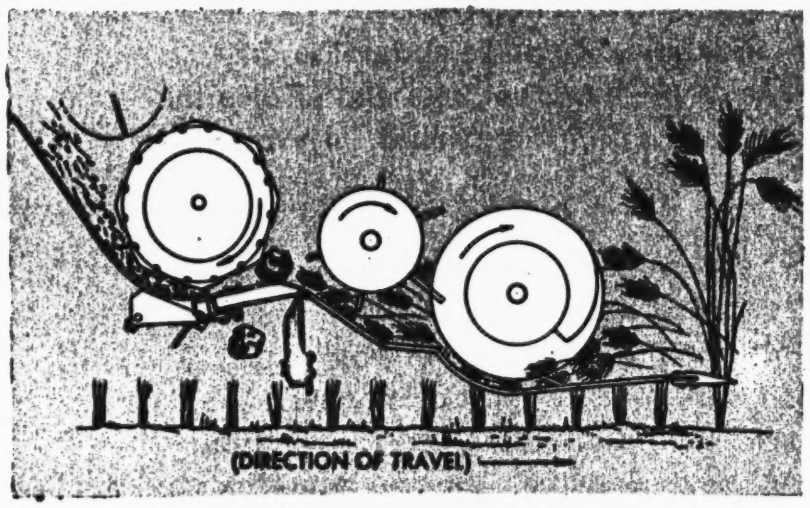


Figure 55. Stone ejector: If a stone or other foreign object enters, the concave door opens to eject it. Merely relatch door and continue combining.

(Courtesy Allis-Chalmers Mfg. Co.)

10. Automatic height of cut controls: Under certain harvesting conditions it is desirable to operate the cutter bar as close to the ground as possible to reduce cutter bar losses. It is difficult for the operator to gauge the height of the cutter bar above the ground. Devices which maintain a pre-set height have resulted in less operator fatigue and more efficient harvesting. (Figure 56)

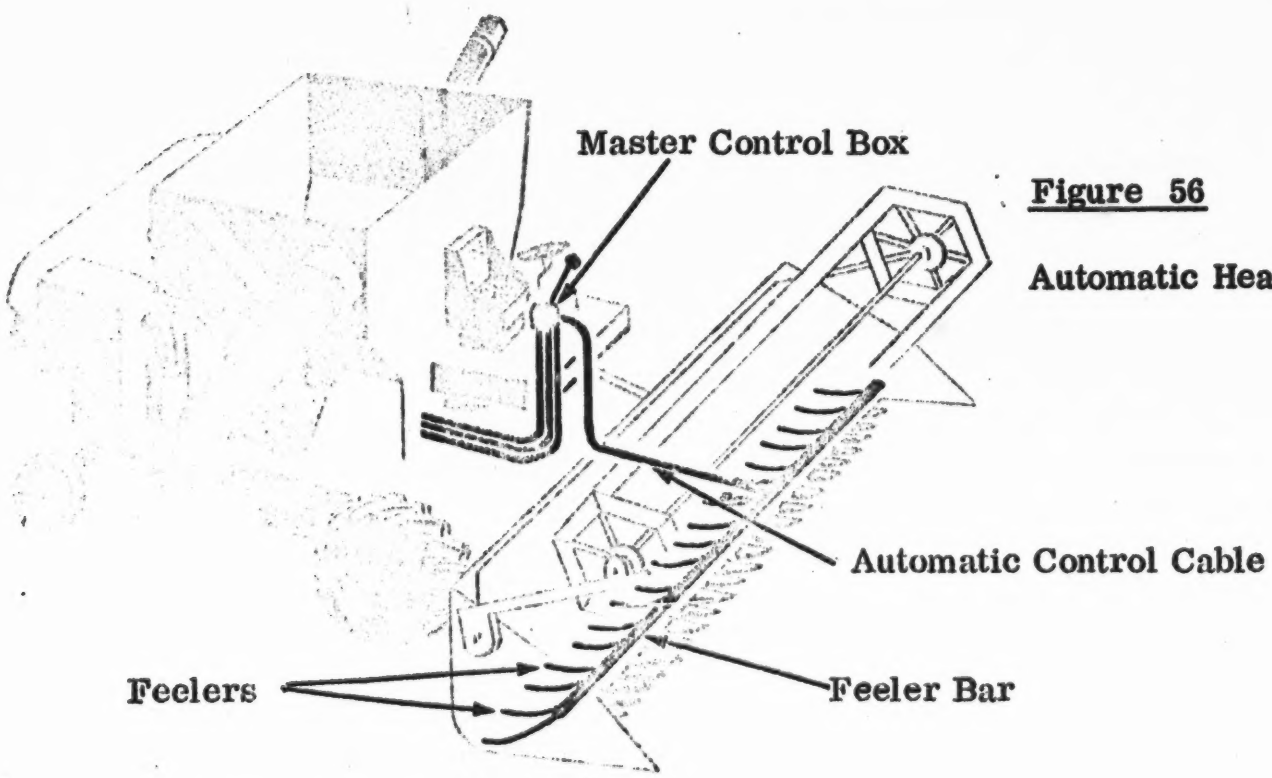


Figure 56

Automatic Header Control

(Courtesy Roper Wright Co., Inc.)

The automatic height of cut controls are of two types:

a. Hydraulic control: (Figure 56) A feeler bar is suspended from the platform on several hangers. The feeler bar is free to move up and down and follows the contour of the ground. When the feelers drop into a low spot they cause the hydraulic control to lower the cutter bar and likewise cause the cutter bar to be raised when the feelers strike a high spot. (For additional information contact M & W Gear Company, Gibson City, Illinois or Roper-Wright Mfg. Company, Inc., Box 343, Elwood, Indiana.)

b. Mechanical spring float has an adjustable plate under the full width of the cutter bar. The device is counterbalanced with springs and allows the cutter bar to float at a uniform height above the surface of the ground. (Available for John Deere Combines)

11. Conclusion: Before the operator makes adjustments on his combine to reduce harvesting losses he should first determine the causes of these losses by means of field checks and observations of the combine while it is working. Adjustments should then be made in the order recommended in this manual. A knowledge of the functional design of the combine and the principles of operation will help him in determining the parts that need adjusting and what the adjustment should be. This knowledge may be obtained by a combination of experience in operating the combine and in studying the operator's manual and other materials on combines.

Experience shows that operators will often make adjustments that do not correct the trouble and move on to make an adjustment in another area of the combine without returning the first adjustment to its original setting. If this procedure is continued the entire combine will soon be completely out of adjustment. Thus, if an adjustment is made that does not correct the trouble the setting should be returned to the position recommended by the manufacturer before making another change.

The service hints given in figures 43 and 44 should serve as a guide in adjusting and maintaining the combine. The charts are adopted from the Massey-Ferguson "Combine Packet Manual."

D. HARVESTING RECOMMENDATIONS BY CROPS

Each crop will present different problems to the combine operator. The combine manufacturer's operator's manual gives recommended adjustments, attachments, and operating suggestions for each of the crops the machine is designed to harvest. These recommended adjustments are starting points for the operator. The procedure outlined previously should be followed to get the best possible job of combining.

Our Experiment Stations have conducted tests to determine the most favorable condition for harvesting some of our main crops. This information can help

us in determining the best time to combine from the standpoint of crop quality and harvesting losses.

1. Wheat harvesting recommendations: [1] The usual recommendations for combine harvesting of wheat is not to start the machine until the moisture level is below 14 per cent. This permits safe storage of the grain or selling without dockage due to excess moisture.

Wheat matures at about 30 per cent moisture. With each day of delay in combining after maturity there is about 12 pounds per acre less grain to harvest due to shattering and other losses.

It is not recommended that wheat be combined when it contains between 20 and 30 per cent moisture for the following reasons:

a. The kernels are badly damaged by the cylinder action.
b. The grain will not keep well in storage.
c. The test weight per bushel is lowered.
d. The germination is lowered.

Some of the problems caused by delaying combining until the grain reaches 14 per cent moisture are as follows:

a. More shattering takes place. (About one bushel per acre each five days.
b. More cutter bar loss.
c. More weed and legume growth takes place causing more green material to be taken into the combine.
d. More risk of lodged grain.
e. Test weight per bushel will be reduced. (Figure 57) (One pound per bushel each four days.)

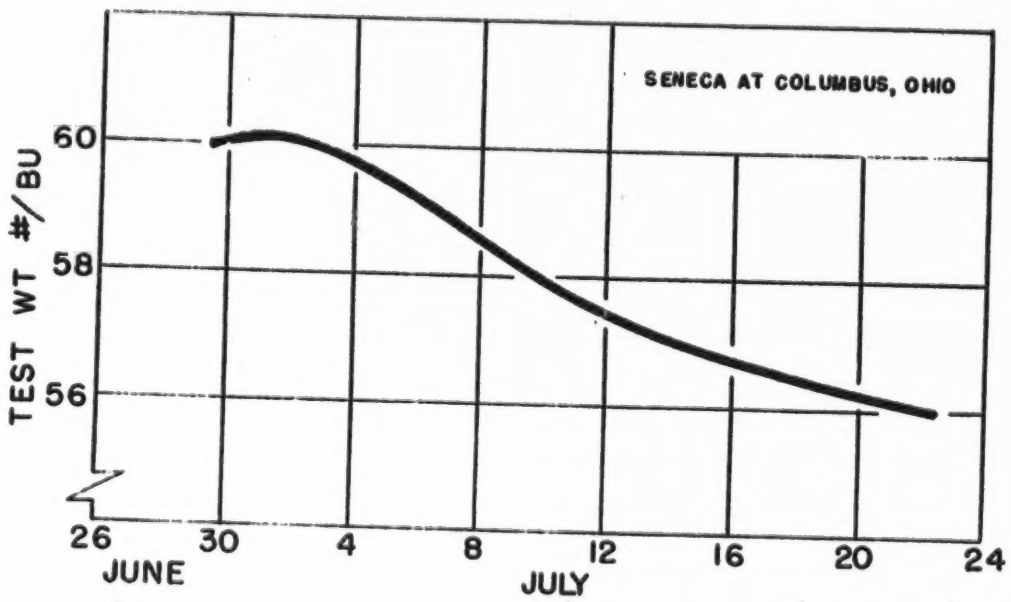


Figure 57. Test weight per bushel decreases as the harvest date is delayed.

1. Johnson, W. H., "Harvesting and Drying of High Moisture Wheat," OAES Bulletin 841, 1959.

The principal reason for the reduction in test weight per bushel for grain standing in the field is that as the grain dries and is rewetted with rain or dew it swells and does not re-dry back to its original volume. Thus there are less kernels in a bushel and the weight is lower.

Recent tests conducted over a period of five years at the Ohio Agriculture Experiment Station show that grain losses can be reduced by starting to combine when the grain reaches 20% moisture. (Fig. 58) At this moisture level the test weight is kept high, germination is not harmed, and the kernels are not damaged if the machine is properly adjusted.

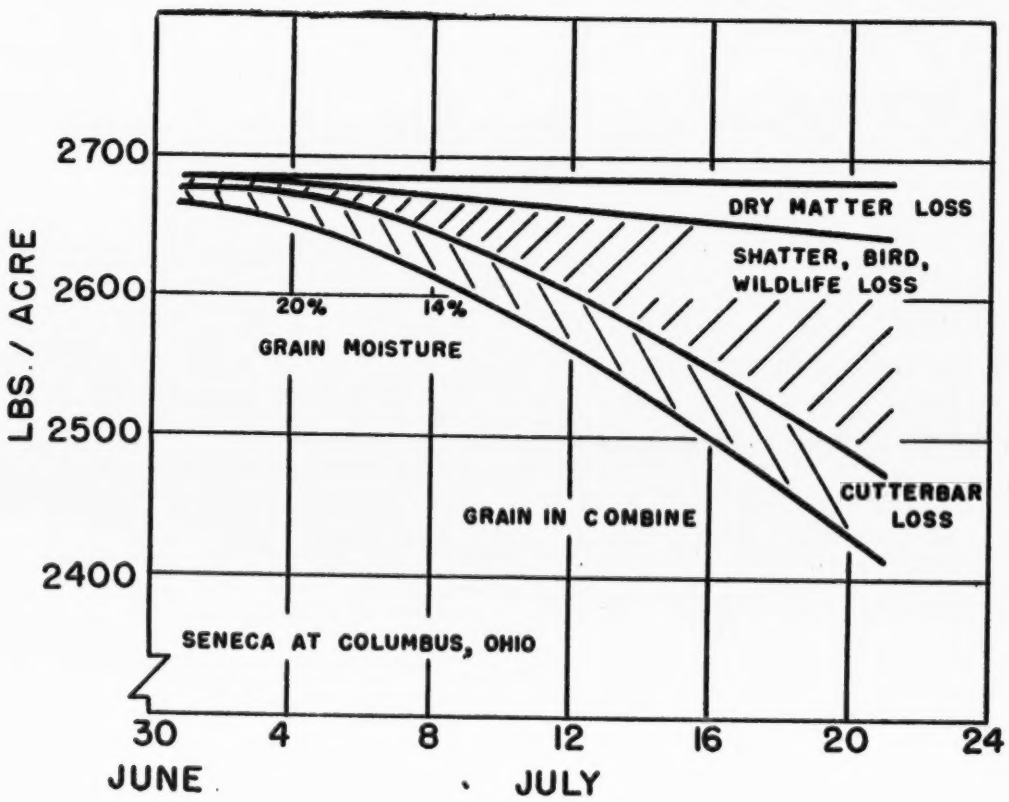


Figure 58. Grain losses increase as harvesting time is delayed.

If high moisture grain is harvested it must be dried to 14 per cent moisture before it can be safely stored. The cost of drying, either on the farm or at the elevator, must be compared with the advantages of early harvesting.

Under good harvesting conditions it will take about 5 days for wheat to dry in the field from 20 per cent moisture to 14 per cent. (Figure 59) Under poor conditions it has required up to 16 days. Thus, at least 5 or more days can be gained by starting to combine when the grain reaches 20 per cent moisture.

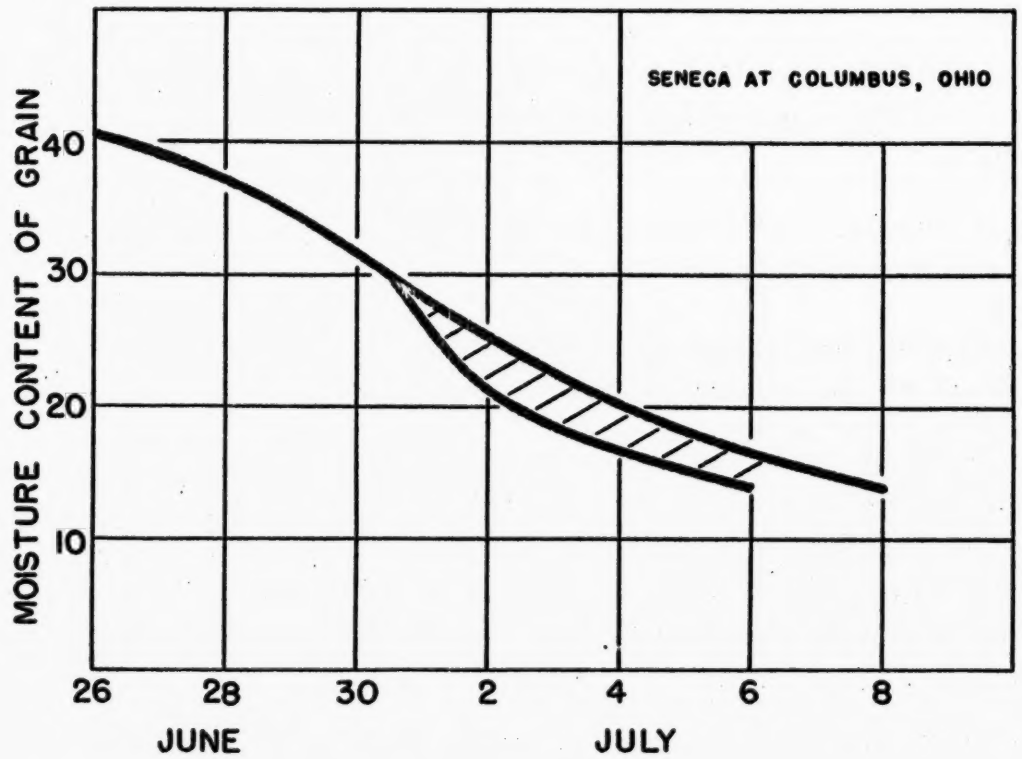


Figure 59

Rate of drying wheat standing in the field.

Tests show that combining high moisture wheat (14 to 20 per cent) has the following effects on losses in the different areas of the combine:

(1) Cutter bar loss is less. The loss in 20 per cent grain is about 1/2 that in 14 per cent grain.
(2) Cylinder loss increases slightly but can be held to less than one per cent with proper cylinder-concave adjustment.
(3) Rack loss is lower. There is less over-threshing.
(4) Shoe loss is lower. There is less over loading since more chaff clings to the straw.

The total loss is less when high moisture wheat is combined. Refer back to Figures 57 and 58.

The following recommendations are given by the Ohio Experiment Station for combining high moisture grain. "At 20 per cent grain moisture the cylinder concave clearance on rasp and bar type cylinders will have to be adjusted at a near minimum, 3/16" to 1/4", for the high moisture harvest, and then be increased as the grain becomes drier. A good rule of thumb is to check for unthreshed grain and adjust the cylinder-concave clearances or cylinder speed until about six grains per square foot are found in the head."

Problem: Farmer Jones started combining his wheat at 20 per cent moisture and completed the job before it reached 14 per cent moisture. His combining losses were 3 bushels per acre, and the test weight per bushel was 59 pounds. His cost of drying the harvested grain was 5¢ per bushel.

Farmer Brown started combining his wheat when it reached the 14 per cent moisture level. His losses were 5 bushels per acre, and the test weight per bushel was 56 pounds. He had no cost of drying.

The actual yield for each farmer was 45 bushels per acre before harvesting losses, and the discount for test weight per bushel is 1¢ for each 1/2 pound under 60 pounds.

If the price of wheat is $1.80 per bushel, what is the gross (total) income per acre for each farmer?

Student exercise: If you raise wheat at home would you recommend the practice of starting to combine when the grain moisture content reaches 20 per cent?

Keeping your home situation in mind, make a list of advantages and disadvantages of the practice. On some of these items you will need to find the extra cost that would be involved and on others the extra returns you might expect if the practice were followed. If you want to do more studying ask your teacher for a copy of the Experiment Station Bulletin 841, "Harvesting and Drying of High Moisture Wheat."

2. Soybean harvesting recommendations: [1] Losses with the combine have commonly been from 10 to 20 per cent of the available crop. Recent research at the Ohio Agricultural Experiment Station shows that with proper adjustment and operation of the combine and timely operation up to 95 per cent of the crop can be harvested.

Source of Loss: The first step in adjusting the combine is to determine the source of loss and its cause as outlined in section III of this manual.

Harvesting Tips: The following harvesting tips have been given by the Experiment Station researchers: High moisture combining of soybeans is considered to be when the kernels are above 12 per cent moisture, and the pods are dampened from dew or rain. (Notice that some of these recommendations are different from those given for wheat.)

a. Adjust the cylinder and concave so that cylinder losses will be practically nothing. In soybeans this will not have a tendency to overload the rack and shoe with chaff as it would in wheat. When high moisture beans are being harvested the cylinder will need to be run at nearly twice the speed recommended for dry beans. Cylinder clearance generally need not be changed. At high cylinder speeds germination will be reduced, but this will not reduce the market quality of the crop.

b. Lower the cutterbar to about four inches above the ground if possible. This adjustment reduces shatter loss due to direct cutting of beans and stubble loss caused by cutting above the pods. The distribution of pods above the ground is affected to some extent by variety, but the greatest difference is caused by the method of planting. The general tendency is that the thicker the plant population the higher the pods will be set on the plant. Thus, if the plant spacing within the row remains nearly constant and the width between the rows is narrowed, the pods should set higher on the plants.

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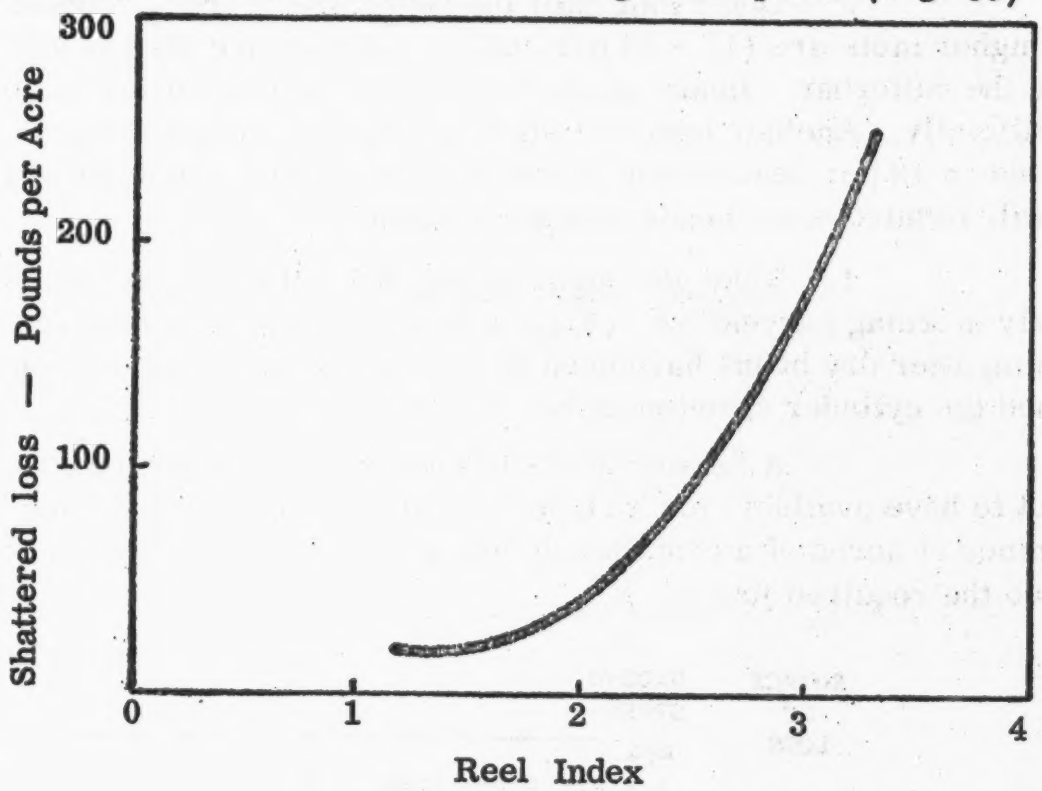
1. Lamp, B. J., Johnson, W. H., Harkness, K. A., Smith, P. E., "Soybean Harvesting," OAES Bulletin 899, 1962.

c. Adjust the reel so that:

(1) The bat speed is about 25% faster than ground speed. (Fig. 60)

Figure 60

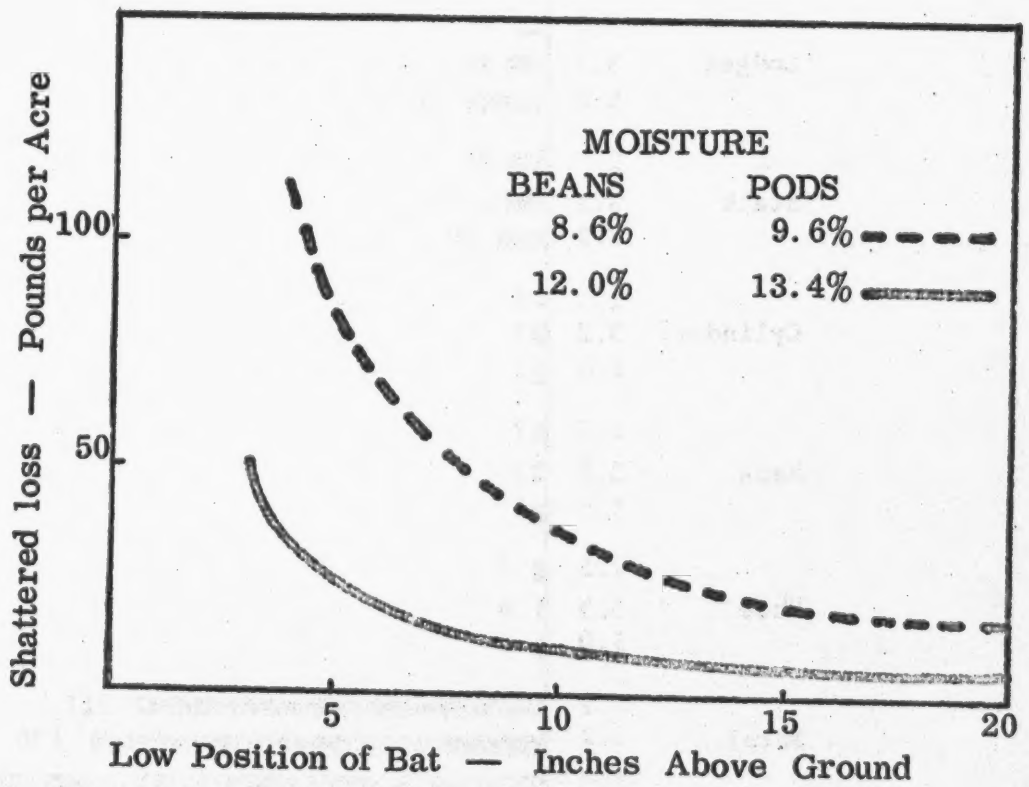
The faster the reel operates in relation to the ground speed the greater the shattered loss will be. Combine speed 2.6 to 2.9 m.p.h. Bean moisture 10 - 11 %. (1 = reel traveling at ground speed of combine, 2 = reel traveling twice combine ground speed, etc.



(2) The bat penetrates the grain no more than necessary to hold the beans while being cut and move them onto the platform. (Figure 61) In case of lodged beans the reel will need to be operated at a lower setting.

Figure 61

Shatter losses increase as the reel is adjusted downward. Dry beans shatter more than moist beans.



(3) The axis of the reel is adjusted so that it is 6 to 12 inches ahead of the knife. Except for stalk carryover this adjustment has little effect upon losses.

d. Keep forward speed reasonable. The effect of speed on losses is shown in Figure 62. The increase in loss is due largely to stripping of beans at the cutterbar.

e. Don't wait until the beans are overdry. Beans are harder to thresh at higher moisture (13 - 16 per cent) , but they are also harder to shatter at the reel and the cutterbar. Beans above 14-15 per cent moisture will need to be dried artificially. Another loss will show up when beans are too dry. Market price is based on 13 per cent moisture and beans with less moisture will be penalized since it will require more beans to make a bushel.

f. Take advantage of the dew. Harvesting losses can be reduced by early morning harvesting. (Figure 63) This same advantage can be gained by combining after dry beans have been re-wet following a rain. When wet beans are combined the cylinder speed must be increased.

A farmer needs to know how many favorable working days he can expect to have available for a given operation. This will help him in determining the number of acres of a crop that he can take care of and the size of machinery he needs to do the required jobs.

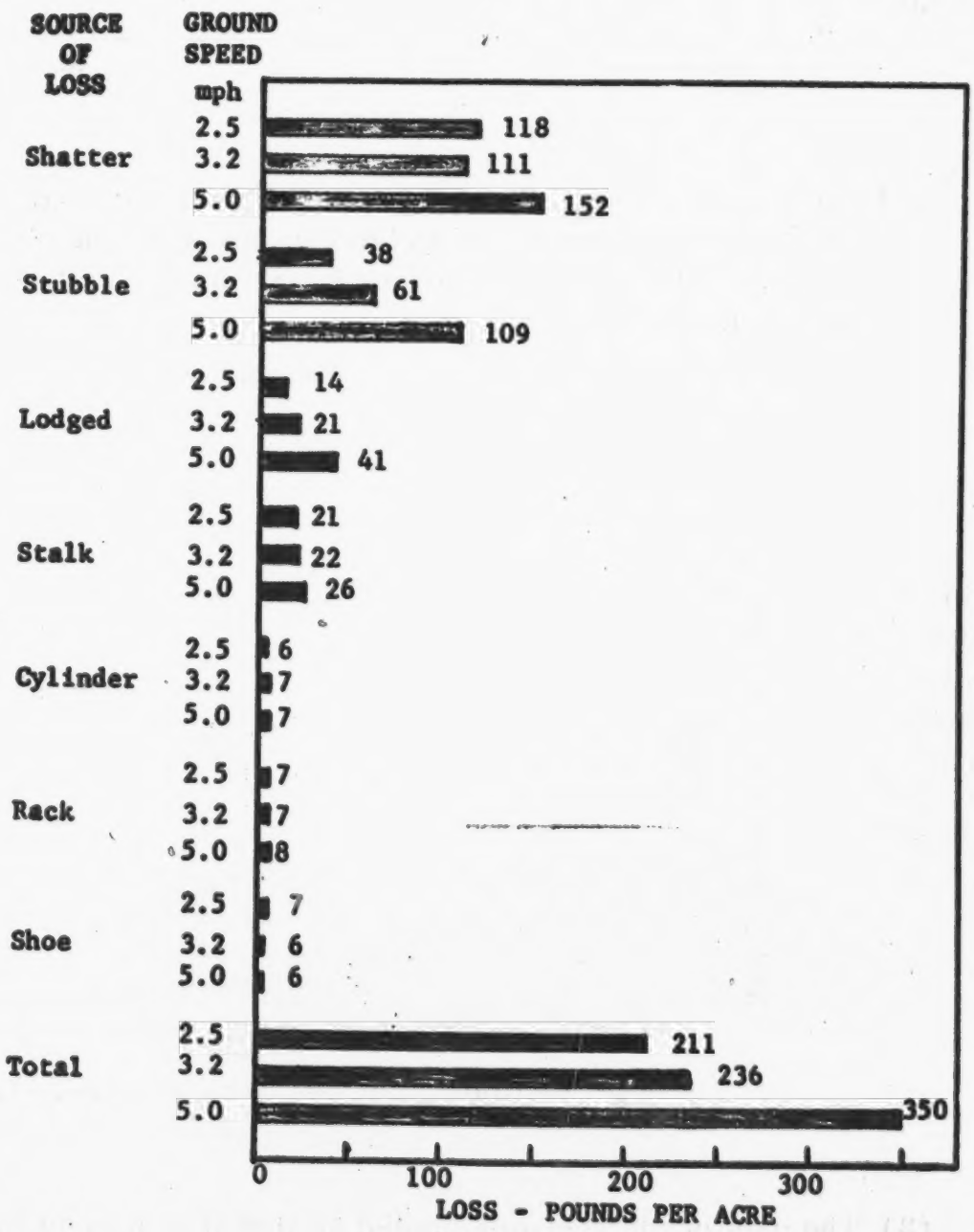
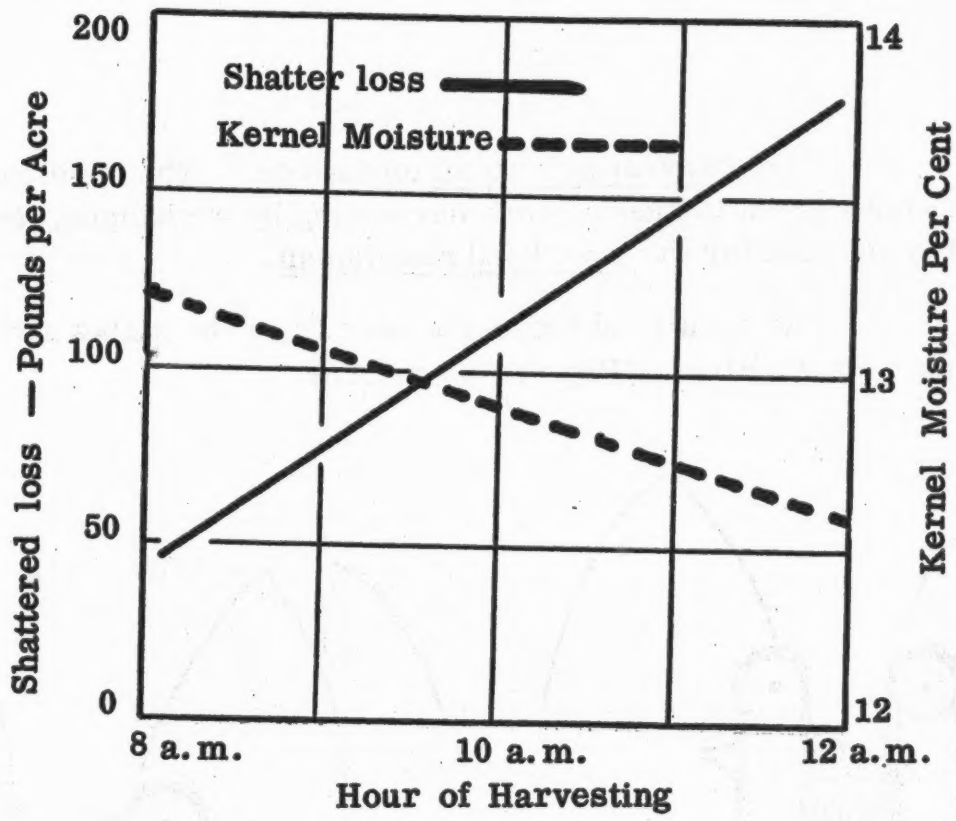


Figure 62. The effect of combine ground speed on harvesting loss.

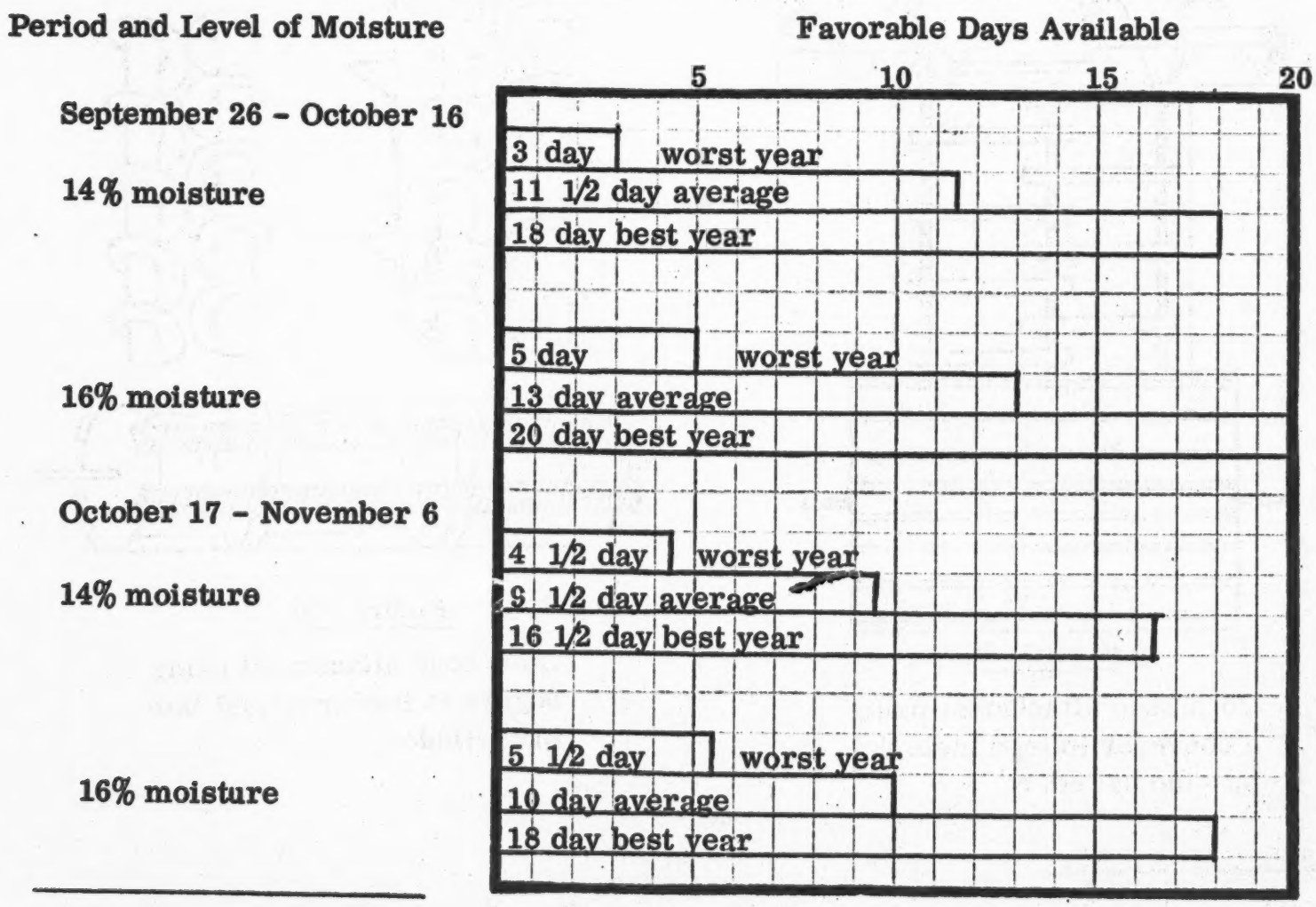
Figure 63

The effect of the time of day upon shattered loss and kernel moisture. As the beans dry during the day the shatter loss increases.



The Department of Agricultural Economics at The Ohio State University[1] has conducted a study to determine the information. The days available for both early and late harvest of soybeans for two moisture levels are given in Figure 64.

Figure 64. Favorable Days Available for Combining Soybeans. (1938-1957)



1. The Effect of Weather on the Days Available to do Selected Crop Operations, 1938 - 1957. Department of Agricultural Economics, The Ohio State University, 1960.

3. Corn harvesting recommendations.[1] The combine can be converted from small grain to shelled corn harvesting by exchanging the small grain cutting and feeding unit for the corn head attachment.

The corn head snaps the ears from the stalks and feeds them into the cylinder for shelling. (Figures 65 and 66)

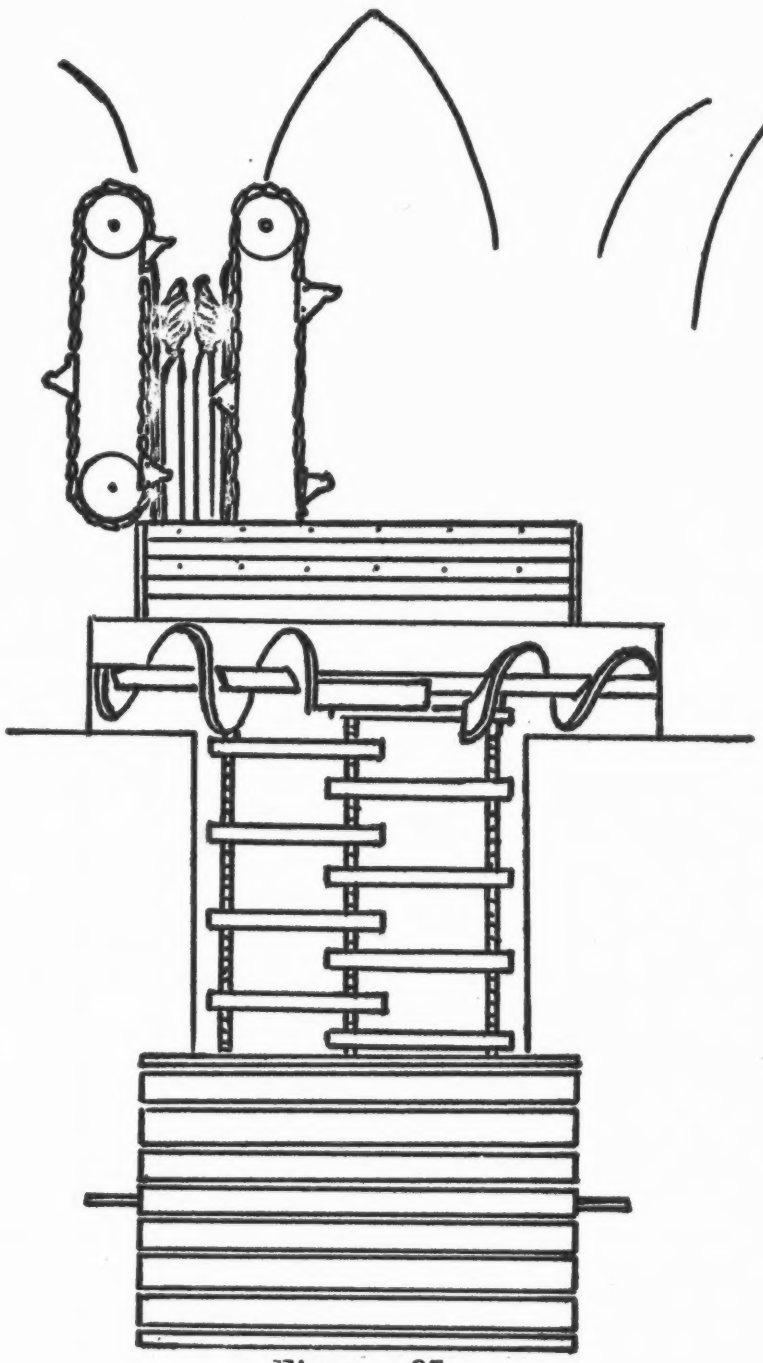


Figure 65.

Corn head attachment using a conveyor to feed material into the cylinder.

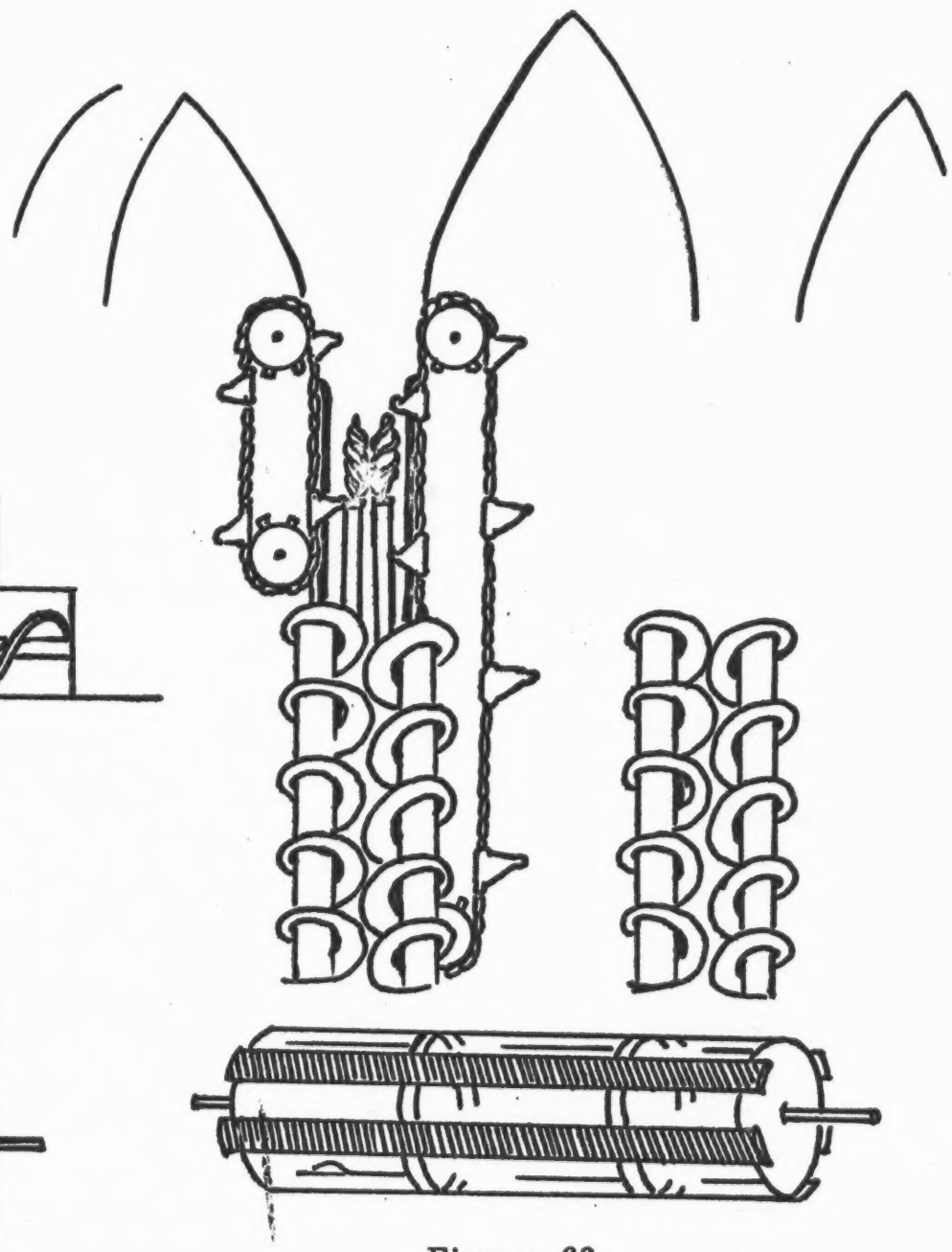


Figure 66.

Corn head attachment using augers to feed material into the cylinder.

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1. Johnson, W. H., Lamp, B. J., Henry, J. E., and Hall, G. E., Corn Harvesting Performance at Various Dates, ASEA Paper 61-603, 1961

The corn head operates somewhat differently than the corn picker. The stalks of corn are pulled straight down through the stalk rolls. Snapping bars or stripper plates snap the ears off at the shank. (Figure 67)

Since the ears do not come in contact with the rolls, as in the picker, there is much less shelling in this area. A field study by agricultural engineers in 1964 revealed that average losses for machines with snapping bars was one bushel per acre as compared to the conventional snapping roll which lost an average of three bushels per acre.[1]

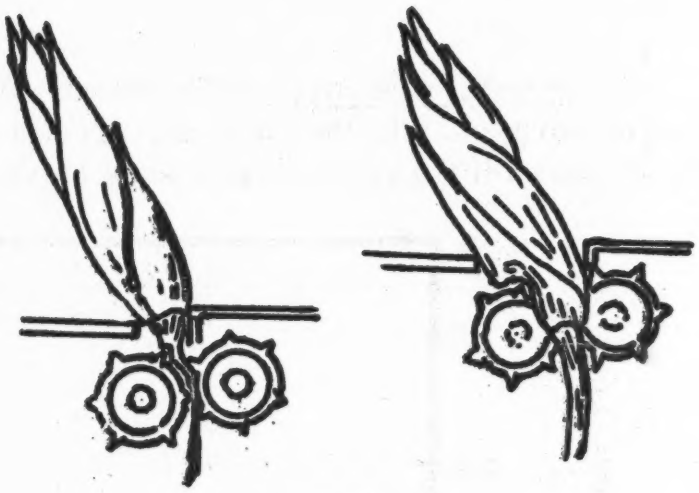


Figure 67

Snapping bars should be adjusted as close together as possible and still allow passage of stalks.

From the snapping area the ears are then fed into the cylinder for shelling. (Figure 68) See your operator's manual for recommended attachments to convert the cylinder and concave to the job of shelling corn.

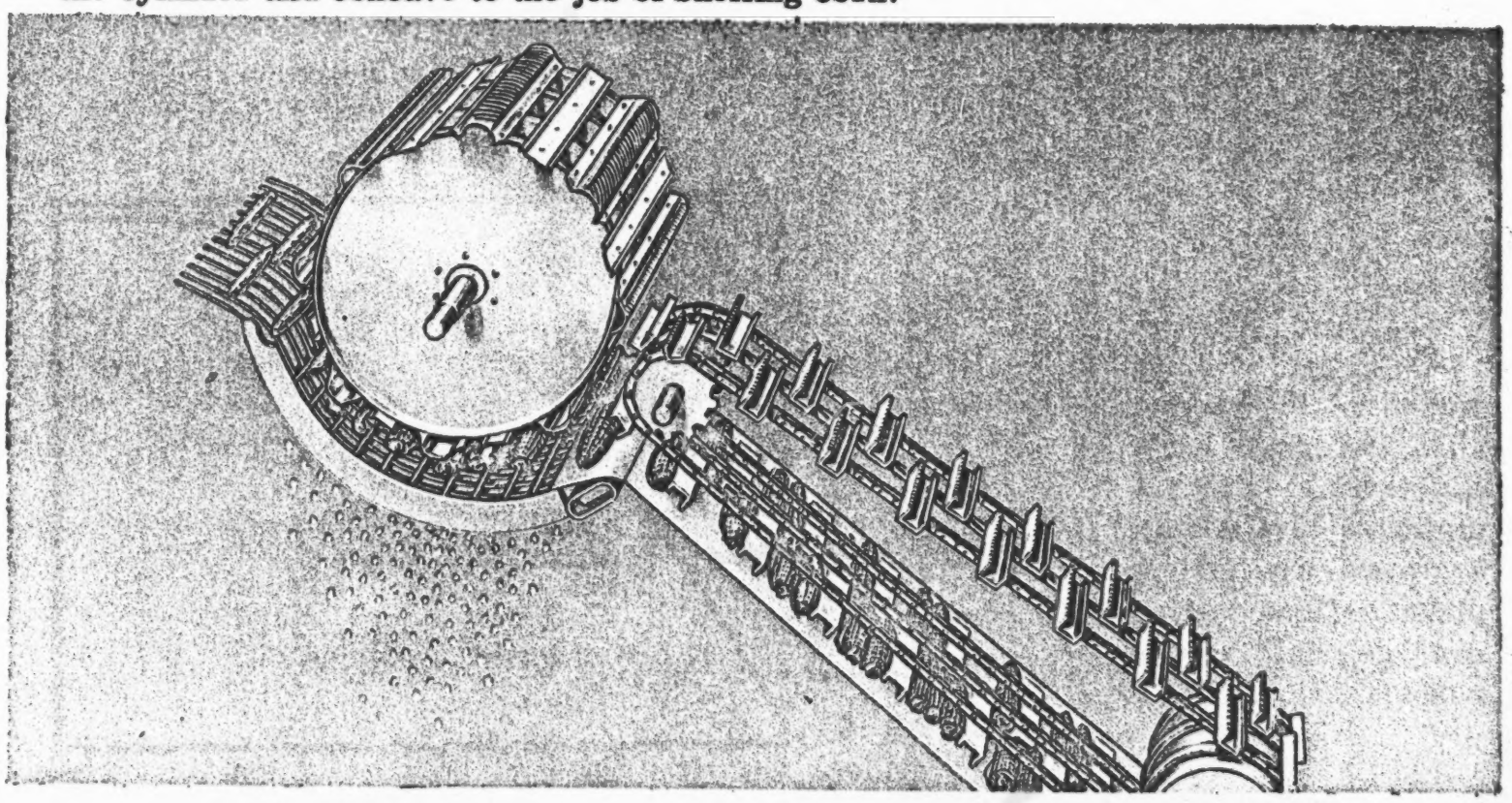


Figure 68. The ears are fed into the threshing unit where they are shelled by the rubbing action of the rotating cylinder against the concave. (Courtesy of International Harvestor Company.)

1. Byg, D. M., Gill, W. E., and Johnson, W. H., "Machine Losses in Harvesting Ear and Shelled Corn," Bulletin MM-247, The Ohio State University, 1965, p. 3.

(1) Pre-harvest loss. (The amount of corn lost before harvesting starts.) The longer corn dries in the field the greater the pre-harvest losses will be. Figure 69 shows that pre-harvest losses increase as corn dries down in the field.

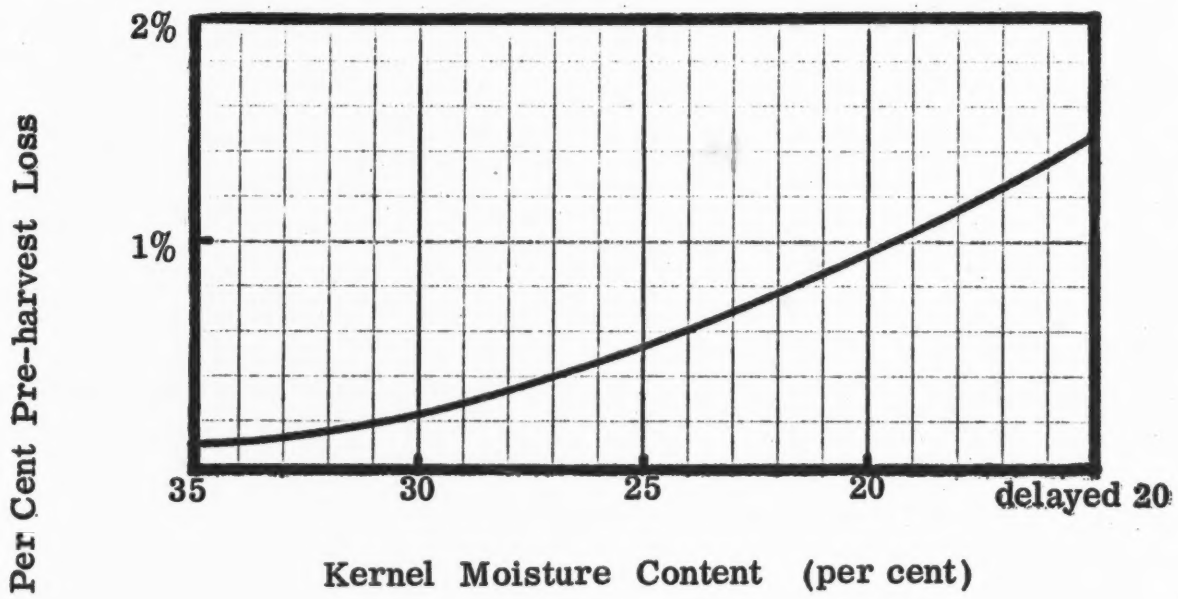
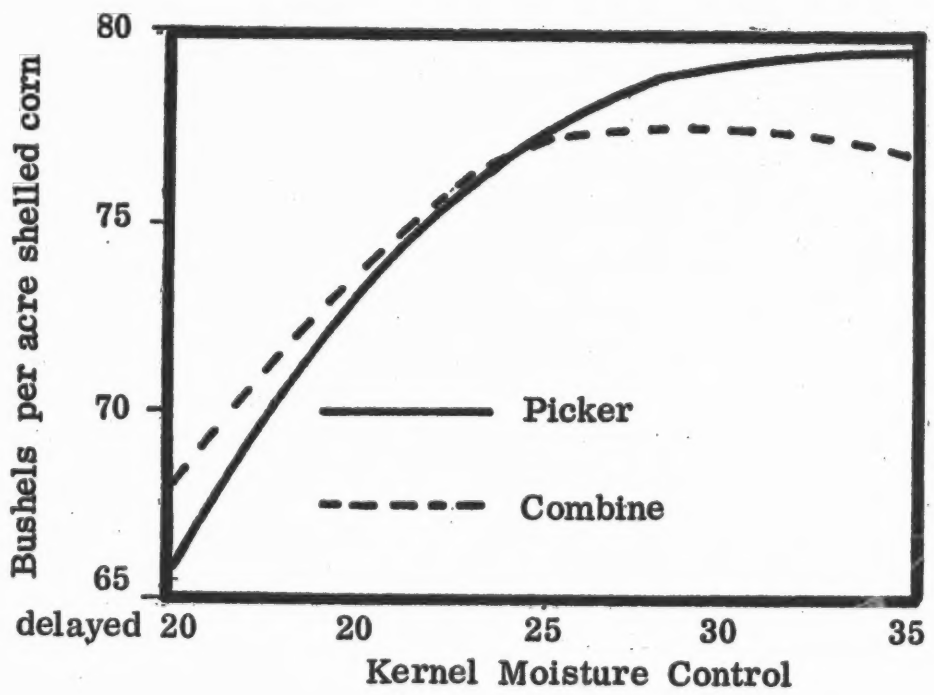


Figure 69. Pre-harvest corn losses increase as corn dries down before harvesting. (W. H. Johnson, "Corn Harvesting Data," OAES, 1964.)

(2) Highest machine yields (the amount of shelled corn actually harvested by the combine or picker) are obtained when corn is combined between 20 and 30 per cent moisture. (Figure 70)

Figure 70

Yields of dry shelled corn per acre when harvested at different moisture levels with a combine and a picker. (Based on an average yield of 80 bushels per acre.)



At high moisture content (35 per cent) a part of the reason for combine yields being lower than picker yields is due to invisible losses. (Losses caused by imperfect shelling such as kernel tips remaining in the cob and small chips of kernels which could not be measured as a visible loss.) The effect of moisture content of kernels on the invisible loss in yield is shown in Figure 71.

A 1964 field survey by agricultural engineers revealed that the amount of fine materials (corn chips and meal) found in the grain tank was in the range of .4 to 3.7 per cent of the total yield and averaged 1.5 per cent.[1]

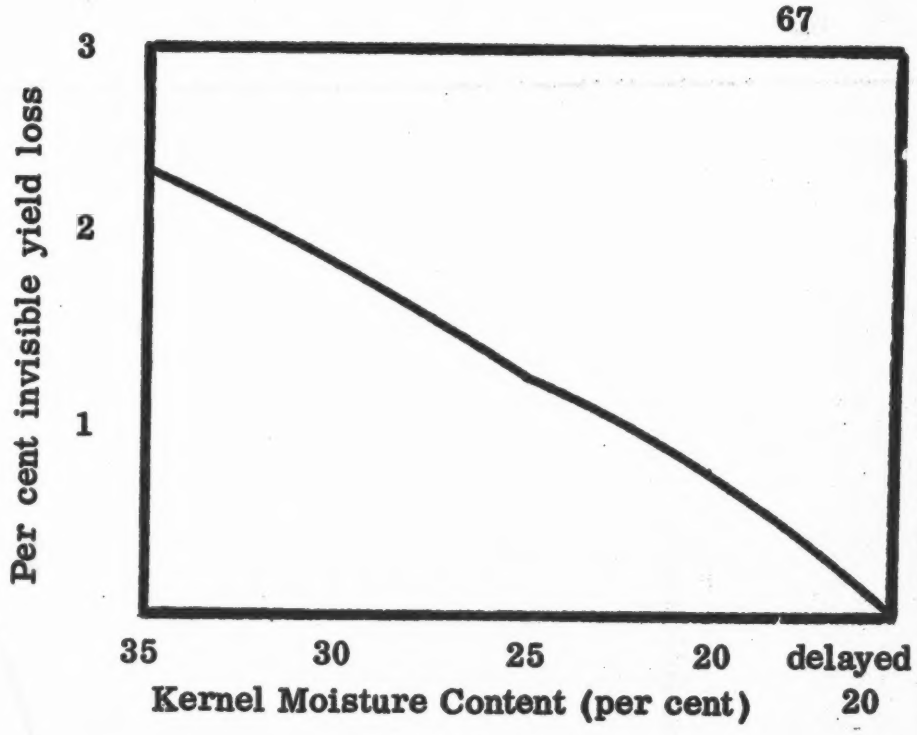


Figure 71 The invisible loss in combining corn decreases as the corn dries down. (W. H. Johnson, "Corn Harvesting Data" OAES, 1964,)

Corn will not mature and dry down at exactly the same dates each year although the moisture content will be approximately the same for a given time each year. Research conducted by the U.S. Department of Agriculture[2] provides us with information that makes it possible to estimate, as early as the water blister stage, when kernels will dry to 30 per cent moisture.

There is no exact guage to use in measuring rate of drying:

(a) Drying rate decreases as moisture in the corn goes down.
(b) Drying rate changes fairly consistently within a certain moisture range, but weather (cool and damp or hot and dry) may greatly influence rate of change in early stages of drying and again when the grain is below the 25 per cent.

The estimated rate of drying is illustrated in figure 72.

(3) Ears dropped. The amount of lodging (a stalk broken over below the ear or leaning greater than 45 degrees) will greatly influence the number of ears lost. (Figure 73)

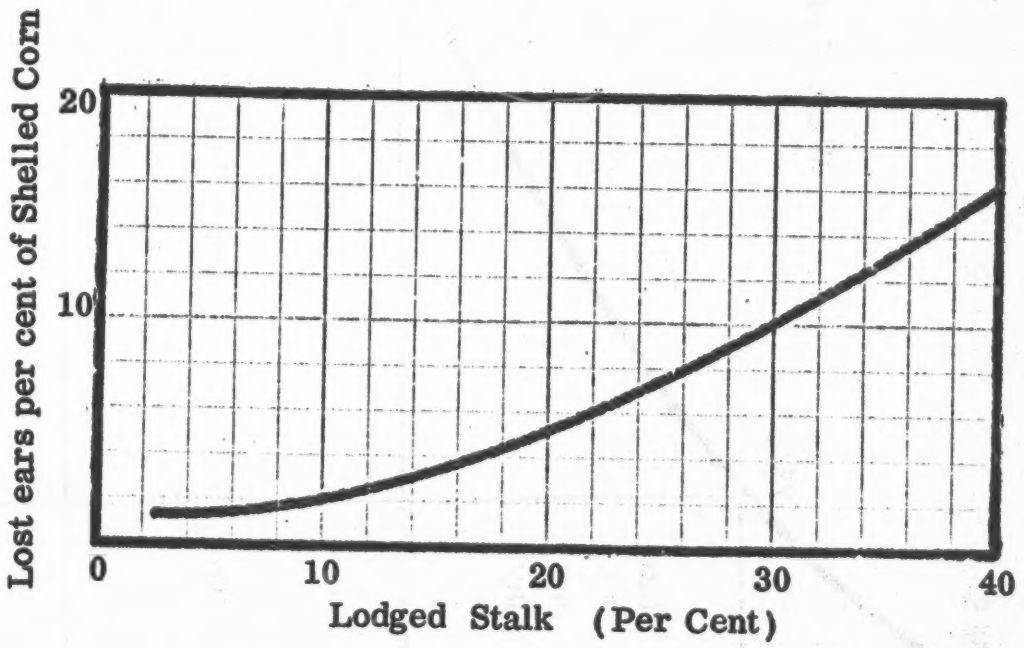
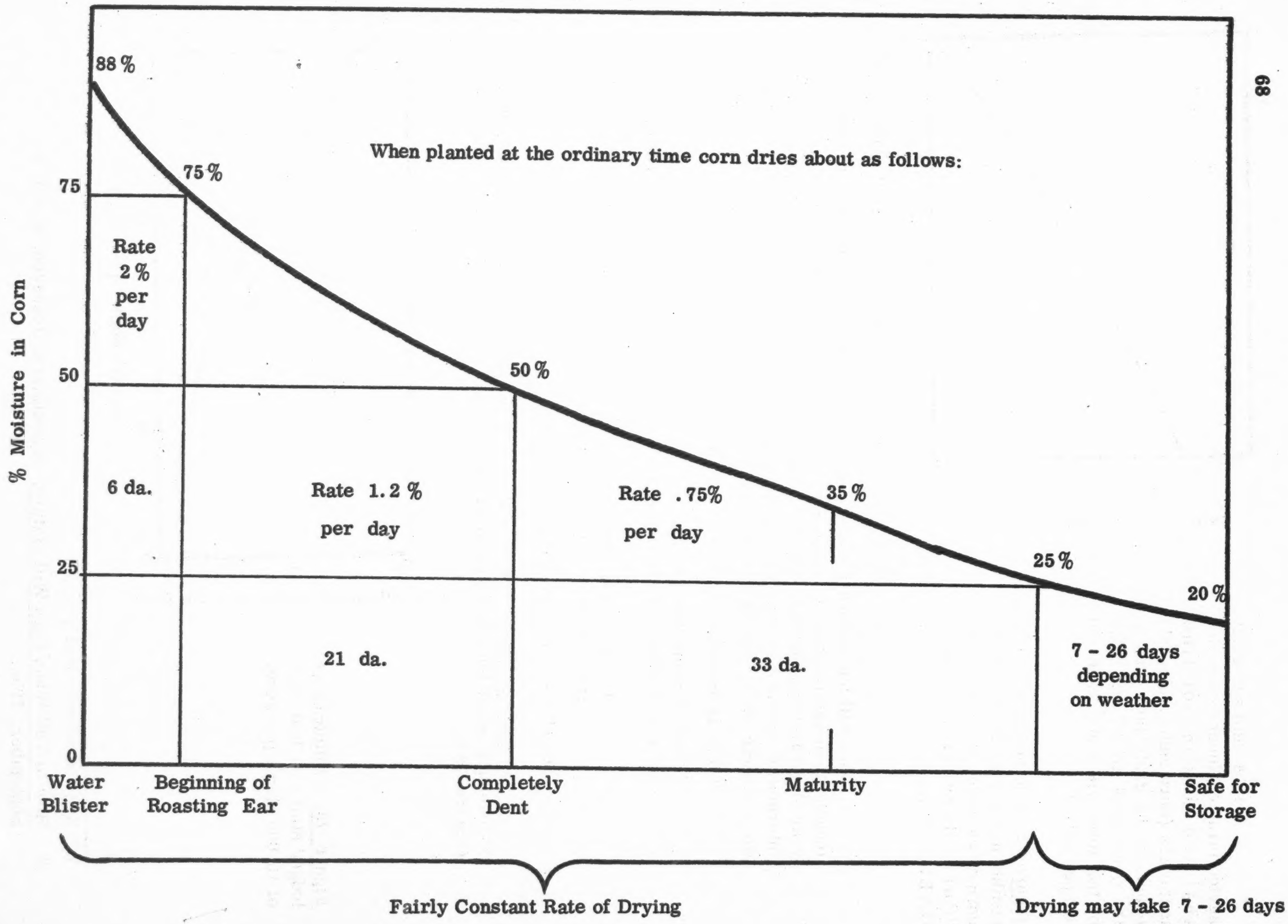


Figure 73. Influence of lodged stalks on lost ears of 15,000 plants per acre.

1. Byg and others, ibid., p. 7.
2. How to Tell When Corn Will Mature, Agricultural Research, U.S.D.A., September, 1955.

Figure 72. How to Tell When Corn Will Mature. (USDA Agr. Research Sept. 1955)



Ear losses from corn combines averaged 3.15 bushels per acre as compared to the corn picker which averaged 1.73 bushels per acre loss. Due to the danger of running stones through the combine many operators are afraid to lower the gathering mechanism enough to pick up broken stalks. The stripping bars, commonly found on combines gathering units, also require more careful driving than the picker snapping rolls to keep losses down.[1]

As corn weathers in the field, some ears drop before harvesting, but the machine is responsible for most of the ears dropped. A light blow by the gathering unit will knock off a mature ear before it is gathered in. Figures 74 and 75 show that date of harvest as well as moisture content influence the amount of lodging. Delayed field drying led to a higher ear loss caused by a greater amount of lodging.

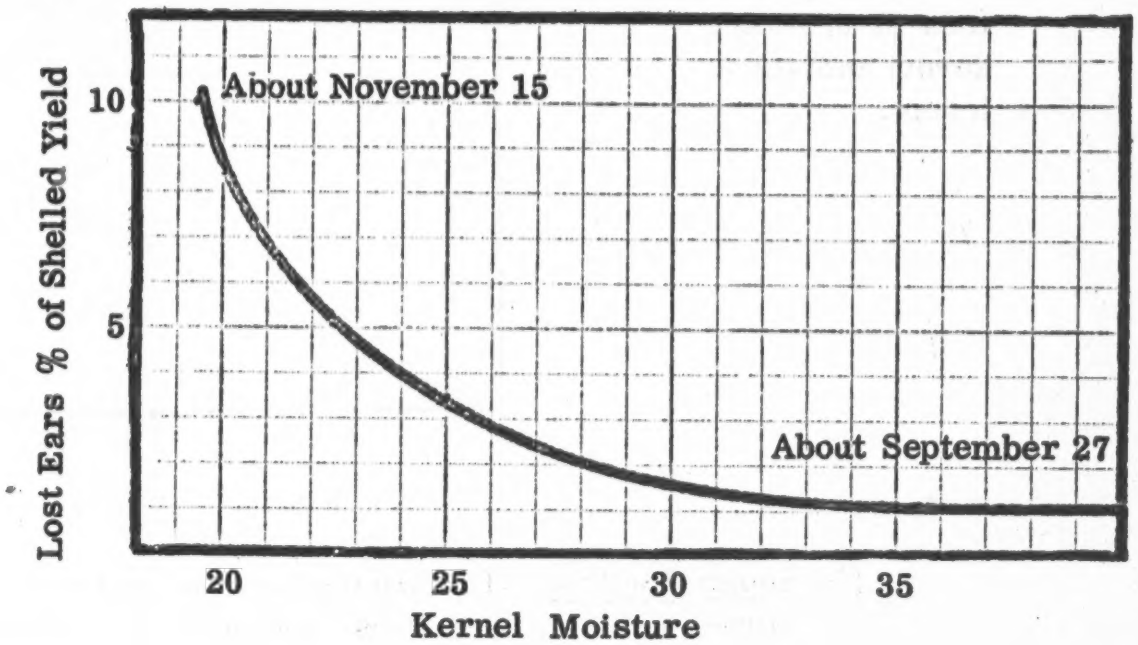


Figure 74

Late season harvesting results in increased loss of ears. (Wooster)

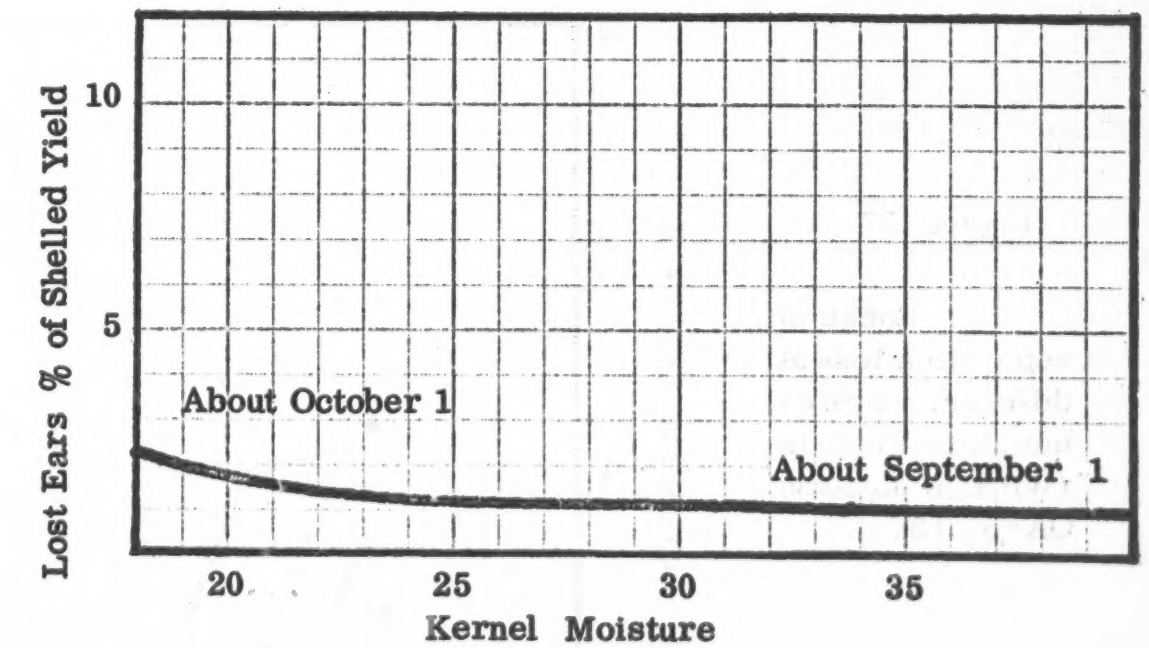


Figure 75

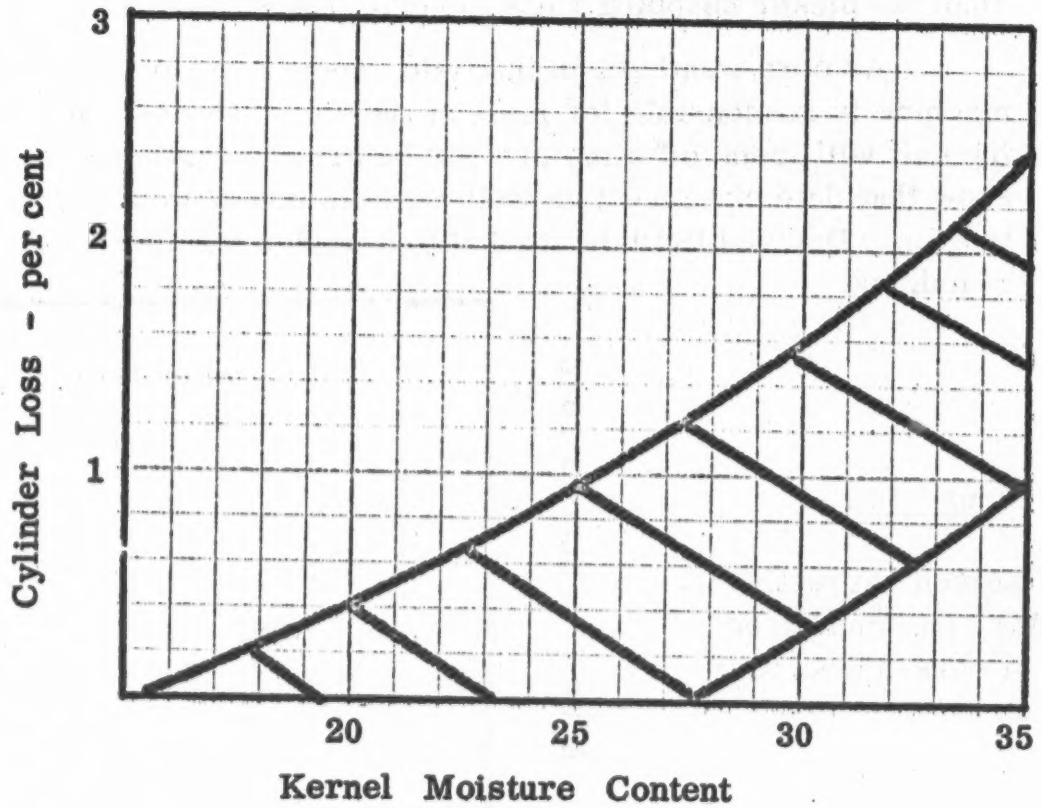
Early season harvesting resulted in less loss of ears. (Columbus)

1. Byg and others, ibid., p. 3.

(4) Cylinder loss. The cylinder loss increases as the amount of kernel moisture increases. (Figure 76) This loss can be recognized by the kernels left on the cob. It is possible through proper adjustment to keep the cylinder loss under one per cent.

Figure 76

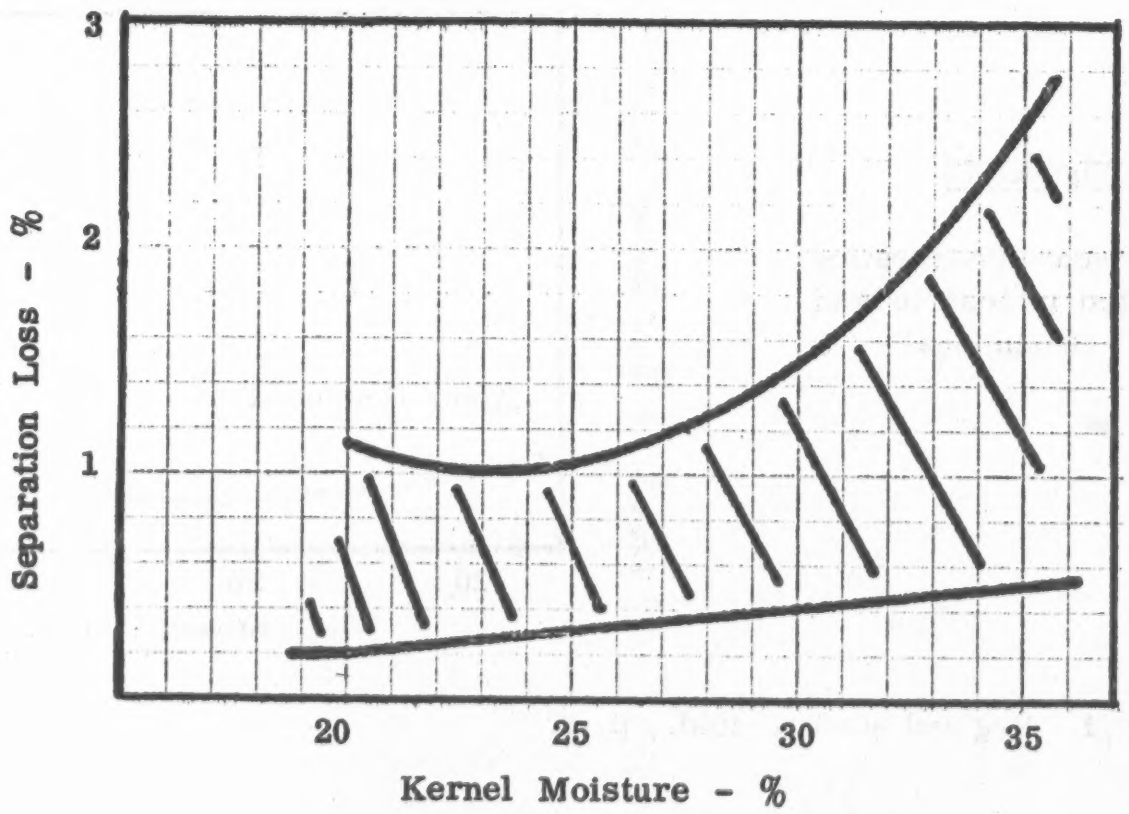
Range of cylinder loss at different kernel moisture levels.



(5) Separation loss. The separation loss increases as the amount of kernel moisture increases. (Figure 77) This loss can be recognized by the amount of loose kernels passing through the machine.

Figure 77

Range of separation loss at different kernel moisture levels. (William Johnson, OAES, 1964.)



(6) Test Weight Per Bushel. The market price of corn may be affected by the test weight per bushel. Tests show that generally high moisture corn tests lighter than dry corn due to moisture and kernel damage. (Figure 78) See Figure 3, page 3, to determine approximate market discounts for corn.

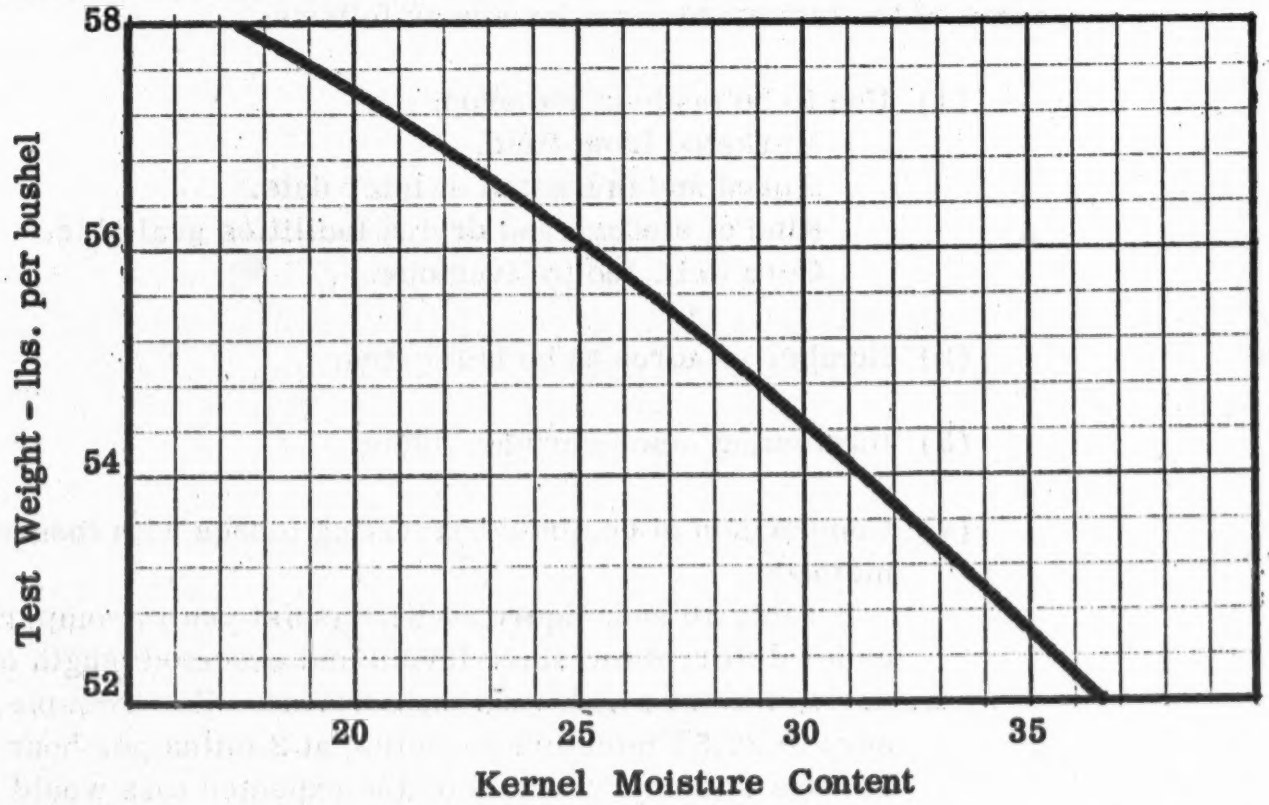


Figure 78. High moisture corn has a lower test weight per bushel. (Test weight observed after corn from field has been dried to 15 1/2 per cent moisture.)

(7) Cracked kernels.
Tests show that kernel damage will be increased when high moisture corn is combined. (Figure 79) For the effect of kernel damage on market price of corn see Figure 3, page 3.) Kernels with cracks in the seed coating will not keep in storage as well as sound kernels. Weevils are more of a problem and air for drying will not flow freely through damaged kernels.

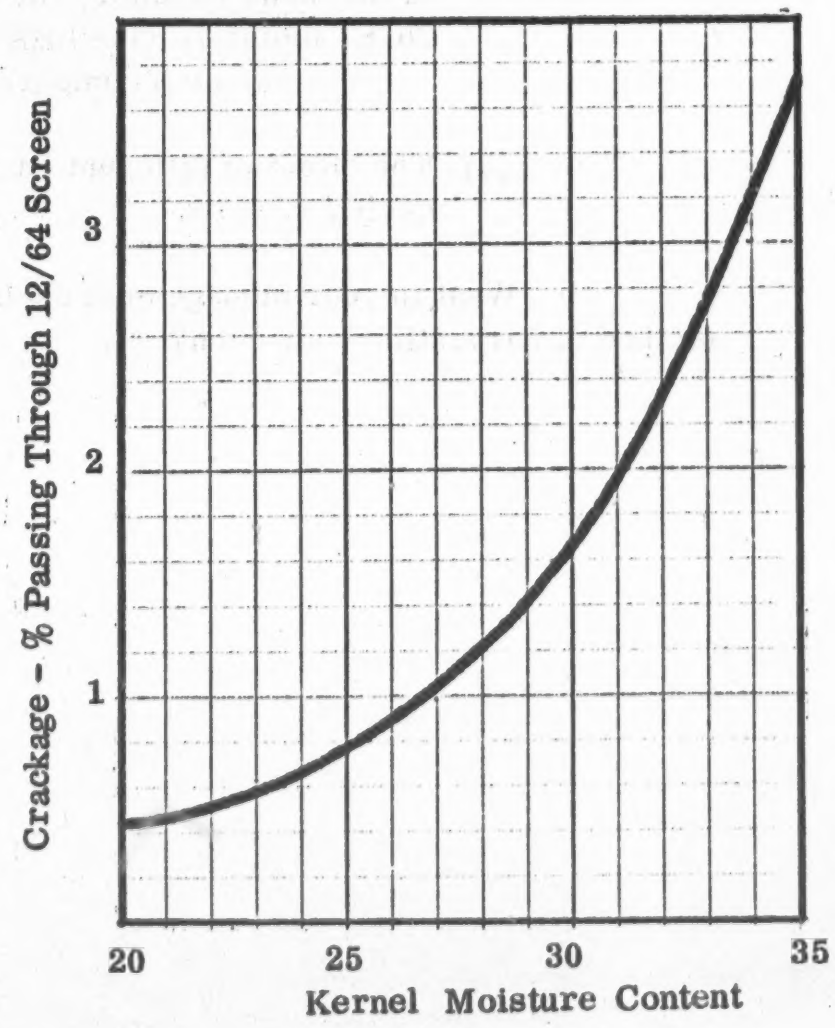


Figure 79. Kernel damage increases when corn is combined at high moisture content.

Student Exercise: Farmers are faced with the management decision of whether to use the combine in harvesting their corn or to use another method. Using the information presented here and other reliable sources decide whether or not you should use the combine in harvesting your corn crop.

Some of the factors to consider are as follows:

(1) Use to be made of the crop:
Marketed from field.
Stored and marketed at later date.
Kind of storage and drying facilities available.
Corn to be fed to livestock.

(2) Number of acres to be harvested.

(3) Harvesting machinery available.

(4) Comparison of combine harvesting losses with losses from other methods.

Table 10 and Figure 80 will assist you in comparing the losses under different moisture levels and expected length of harvest period for the picker and the combine. For example, if you pick corn at 27.5% moisture traveling at 2 miles per hour and require 21 days to complete the job, the expected loss would be 6.7% of the total yield. Under the same conditions of time and moisture the expected combine loss would be 7.3% of the total yield. If, in the same example, picking was delayed until the corn reached 20.8% moisture, the loss would be 13.8% of the total yield.

You can also compare losses at 2 m.p.h. and 5 m.p.h.

(5) The effect of different harvesting methods on market and storage quality of corn.

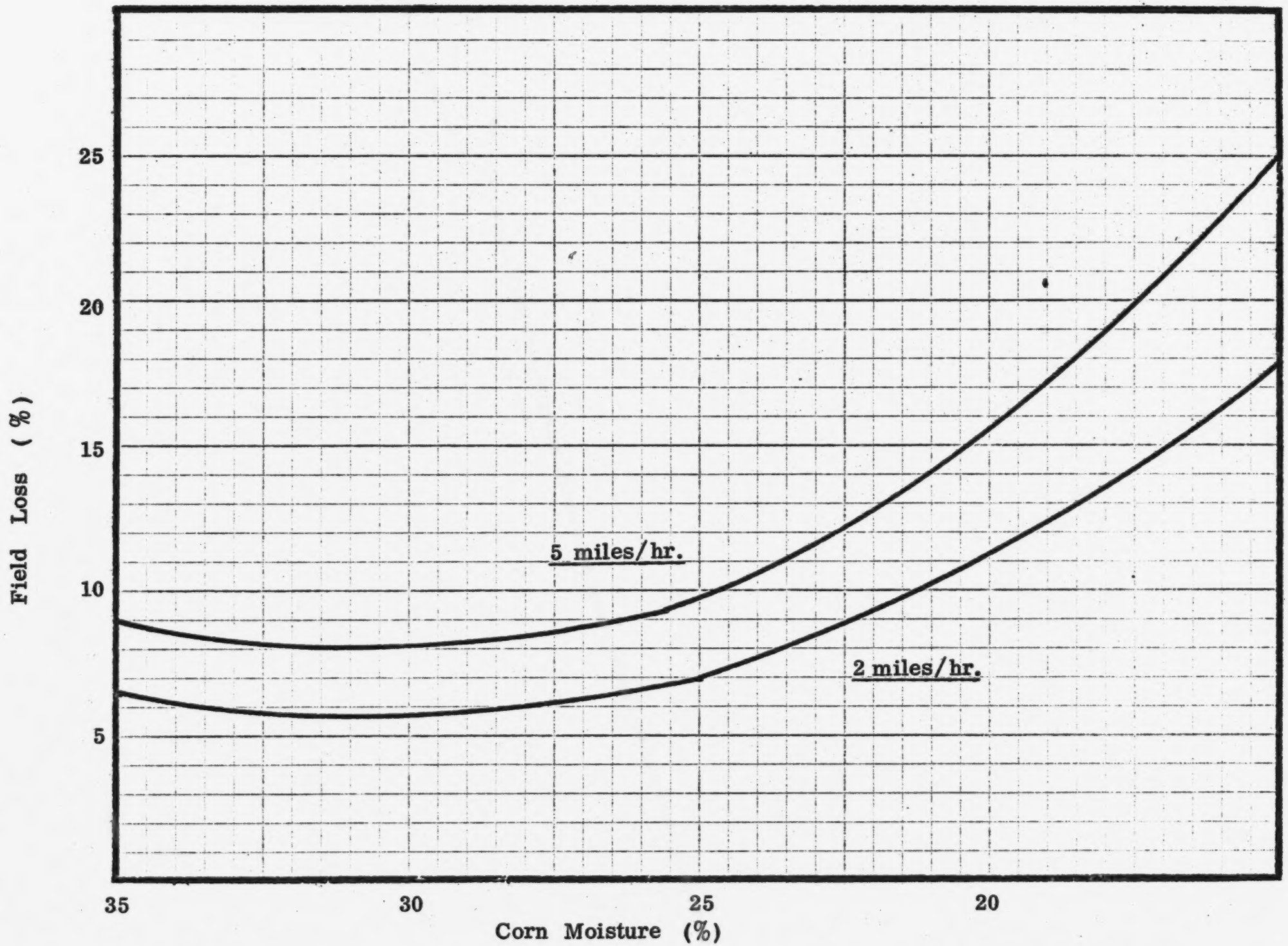
What is your management decision, and why did you decide on this method of harvesting your corn?

Table 10. Average total field losses of corn as a percentage of gross corn yield, by length of the harvest period and moisture content at the beginning of harvest

Length of harvest, days	Moisture at beginning of harvest, %						
	35.0	33.0	30.2	27.5	25.1	22.9	20.8
	Average field losses, % of gross corn yield						
	Picker at 2 mi. per hour						
9	3.2	3.2	3.9	5.2	7.1	9.4	11.8
13	3.3	3.4	4.0	5.7	7.7	10.0	12.4
17	3.4	3.6	4.6	6.2	8.3	10.6	13.1
21	3.5	3.8	5.0	6.7	8.9	11.2	13.8
25	3.8	4.1	5.4	7.3	9.4	11.9	14.5
29	4.1	4.5	5.9	7.8	10.0	12.5	15.3
	Picker at 5 mi. per hour						
9	4.8	4.7	5.6	7.6	10.3	13.5	16.9
13	4.9	4.9	6.1	8.3	11.1	14.4	17.8
17	5.0	5.2	6.6	9.0	11.9	15.2	18.6
21	5.2	5.6	7.2	9.7	12.8	16.1	19.6
25	5.6	6.1	7.9	10.5	13.6	16.9	20.5
29	6.0	6.6	8.6	11.3	14.4	17.9	21.5
	Combine at 2 mi. per hour						
9	6.5	6.2	6.1	6.4	7.4	9.2	11.3
13	6.4	6.2	6.2	6.7	7.9	9.7	11.8
17	6.3	6.2	6.3	7.0	8.3	10.3	12.3
21	6.3	6.2	6.4	7.3	8.8	10.8	12.9
25	6.3	6.3	6.7	7.7	9.3	11.3	13.4
29	6.3	6.4	7.0	8.2	9.8	11.8	14.0
	Combine at 5 mi. per hour						
9	8.3	8.0	7.9	8.5	10.1	12.7	15.5
13	8.2	8.0	8.0	8.9	10.8	13.4	16.1
17	8.1	8.0	8.2	9.4	11.5	14.1	16.8
21	8.1	8.0	8.5	10.0	12.2	14.8	17.6
25	8.1	8.2	8.9	10.5	12.8	15.5	18.3
29	8.3	8.4	9.4	11.2	13.5	16.2	19.1

Prepared by William H. Johnson, Department of Agricultural Engineering, The Ohio Agricultural Experiment Station.

Figure 80 Relation of Moisture and Date of Harvest to Average Field Loss of Corn With Combine Under Ohio Conditions.



Ohio Agricultural Experiment Station

Byg, D. M., Gill, W. E., Extension Agricultural Engineers, The Ohio State University.

Corn Harvesting

OPERATIONAL AIDS

Condition \ Cause	Not Driving in Center of Rows	Ground Travel Too Fast, *Too Slow	Front End of Corn Head Too High	Snouts Not Free to Float	Snapping Rolls Too Loose, *Too Tight	Stripper Plates Too Wide, *Too Close	Gathering Chains Too Wide at Front	Gathering Chains Too Loose	Stripper Plates Too Close at Front	Stalks Too Green -- Moisture High	Gathering Chains Too Close at Rear	Broken Snapping Roll Tension Spring	Snapping Rolls Worn	Foreign Matter in Roll Tension Spring	Snapping Rollsclips Worn or Missing	Plugging Over Rolls	Cylinder Speed Too High, *Too Low	Engine Speed Too High, *Too Low	Rack Speed Too High	Excessive Tailings Return	Walkers Plugged	Chaffer Sieve Opening, Too much,*Too little	Improper Air Direction	Air Amount Too Much, *Too little	Concave Clearance, Too great,*Too little	Tailing Gate Too High, *Too low	Bottom Sieve Open Too Far
Leaving Ears in Field	x	x x*	x	x	x		x																				
Stalks Not Entering Stripper Plates	x	x				x*	x	x																			
Plugging over Snapping Rolls		x			x	x*				x	x	x	x	x	x												
Shelling at Snapping Rolls		x	x		x	x										x											
Losing Corn Over Rack		x								x							x	x	x	x	x						
Losing Corn Over Shoe		x																x x*				x*	x	x x*		x*	
Sieves Plugging																	x					x	x	x*	x*		
Corn Kernels Still on Cob		x								x							x*								x		
Excessive Cracking										x							x			x					x*	x	
Unclean Grain in Tank										x												x	x	x*	x*		x

Figure 81. Corn Harvesting Condition Operational Aids.

IV. ECONOMICS OF OWNING A COMBINE.

References for additional study: "Crop Economics for Ohio," Bulletin 423 and "Farm Custom Rates," Leaflet 74, Agricultural Extension Service, The Ohio State University.

If you are a grain farmer you will be faced with the following problem: Should I own my combine or hire a custom operator to harvest my grain? In solving this problem you will need to keep two things in mind.

1. How many acres of all grain crops will I be harvesting? The more acres you harvest the lower your cost per acre will be when you own your combine.

2. How long would I need to wait for a custom operator? Harvesting losses increase rapidly after the best date for combining has passed.

A. What are the costs of combining?

It is easy to determine the charge per acre for custom combining. If you do not know the usual rate for your area call some local custom operator for their prices or refer to the Farm Custom Rates bulletin.

It is much more difficult to determine the cost per acre for combining when you own your own machine. Your costs of combining can be divided into the following three areas:

1. The overhead or fixed cost of owning the machine. These are costs you have whether you use your machine or not. They are as follows:

a. Depreciation
b. Interest on the invested capital
c. Taxes
d. Insurance

2. The variable or operating costs. These costs largely depend on the amount of use given the machine during the year. They include the following items:

a. Fuel
b. Lubrication
c. Repairs
d. Operator's labor

3. Risk-loss from delayed harvesting. This cost will only appear when you must wait for the custom operator to do your combining. (Refer to section III of this publication.)

B. Determining the cost of owning and operating a combine.

The following example will help you in figuring how much it will cost you to own and operate a combine on your farm.

Example: A farmer has 40 acres of soybeans, 40 acres of oats, and 20 acres of wheat to harvest each year. He has been using a custom operator to harvest these crops and has found that on the average he has to wait about five days beyond the best time to combine for the custom operator to do his work. He has priced a twelve foot, 70 horsepower gasoline engine driven self-propelled combine and found that the model he needs costs $7,000. Should he continue using a custom operator or should he buy the new machine? How can he determine which decision to make?

Procedure for estimating the cost of owning the combine:

Step 1. Determining the overhead costs.

a. Annual depreciation:

$$\frac{\text{Purchase price } \$7,000}{\text{Expected life} \ldots 10 \text{ years}} = \text{annual depreciation } \underline{\$700.00}$$

b. Annual interest:

$$\text{Interest rate 8\% short term} \times \frac{\text{Purchase Price } \$7,000}{2} = \text{Annual interest on capital invested } \underline{\$280.00}$$

c. Annual personal property tax: (This is an average figure. Check the local rates when figuring your situation.)

Purchase Price $7,000 x 30% = $2,100.00 Assessed value.

Assessed Value $2,100.00 x 3% = Annual Property Tax $63.00.

d. Annual Insurance:

$$\text{Purchase Price } \frac{\$7,000.00}{2} = \$3,500.00 \text{ Average Value}$$

$$\text{Average Value } \frac{\$3,500.00}{100} \times \$.40 \text{ (rate per \$100)} = \text{Annual Insurance } \underline{\$14.00}$$

Total Overhead Costs $1057.00

Step 2. Determining Variable Costs.

The actual variable costs cannot be accurately determined without records of these items of expense. However, few farmers would have these detailed records available. The figures used in this illustration to estimate costs have been taken from the University of Illinois farm management studies.

a. Fuel costs: Motors normally require about .07 gallons of gasoline or .05 gallons of diesel fuel per horsepower hour of operation. Hours of use can be estimated by using the following table from Ohio Bulletin 423, "Crop Economics in Ohio."

Time Used for Combining in West Central Ohio

Job Done	Size of Tractor Used[1]	Man Hours Used per acre[2]	
		Average	Range for Middle Half of Farms
Combine with 5-foot combine	2,3	.95	.97-1.27
Combine with 6-foot combine	2,3	.85	.72-1.05
Combine with 7-foot combine	2,3	.75	.65- .95
Combine with 10-foot combine	SP[3]	.46	.38- .59
Combine with 12-foot combine	SP	.42	.36- .50

R. H. Blosser, "Crop Economics for Ohio," The Ohio State University.

1. Stated in number of plows tractor is rated to pull.
2. Unless otherwise stated, number of tractor and machine hours used per acre is same as number of man hours used.
3. Self-propelled.

Maximum drawbar horsepower 70 x .07 gasoline or .05 diesel x price of fuel $.20 x 42 hours* = fuel cost $41.16

*100A x .42 hr. per A = 42 hrs. use.

b. Lubrication Costs: Oil costs about 10 per cent of the total fuel cost and grease about 3 per cent of the total fuel cost making a total of 13 per cent of fuel costs for lubrication charges.

fuel cost $41.16 x 13% = lubrication cost $5.35

c. Repair Costs: Repair costs are caused by deterioration, rust, accidental breakage, and wear. They do not depend entirely on the amount of use given a machine and usually increase as the machine ages. An average charge per year is 4 per cent of the purchase price of the combine.

purchase price $7,000 x 4% = annual repair charge $280.00

d. Operator's Labor:

hours per acre .42 x 100 acres x $1.50 per hr. = labor costs $63.00

Total Variable Costs $389.51

Step 3. Determining Total Cost Per Year:

Overhead Costs ..... $ 1057.00
Variable Costs ..... $ 389.51
Annual Cost of Owning Combine ..... $ 1446.51

Step 4. Determining Average Cost Per Acre for Combining:

$$\frac{\text{Annual Cost of Owning Machine } \$1446.51}{\text{Number Acres Harvested } 100 \text{ acres}} = \$14.46 \text{ Cost Per Acre}$$

This is the actual cost per acre based on the situation used in this example and will change as any of the factors in the example change. The figures for the factors in your situation will be different from those used here.

Step 5. Comparing Cost of Owning a Combine With the Custom Rate:

My cost per acre when I own my combine is $_____
The custom rate per acre in my community is $_____

The extra cost of custom combining due to crop loss caused by delay beyond the best harvest date is not figured here. You may obtain information that will help you in estimating your probable losses due to delayed harvesting be referring to Section III of this publication.

Some additional factors to consider before deciding to buy a combine or hire a custom operator are as follows:

a. Timeliness of operation. What will be the loss in yield and quality if the time of the crop is delayed?
b. Does the custom worker have the ability to do a satisfactory job of combining?
c. Do I have the mechanical ability to operate a combine efficiently?
d. How does owning a combine fit into my overall farm plan? (Labor supply, crops raised, long time farm plan.)
e. Can I reduce my cost by joint ownership?
f. Will a used machine meet my needs?
g. Is it possible to lease a combine when I need one?
h. Is adequate repair service available in my community?
i. Will the combine become obsolete before I have it paid for or worn out?
j. Could I use the money I would invest in the combine to a better advantage elsewhere in my business ? (Opportunity cost.)
k. If I purchase the combine do I have the financial ability to pay for it? (Debt load, repayment ability, capital resources.)
l. Would I have time to do custom work?

Step 6. Determining the Number of Acres of Annual Use of a Combine to Justify Owning a Machine:

The more acres combined per year, your own as well as custom work, the lower the overhead cost per acre will be. The following formula will help you in determining the number of acres of annual use required to cover the overhead cost of owning the machine:

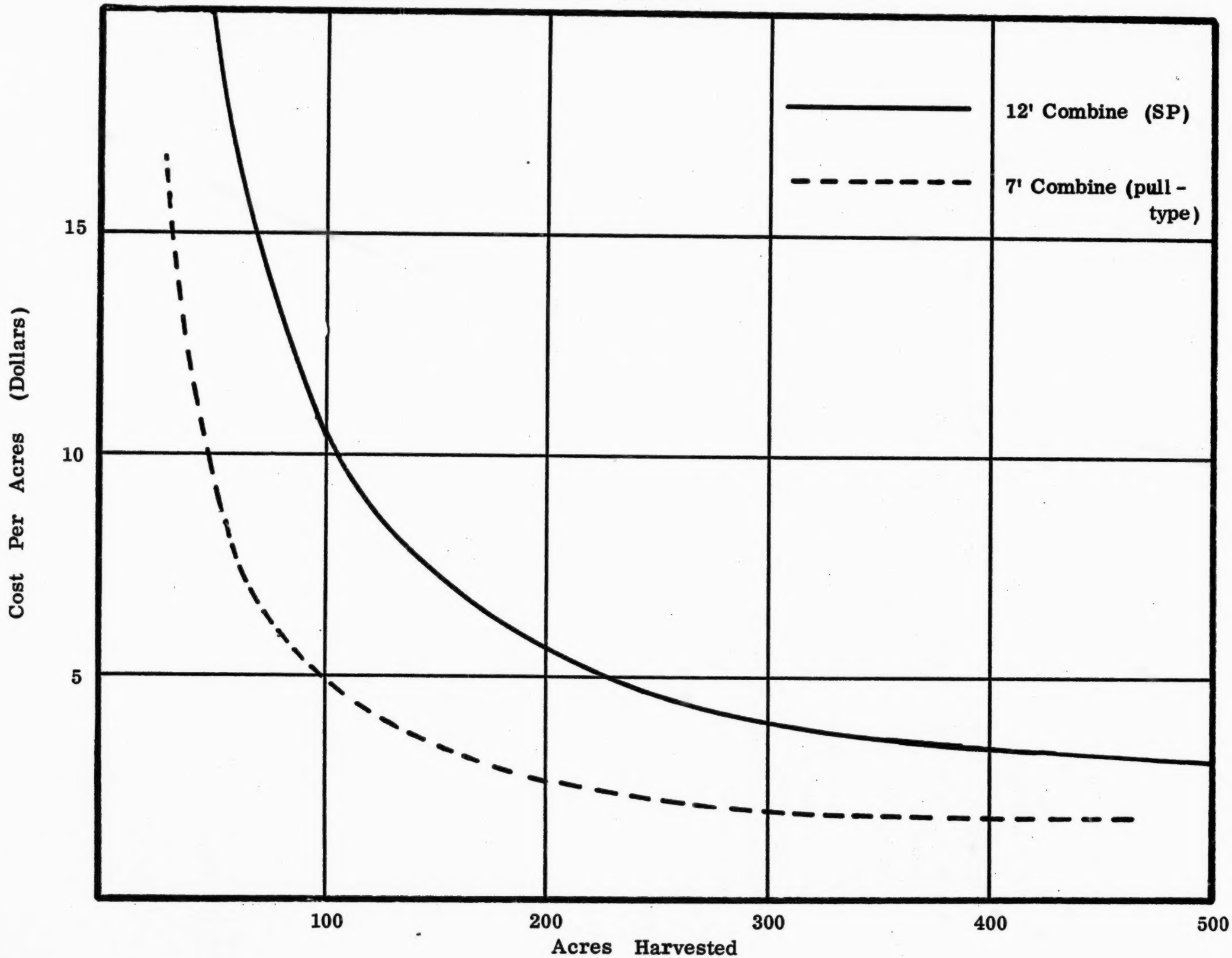
$$\frac{\text{Annual Overhead Cost } \$\,1,057.00}{\text{Custom Rate } \$500 - \text{Variable Cost/A } \$3.89} = \text{Number of acres combining required to break even } 952\text{ A}$$

As the difference between custom rates and variable costs per acre becomes smaller more acres must be harvested to make the overhead cost per acre comparable to custom rates.

Farm management studies show that high overhead costs result in low profits on many farms. The procedures explained in the example above can serve as a guide in determining the overhead costs involved in owning a given combine for harvesting your crops. For a more detailed study of the effect of overhead costs on profits see Part V, Analysis of the Farm Business, page 55, of the publication, "Farm Records - A Management Tool," available from the Ohio Vocational Agriculture Instructional Materials Service.

The cost per acre of combining is shown graphically for a 7 foot pull-type and a 12 foot self-propelled combine in Figure 82. A study of this chart will give you a rough estimate of whether or not you can afford to own a combine. Figure 82 was adapted from "Crop Costs and Returns," B 909, Ohio Agricultural Experiment Station, 1962.

Figure 82. Combining costs decline as acreages increase.



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ORGANIZATION AND MANAGEMENT OF MACHINERY DEALERSHIPS

One of Sixteen Modules in the Course Preparing for Entry in

AGRICULTURAL MACHINERY - SERVICE OCCUPATIONS

Module No. 1

The Center for Research and Leadership Development

in Vocational and Technical Education

The Ohio State University
980 Kinnear Road
Columbus, Ohio, 43212

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United States Office of Education

August, 1965

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Appropriate School Setting Post high school
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Occupational Focus Agricultural machinery service occupations
Geographic Adaptability Nationwide
Uses of Material Instructor course planning
Users of Material Teachers

(4) Requirements for Using Material:
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Student Selection Criteria Post high school, mechanical aptitude, high school background, goal in agricultural machinery service occupation.
Time Allotment Estimated time listed in module. (P)

Supplemental Media --
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Desirable ____ (Check Which)

Describe Suggested references given in module. (P)

Source (agency)
(address)

ORGANIZATION AND MANAGEMENT OF AGRICULTURAL MACHINERY DEALERSHIPS

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1. Instructor's Name _____

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_____Ornamental Horticulture--Service Occupations
_____Agricultural Machinery--Service Occupations

4. Name of module evaluated in this report _____

5. To what group (age and/or class description) was this material presented? _____
_____

6. How many students:
   a) Were enrolled in class (total) _____
   b) Participated in studying this module _____
   c) Participated in a related occupational work experience program while you taught this module _____

7. Actual time spent teaching module:

		Recommended time if you were to teach the module again:
_____hours	Classroom Instruction	_____hours
_____hours	Laboratory Experience	_____hours
_____hours	Occupational Experience (Average time for each student participating)	_____hours
_____hours	Total time	_____hours

(RESPOND TO THE FOLLOWING STATEMENTS WITH A CHECK (✓) ALONG THE LINE TO INDICATE YOUR BEST ESTIMATE.)

	VERY APPROPRIATE	NOT APPROPRIATE
8. The suggested time allotments given with this module were:	___.___.___.___	
9. The suggestions for introducing this module were:	___.___.___.___	
10. The suggested competencies to be developed were:	___.___.___.___	
11. For your particular class situation, the level of subject matter content was:	___.___.___.___	
12. The Suggested Teaching-Learning Activities were:	___.___.___.___	
13. The Suggested Instructional Materials and References were:	___.___.___.___	
14. The Suggested Occupational Experiences were:	___.___.___.___	

(OVER)

15. Was the subject matter content sufficiently detailed to enable you to develop the desired degree of competency in the student? Yes_____No_____
Comments:

16. Was the subject matter content directly related to the type of occupational experience the student received? Yes_____No_____
Comments:

17. List any subject matter items which should be added or deleted:

18. List any additional instructional materials and references which you used or think appropriate:

19. List any additional Teaching-Learning Activities which you feel were particularly successful:

20. List any additional Occupational Work Experiences you used or feel appropriate:

21. What do you see as the major strength of this module?

22. What do you see as the major weakness of this module?

23. Other comments concerning this module:

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ORGANIZATION AND MANAGEMENT OF AGRICULTURAL MACHINERY DEALERSHIPS

Major Teaching Objective

To develop an understanding of the organization and management of agricultural machinery dealerships

Suggested Time Allotments

At school		
Class instruction	18 hours	
Laboratory experience	0 hours	
Total at school		18 hours
Occupational experience		0 hours
Total for module		18 hours

Suggestions for Introducing the Module

A person planning to work in the service occupations of an agricultural machinery dealership must understand the organization and management of the dealership if he is to be effective as a service employee. He must understand (1) the importance of the local dealership and the agricultural machinery industry to the agricultural industry of the community, nation, and world, (2) the relationship of the local dealership to the farmer and the parent organization, (3) the ways the local dealership carries out its business, (4) the jobs and job functions of employees in the local dealership, and (5) show the relationship of farming to merchandise handled by the dealership. A local agricultural machinery dealer expects his employees to be able to do their jobs with a high degree of speed and efficiency. In order to meet these expectations, the employees must have a thorough knowledge of the complete operation of the business.

The techniques to use in creating interest in the module are:

1. Tour a local agricultural machinery dealership emphasizing the availability of modern equipment and the variety of services provided by the dealer.

2. Thought questions

   a. What is a retail agricultural machinery dealership?

   b. What is meant by "dealership"?

   c. How is an agricultural machinery dealership organized?

d. What do people do who work in these dealerships?

e. How is a local agricultural machinery dealer able to provide these services for the farmer?

3. Point out that approximately fifty per cent of the employment appointments are in the service occupations of the agricultural machinery industry.

Competencies to be Developed

1. To understand the importance of the retail agricultural machinery industry

Teacher Preparation

Subject Matter Content

Agricultural machinery dealers have played a vital role in the social and economic life of those engaged in production agriculture as well as the standard of living of all people.

1. They have provided the farmer with efficient and economic production tools.

2. Modern agricultural machinery has lowered the costs of production for the farmer. The following table bears out this fact.

Farm Output and Labor and Machinery Inputs
Index 1947-49 = 100

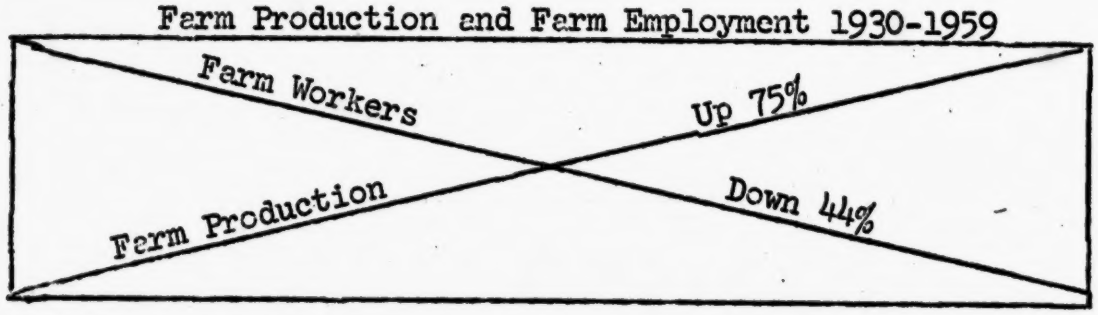
(Indices)

Year	Farm Output	Farm Labor	Power and Machinery	Labor Plus Machinery	Relation of Combined Labor and Machinery Inputs to Output
1910	61	135	28	163	133
1920	70	143	44	187	133
1930	72	137	55	192	133
1940	82	122	58	180	110
1950	101	90	118	208	103
1955	113	76	136	212	94
1956	114	72	137	209	92
1957	114	68	138	206	93
1958	124	66	137	203	84
1959	126	64	139	203	81

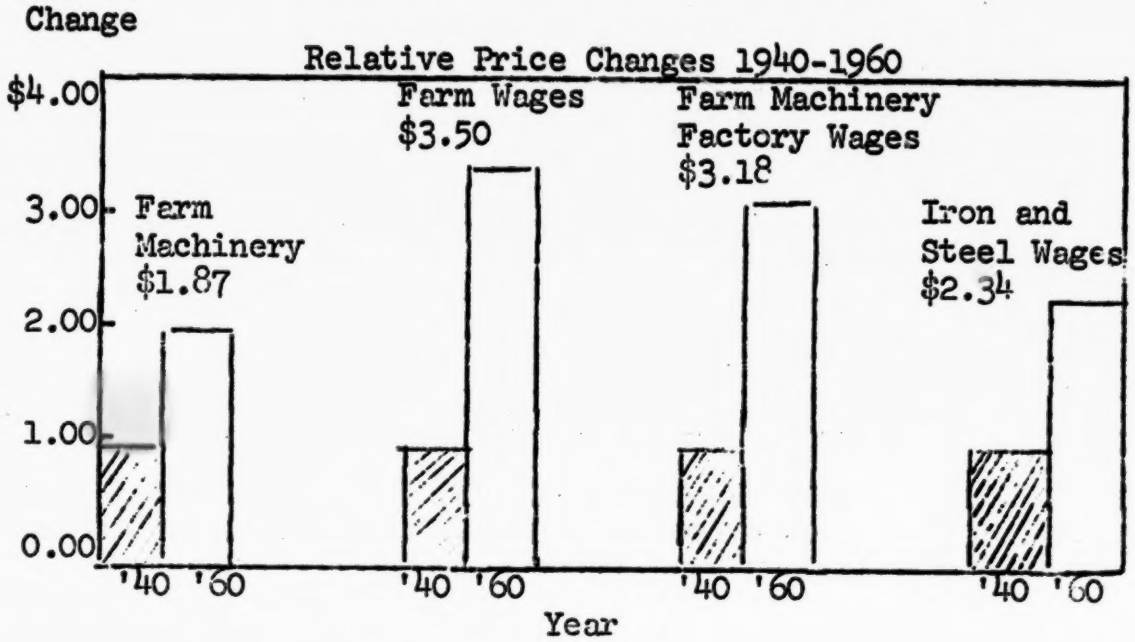
The use of agricultural machinery has promoted an increase in farm production and income in spite of a decrease in the number of persons employed on the farm.

1. While farm workers have decreased in number, farm production has increased.

Farm Production and Farm Employment 1930-1959



2. The agricultural machinery industry has managed to keep its price rise on production costs relatively low.



3. Fifty years ago one farmer could produce food and fiber for 6 other persons, whereas today, that same man can produce food and fiber for at least 29 others.

4. Today, 40 per cent of the farms produce 87 per cent of the food and fiber sold from the farms.

The use of modern agricultural machinery has aided in raising the standard of living of the farmers.

1. Today farmers have more time for recreation, more conveniences, better educational advantages and improved facilities.

2. The investment in agricultural machinery is highest on farms in states having the highest standard of living.

3. The development and use of labor saving machines have made it possible for millions of farm workers to enter other industries, the arts, sciences, and professions.

Suggested Teaching-Learning Activities

1. Bring a local farm machinery dealer before the class to discuss his role as an agricultural machinery dealer in the community.

2. Using the latest census, have each student identify the number of farms in the county, state, and nation and the number of tractors and agricultural machines on these farms.

Suggested Instructional Materials and References

Instructional Materials

Overhead transparencies of the table and graphs presented

References

S*Farm and Power Equipment Retailers Handbook, pages 1-7.

*The symbol T (teacher) or S (student) denotes those references designed especially for the teacher or for the student.

II. To understand the methods of distributing agricultural machinery

Teacher Preparation

Subject Matter Content

The distribution of agricultural machinery follows this route: from manufacturer - to dealers - to customers. All orders for machines by the local dealership are placed with the branch house.

The above pattern of distribution accounts for practically the entire output of domestic sales of tractors and other agricultural machinery.

The primary function of the manufacturer is to supply the agricultural machinery needed by the agricultural industry.

1. Manufacturers employ competent product engineers to design the new machines needed by the agricultural industry.

2. Manufacturers supply the branch houses with the parts and some machines to supply their dealers.

In addition to performing these functions, the manufacturer does the following:

1. Keeps in touch with machinery problems and needs of farmers

2. Through research, develops machines and systems to meet the needs of the farmer

The function of the branch house is to move the machinery from the factories to the farms in the most economical manner.

1. The branch house provides storage for the manufacturer.

2. The task of sales and distribution for the manufacturer is undertaken by the branch house.

3. Through this medium, the manufacturer gets national distribution more quickly and more thoroughly.

4. Retail dealers get more prompt and reliable service.

5. As the manufacturer's distributive agent, the branch house keeps the manufacturer advised on market conditions and needs of a particular area.

6. The branch office lowers substantially the manufacturer's handling cost of agricultural machinery and ultimately the farmers' purchasing costs.

7. The branch house buys parts in large quantities, relieving the manufacturers of the details of selling, warehousing, shipping of merchandise to individual dealers, and carrying of dealer accounts.

8. The branch house carries adequate stocks of repair parts at strategic locations, resulting in better service to the dealer, and thus the customer.

The distributor (branch house) builds a good dealer's organization and confines all his efforts to selling through dealers.

1. The distributors organization includes a service department with personnel who thoroughly understand the servicing of each machine handled.

2. A well developed program of selling is maintained by the distributor who aids the dealer in realizing a greater profit through better service to the customer.

The local agricultural machinery dealer is the vital link in this distribution pattern.

1. The dealer is the final link between the manufacturer and the user of the machine.

2. The dealer contributes greatly to the farmer's knowledge of machinery servicing.

3. He demonstrates the efficiency of the company machines to the farmer and explains how the machine can benefit the farmer.

4. He extends credit in many cases to the farmer so the machine can pay for itself in labor saved or money earned.

5. The dealer makes an effort to understand farm machinery problems and the need of the farmer and conveys these needs back to the manufacturer to provide a basis for improvement of farm machines through research.

Suggested Teaching-Learning Activities

1. Have a branch house employee discuss with the class how parts or machines are supplied to the branch house and from the branch house to the dealer.

2. Tour a branch house.

Suggested Instructional Materials and References

Instructional Materials

1. Overhead transparencies and mimeos on the organization of a major line of agricultural machinery

2. Overhead transparencies and mimeos showing the pattern of distribution of agricultural machinery

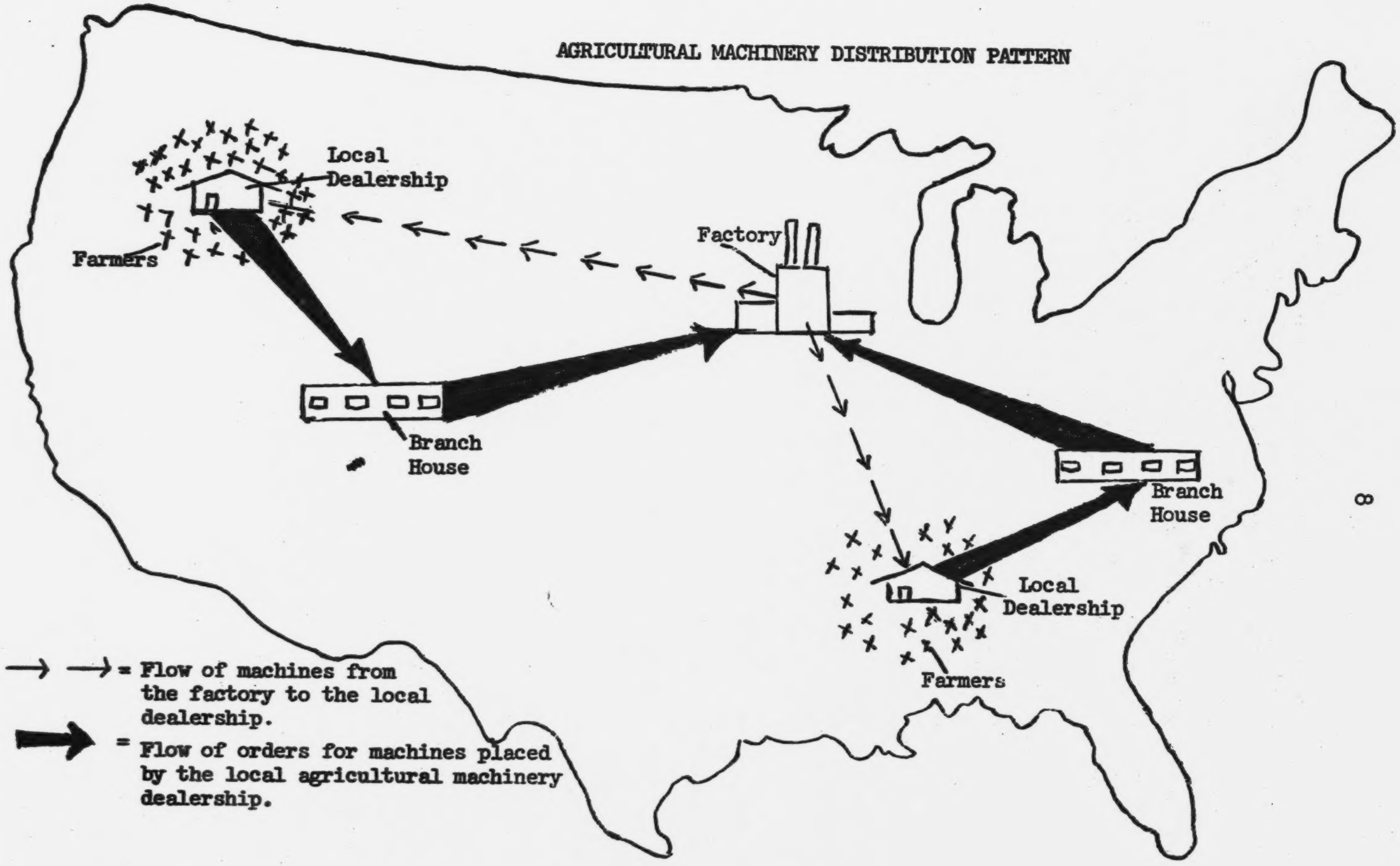
References

S Farm and Power Equipment Retailers Handbook, pages 7-21.

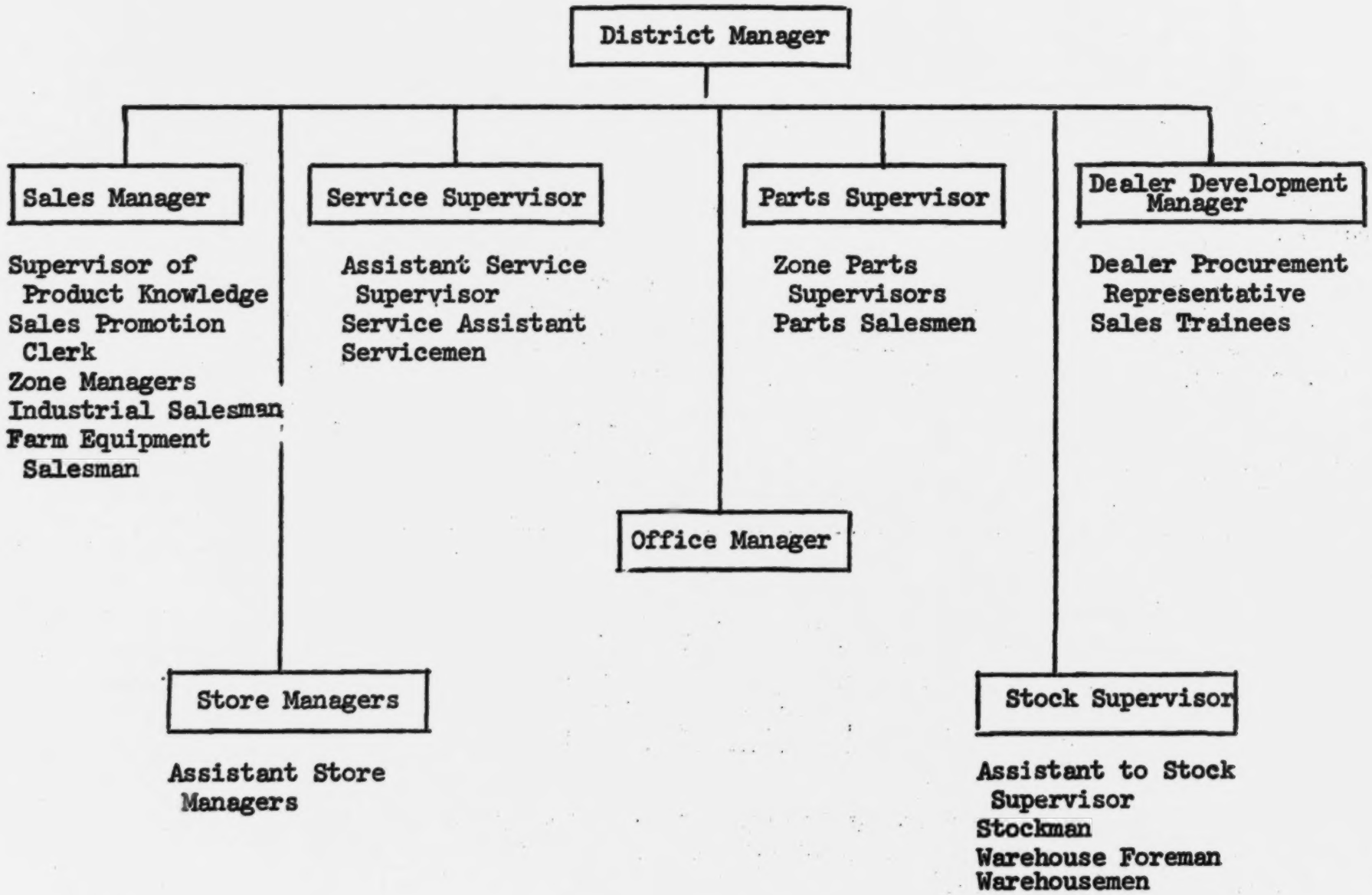
Suggested Occupational Experiences

If the class is being conducted in an area close to a branch house, each student should be required to spend a week observing and taking part in the operating of the service and parts department in the branch house.

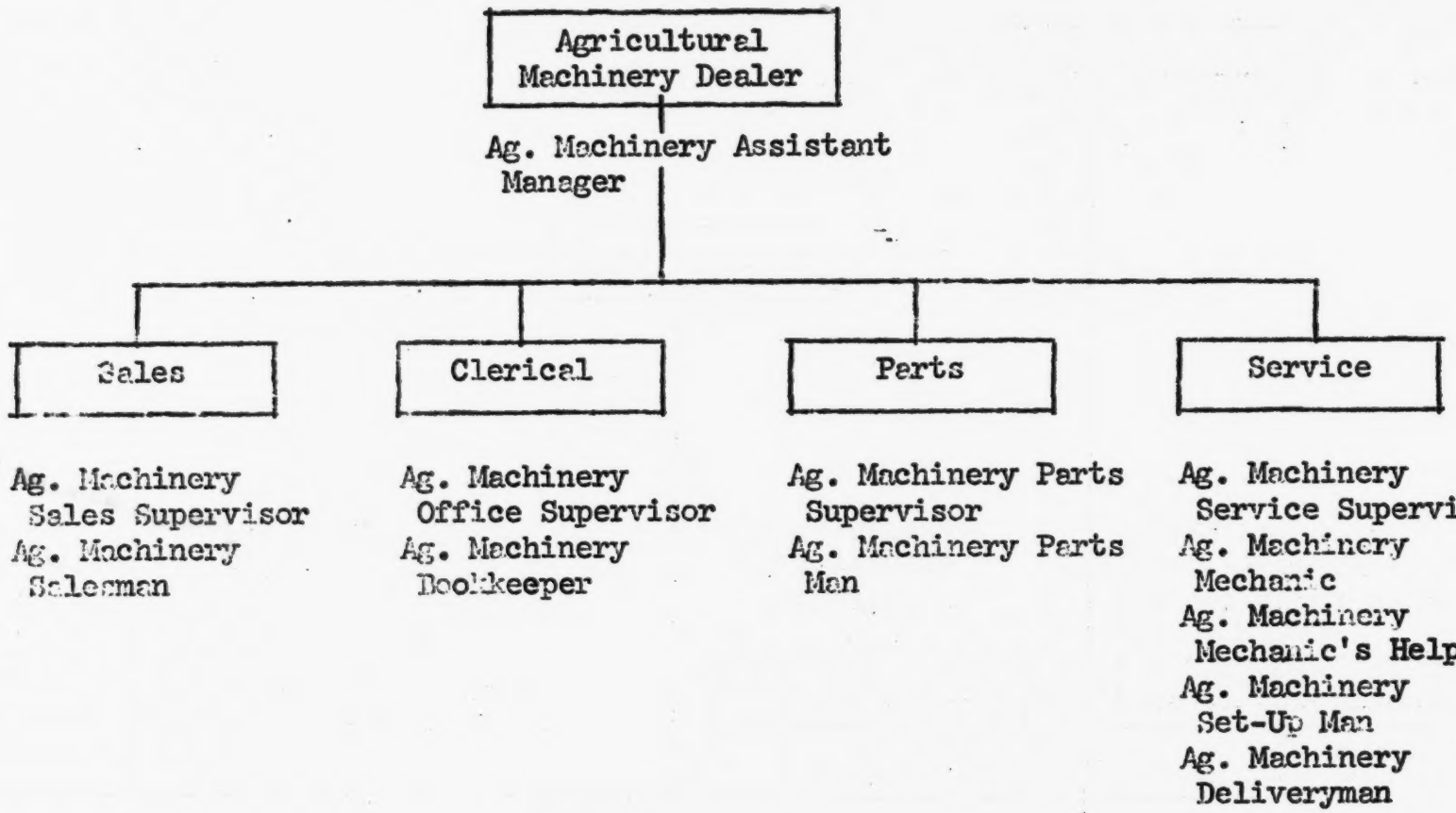
AGRICULTURAL MACHINERY DISTRIBUTION PATTERN



An Example of the Organizational Structure of a Major Line Agricultural Machinery Branch House



Organizational Structure of a
Local Agricultural Machinery Dealership



III. To understand the jobs and job functions in the organization of the local agricultural machinery dealership

Teacher Preparation

Subject Matter Content

The operation of the agricultural machinery dealership is divided into five areas.

1. Management
2. Sales
3. Clerical
4. Parts
5. Service

The nature of the work carried out in each area is determined by its function in the operation of the total business.

People in each area are employed with specific responsibilities.

1. Management

   Determine company policies
   Exercise financial control over the business
   Select, train and supervise employees
   Forecast and plan future company business
   Direct customer and employee relations
   Promote sales
   Coordinate jobs

2. Sales

   a. Sales Supervisor

      Directs sales work
      Directs sales records
      Promotes sales
      Trains sales employees
      Assists in job coordination

   b. Salesman

      Finds prospective buyers
      Conducts demonstrations

Appraises used machinery
Closes sales
Makes financial arrangements for customer to purchase machinery
Maintains sales room
Follows up past sales

3. Clerical

a. Office Supervisor

Directs record keeping
Directs office procedures
Directs collections
Directs payments
Checks financial standing of potential customers

b. Bookkeeper

Posts books
Directs depository funds
Writes orders and letters
Prepares payroll
Writes contracts
Assists in closing books

4. Parts

a. Parts Supervisor

Directs ordering and selling of parts
Selects parts employees
Trains parts employees
Maintains inventory control
Maintains catalogues and price lists
Plans merchandising programs

b. Parts Man

Dispenses shop parts
Dispenses customer parts
Maintains parts inventories
Checks inventories
Maintains price catalogue
Constructs displays
Maintains parts identification

5. Service

a. Service Supervisor

Directs personnel
Selects and trains personnel
Maintains service records
Advises on service problems
Inspects repair jobs
Directs machinery storage
Schedules machinery assembly
Prepares delivery orders
Directs delivery

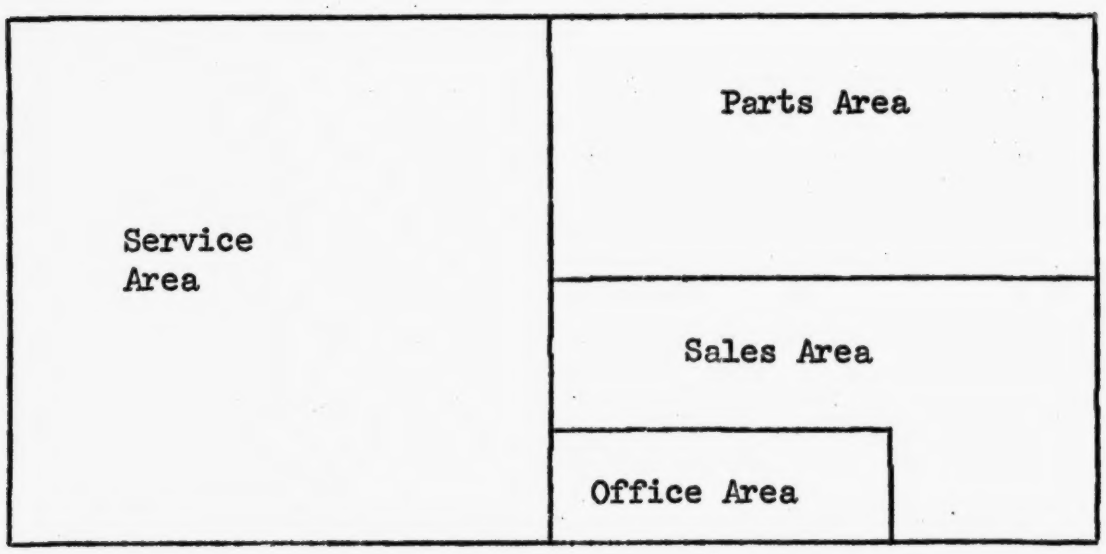
b. Mechanic

Makes general repairs
Handles field repairs
Conducts special operations
Reconditions trade-ins
Makes pre-delivery checks
Maintains demonstration units
Services rolling stock
Maintains shop equipment

c. Set-up and Deliveryman

Picks up and receives new machinery
Assembles new machinery
Delivers and starts machinery

These areas have well-defined limits in which to operate in the dealership.



Suggested Teaching-Learning Activities

1. Tour a local agricultural machinery dealership to observe the five areas of operation in the dealership.

2. Have each student visit a local dealership and prepare a detailed floor plan of the facility.

3. Have each student interview a parts man and a service man to understand their jobs. The student should present a written and oral report of his interview.

Suggested Instructional Materials and References

Instructional Materials

1. Mimeo of the activities of each area in the dealership

2. Overhead transparencies of the organization of a local agricultural machinery dealership and the floor plan of the dealership included in this module

3. Floor plans of local agricultural dealerships for use with the class at the time the areas are discussed

References

S Farm and Power Equipment Retailers Handbook, pages 74-76 and 251-256.

Suggestions for Evaluating Educational Outcomes of the Module

The following criteria should be used to evaluate the educational outcomes of this module:

1. Student interest in the module

2. Extent to which class assignments are carried out

3. The quality of the written and oral reports

Source of Suggested Instructional Materials and References

Wilson, L. W. Farm and Power Equipment Retailers Handbook, 1964. National Farm and Power Equipment Dealers Association, 2340 Hampton Avenue, St. Louis, Missouri. Price: $7.50.

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AGRICULTURAL MACHINERY SERVICE DEPARTMENT OPERATING PROCEDURES

One of Sixteen Modules in the Course Preparing for Entry in
AGRICULTURAL MACHINERY - SERVICE OCCUPATIONS

Module No. 2

The Center for Research and Leadership Development
in Vocational and Technical Education

The Ohio State University
980 Kinnear Road
Columbus, Ohio, 43212

The development of these materials was supported by a grant
from the
Division of Adult and Vocational Research
United States Office of Education

August, 1965

VT 00489

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(Address) 980 Kinnear Road, Columbus, Ohio 43212

DATE: August 4, 1967

RE: (Author, Title, Publisher, Date) Module No. 2, "Agricultural Machinery Service Department Operating Procedures," The Center for Vocational and Technical Education, August, 1965.

Supplementary Information on Instructional Material

Provide information below which is not included in the publication. Mark N/A in each blank for which information is not available or not applicable. Mark P when information is included in the publication. See reverse side for further instructions.

(1) Source of Available Copies:
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Limitation on Available Copies No Limit Price/Unit $ 7.50/set
(quantity prices)

(2) Means Used to Develop Material:
Development Group National Task Force
Level of Group National
Method of Design, Testing, and Trial Part of a funded project of the USOE, OE-5-85-009; materials based on research from state studies; see preface material in the course outline.

(3) Utilization of Material:
Appropriate School Setting Post high school
Type of Program General post high school class in agricultural machinery
Occupational Focus Agricultural machinery service occupations
Geographic Adaptability Nationwide
Uses of Material Instructor course planning
Users of Material Teachers

(4) Requirements for Using Material:
Teacher Competency Background in agricultural machinery
Student Selection Criteria Post high school, mechanical aptitude, high school background, goal in agricultural machinery service occupation.
Time Allotment Estimated time listed in module. (P)

Supplemental Media --
Necessary x
Desirable ____ (Check Which)

Describe Suggested references given in module. (P)

Source (agency)
(address)

AGRICULTURAL MACHINERY SERVICE DEPARTMENT OPERATING PROCEDURES

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AGRICULTURAL MACHINERY SERVICE DEPARTMENT OPERATING PROCEDURES

Major Teaching Objective

To develop (1) an understanding of the operating procedures of an agricultural machinery service department and (2) the ability to carry out the functions of a service employee.

Suggested Time Allotments

At School		
Class instruction	30 hours	
Laboratory experience	36 hours	
Total at school		66 hours
Occupational experience		96 hours
Total for module		162 hours

Suggestions for Introducing the Module

The service department is an integral part of the agricultural machinery dealership. It, along with the parts department, is one of the main customer attractions to the dealership and is often the only department within the dealership with which the customer does business regularly. To the agricultural machinery dealer, the service department is the dealer's master salesman. The service department keeps the customer "sold" by reselling him time and time again on the dependability of the dealer's entire establishment. A good job of repairing, diagnosing trouble, and servicing agricultural machinery sells new and used goods for the future.

A person preparing for employment as a service department employee must understand thoroughly the function of the service department and the procedures employed in carrying out its business. He must understand dealership layout and equipment requirements, service selling, work scheduling and job ticketing procedures, service pricing, pre-delivery and delivery servicing, and warranty allowances.

Some activities to stimulate interest in the module are as follows:

1. Tour a local agricultural machinery service department, emphasizing the equipment and facilities used by service employees and the services rendered to customers. Have the local dealer make a comparison between the dollar volume of his service department and that of his equipment sales division.

2. Have a farmer speak to the class on the importance of the service department and the service he expects from the agricultural machinery service department.

Competencies to be Developed

I. To develop an appreciation of the importance of the service department and the role service employees play in the total operation of the dealership

Teacher Preparation

Subject Matter Content

A good, well-managed service department builds the business of the dealership.

1. Efficient service brings customers in contact with new and used equipment and thus increases sales.

2. An efficient, dependable service department establishes dependable customers.

3. The service department attracts trade by developing customer confidence in the dealership.

Labor is the commodity sold in the service department of an agricultural machinery dealership.

1. It is bought and sold in the same manner as new and used equipment and repair parts.

2. Every job performed in the service department is a sale of labor.

3. Every minute spent by a mechanic or set-up man in the service department must be accounted for as either gain or loss.

4. Efficiency in the service department requires highly organized management with rigid control of the labor force and work to be done.

The service department is a very important segment of the total agricultural machinery dealership operation.

1. Service department labor revenue in the average agricultural machinery dealership accounts for five to seven percent of the total sales volume. Small as the figure is, in many cases it may make or break the dealership.

2. Relationships between the dealer and customer depend on efficient service department work.

Efficient service department labor does more than repair machines.

1. It develops customer confidence in the whole dealership.

2. It enables a dealer to hold his customers.

The following items have been identified as the chief factors causing inefficient service department operation:

1. Poor working conditions

2. Lack of common tools, special tools, and cleaning facilities

3. Inconvenience in obtaining replacement parts

4. Frequent interruptions of the work schedule

5. Lack of product service knowledge

6. Lack of planning and coordination by the chief mechanic or foreman

7. Lack of apprentices in training to replace retiring workers or to permit dealership expansion.

Competent personnel is the key to successful service department management.

1. A serviceman with low productivity ties up as much space and tooling equipment as a good serviceman. The efficiency, and, ultimately the profit possibilities, of such an employee are low.

2. Poor work turned out by service personnel in a dealership spoils customer confidence in the dealership and sends the customer elsewhere for service.

3. Through time allocated by the manager of the local agricultural machinery dealership, the skill level of the service department employee can be raised by his local manager's sending him to company-sponsored service schools.

A competent service department employee must be well-acquainted with his job responsibilities and capable of performing them with a high degree of speed and accuracy. He will be required to perform a variety of activities. He must be able to do the following:

1. Make general repairs on all agricultural machinery.
2. Handle agricultural machinery repairs on the farm
3. Make pre-delivery checks on all new machines.
4. Re-condition machines taken in trade-in
5. Pre-service demonstration units.
6. Take care of the service area and equipment
7. Maintain excellent customer relations.

Efficient service employees display the following personal attributes:

1. A pleasing personality
2. Courtesy when dealing with customers and other employees
3. A thorough knowledge of farm machinery
4. Dependability
5. Good, neat work habits
6. An aptitude for diagnosing machinery problems and making necessary corrections
7. Loyalty toward the dealership

The shop supervisor is directly responsible for conducting an efficient, orderly service department. His functions include:

1. Directing service personnel activities in the shop
2. Supervising, instituting, and scheduling mechanics training programs
3. Supervising housekeeping in the service department

4. Following the progress of each job assigned to each mechanic

5. Inspecting and checking work completed by the mechanics

6. Seeing that all new tractors and other new equipment are prepared properly before delivery to the customer

7. Directing the repairs and maintenance of all machines brought in by customers

8. Overseeing the re-conditioning, repairing, and handling of all used or traded-in pieces of equipment

9. Supervising the installation of additional attachments or equipment on new tractors and other machinery

10. Inspecting and recommending corrective measures for machinery being used by the customer while he is in the service department

11. Analyzing product problems, taking corrective action, and exerting control on warranty expenses

12. Referring employee problems to the management, in order to create better employer-employee relations

The degree of success the service department supervisor has in carrying out the above activities depends on his ability to lead and direct those who are working under him.

The service supervisor should exert leadership in the following ways:

1. Treat employees with consideration.

2. Be fair but firm.

3. Set a good example for other service personnel to follow.

4. Take his work seriously.

5. Make other people feel important.

6. Have drive, but do not drive other people.

7. Maintain loyalty to the dealer.

8. Like people and be friendly.

9. Be a good listener and welcome suggestions.

Suggested Teaching-Learning Activities

1. Show charts (as overhead transparencies, if possible) pertaining to the responsibilities of a service employee and shop supervisor.

2. Have each student develop a list of the functions carried out by an employee in each of the job classifications in the service department.

3. Bring an agricultural machinery dealer to the class to speak on the role of the service department in his dealership.

4. Bring a service employee to the class to explain his job responsibilities.

5. Set up interrogating panels composed of class members to quiz both the dealer and the service employee.

6. Have students visit an agricultural machinery dealership and observe the activities carried out in the service department.

7. Have students talk with farmers at the dealership about their machinery problems.

Suggested Instructional Materials and References

Instructional Materials

Overhead transparencies

References

S* 1. Farm and Power Equipment Retailer's Handbook, Pages 395-399.

S 2. Management Course in Dealer Service Operations, Section III, pages 1-6.

S 3. Service Center Management, Personnel Section, Pages 1-3.

*The symbol T (teacher) or S (student) denotes those references designed especially for the teacher or for the student.

II. To understand service department layout and equipment requirements

Teacher Preparation

Subject Matter Content

The service department uses the largest amount of floor area in the agricultural machinery dealership. (Refer to Farm Power and Equipment Retailer's Handbook, pages 74-76.)

All the space allotted to the service department must be properly used to produce maximum profits for the dealership.

A well-laid-out service department usually has the following features:

1. Accessibility to all equipment and service areas
2. A good floor pattern for work being done in the service department
3. Work stalls that are sufficiently large and well-equipped to handle jobs coming into the service department
4. Areas large enough to service large equipment, such as combines
5. Good use of natural light
6. Work rooms for performing special jobs, such as paint room and diesel tune-up area
7. Service equipment located in areas where it can be easily used
8. Easy access to the parts department
9. A handy loading and unloading area, including a dock
10. Suitable clean-up facilities for employees
11. A service supervisor's desk and library area

Various service department layout patterns are used by agricultural machinery dealers. These patterns emphasize service department efficiency by making maximum use of the space available in the department. The following patterns are commonly used by agricultural machinery dealerships:

1. "U"-shaped
2. "O"-shaped
3. "T"-shaped
4. "I"-shaped
5. "L"-shaped

(See Service Center Management, page one, for examples.)

In the service department, specific well-defined areas are used to conduct certain service department activities. The areas are:

1. Work stalls
2. Welding area
3. Steam cleaning and painting area
4. Light workroom
5. Tool storage area
6. Parts cleaning area
7. Supervisor's desk area, which includes the library for the service department

(See Management Course in Dealer Service Operations, Section IV, page 5; and Farm and Power Equipment Retailer's Handbook, pages 442-448, for examples of the above.)

An efficient service department usually contains the following pieces of large equipment:

1. High and low speed grinders
2. Valve grinder
3. Air compressor
4. Steam cleaner
5. Drill press
6. Dynamometer

7. Industrial welder

8. Oxyacetylene welder

9. Painting equipment

10. Hydraulic press and puller set

In addition to the heavy equipment listed above, the well-equipped service department includes many smaller specialized tools and pieces of equipment. (See Farm and Power Equipment Retailer's Handbook, pages 436-440, for a suggested list of tools and equipment.)

Suggested Teaching-Learning Activities

1. Present to the class several local dealership building layouts, emphasizing the space used by the service department.

2. Present several patterns of service department layouts, emphasizing the areas in which the various service department activities are conducted.

3. Have the class visit a local agricultural machinery dealership and draw up a detailed floor plan of the service area arrangements with location of equipment. Have the supervisor of the service department discuss alternative and/or ideal service layouts with which he would like to work.

4. Have students find out the replacement value of the machines used in a service department of an agricultural machinery dealership.

5. Have some students visit other machinery dealerships individually to draw up floor plans of service area arrangements and location of equipment. Students should present the floor plans to the class for analysis of their differences and similarities and, ultimately, their efficiency.

Suggested Instructional Materials and References

Instructional Materials

1. Transparencies or plans of local dealership building layouts

2. Transparencies of service department layouts

3. Drawing materials for the student to make detailed drawings of service departments

References

1. Farm Power and Equipment Retailer's Handbook, pages 74-76, 436-499.

2. Service Center Management, Service Center Layout Section, pages 1-3.

3. Management Course in Dealer Service Operations, Section IV, pages 1-10.

III. To understand the selling of service

Teacher Preparation

Subject Matter Content

The commodity for sale in the service department of an agricultural machinery dealership is labor.

Selling labor through service to the customer is the same as selling a tractor or piece of machinery. The customer must be made aware of the services available to him through the service department and the advantages of buying such service.

The customer purchases service from the agricultural machinery dealership for several reasons.

1. Inability to perform service jobs for himself because of lack of knowledge or skill

2. Lack of time to make repairs and/or needed adjustments on machinery

3. Belief that work done by trained, experienced persons will save money

In order to sell service, the dealer must follow these rules:

1. Take the initiative and ask farmers when they can spare the equipment for two or three weeks during slack periods of work.

2. Have a good sales-minded service supervisor supported by mechanics with good local reputations.

3. Have a completely equipped, clean, and well-arranged shop.

4. Use local advertising media to supplement personal calls to induce farmers to bring in repair work.

5. Charge reasonable rates.

6. Provide enough room in shop, tool, and paint rooms.

7. Maintain efficient work schedules.

The responsibility for developing and directing programs for selling service rests with the service department supervisor.

1. It is one of the activities normally associated with his job.

2. The selling program set up by the service department supervisor is aimed at preventive maintenance. It should

   a. Identify sources of trouble and mechanical failure.

   b. Inform the farmer about costs and inconveniences caused by such trouble or failure.

   c. Present authentic and up-to-date information about corrective and preventive maintenance of agricultural machinery.

   d. Inform customers of their potential problems and ways of solving them in the service department.

   e. Present a plan of action to correct or prevent machinery problems.

   f. Have a budget on which to operate and a schedule for advertising and promotion.

A variety of advertising media is used by agricultural machinery service supervisors in carrying out the above program.

1. Newspapers

2. Radio and T.V.

3. Direct mail advertising

4. Service sales through the sales department

5. Retail sales of parts and accessories

6. Displays

7. Customer days

8. Service specials

(See references listed for further information on each of the above.)

Successful service selling campaigns depend primarily on the following factors:

1. Proper timing

2. Use of a personalized approach in selling

3. Constant advertising throughout the year

4. Effective use of all advertising media

5. Ability of service department employees to carry out the services advertised

A very important, but often overlooked, item in selling service is maintaining a clean, neat, and attractive service department.

1. It enables service employees to do their best work, improves their efficiency, and raises their morale.

2. It impresses regular and prospective customers with the efficiency of the service department.

3. It develops customer confidence in the dealership.

Suggested Teaching-Learning Activities

1. After discussion of content materials in class, bring a service department supervisor to class to discuss service selling with the class. Use a questioning panel to stimulate discussion after his talk.

2. Have each student interview an above average farmer in the community to find out how often he takes his machinery to the local agricultural machinery dealer for repair, adjustment, and tune-up. Have each student report his findings to the class. As the reports are given, identify the common services used by all farmers.

3. Have each student select a shop item and set up advertisements using the following media: the newspaper, radio, direct mail, displays, and service specials.

4. Have students make a list of the ways they have seen agricultural machinery services advertised.

5. Invite a person from an advertising firm to discuss advertising of agricultural machinery with the class.

Suggested Instructional Materials and References

Instructional Materials

1. Materials for use in setting up service department displays

2. Sample advertisements of service selling from newspapers, radio, direct mail and service specials

References

1. Service Center Management, Selling Service Section, pages 1-5.

2. Management Course in Dealer Service Operations, Section IV, pages 1-3.

3. Farm and Power Equipment Retailer's Handbook, pages 408-411.

Suggested Occupational Experiences

1. Have students prepare displays of services in local dealerships.

2. In cooperation with a dealer and a local radio announcer, write a script for a spot announcement advertising services available at the agricultural machinery dealership.

3. Have students select a special service offered by a dealership and set up and direct a complete sales campaign for it.

IV. To understand work scheduling and job ticketing procedures in agricultural machinery dealerships

Teacher Preparation

Subject Matter Content

Scheduling service department work on an efficient, systematic basis is of utmost importance to the success of the department's operation. It is necessary to know what time is available at all times in order to schedule and complete service work quickly.

The service supervisor is responsible for seeing that time is used wisely. He uses a serviceman's schedule, which provides the following information:

1. Each service employee's number
2. Open hours on a daily basis
3. Forecast of work on a weekly basis

This schedule is valuable in exposing inefficiency in service department operation.

1. The service department supervisor can review the work schedule of each employee and check his progress.
2. The supervisor can check the progress of the entire department in terms of the goals set up for the week.
3. He can use the schedule to keep work available at all times and avoid time waste.
4. He can use it to schedule the right man for the right job, such as a skilled mechanic to overhaul a Diesel tractor, and a mechanic's helper to put new brushes in a generator.

   (See references for examples of service department work schedules.)

The final and perhaps most important step in completing work in the service department is filling out the job ticket.

Often, important items don't get charged to the customer as a result of negligence on the part of the service employee who did the work. The job ticket provides the following information which should be carefully recorded when the customer brings the machine to the service department and immediately after the work on that machine has been completed:

1. Customer's name, address and phone number

2. Method of payment for work done in the service department-cash, charge, no expense

3. Complete description of the work to be done on the machine

4. Customer's signature authorizing the work to be done

5. Machine model, chassis, serial number, engine number, etc.

6. New parts put on the machine and their costs

7. Outside labor and materials used in repairing the machine and their costs

8. Amount of oil and grease used

9. Amount of labor and its cost

(For an example of the job ticket above, refer to Service Center Management reference.)

Service employees must complete job tickets with the utmost care. One of the biggest losses of profits in the service department results from incomplete charges on the job ticket.

The daily time ticket is used by dealers to determine accurately the amount of time spent by service employees in doing the work scheduled.

1. It provides the manager with a daily payroll form, if needed.

2. It provides the service employee with a daily summary to check his gross earnings if he is paid on an hourly or flat rate basis.

3. It provides the dealer with information to check the efficiency of his pricing system.

When a repair order describing the work to be performed is handed to the mechanic, the bottom perforation should be filled out showing

1. The repair order number
2. The operator number or description
3. The mechanic's number or name
4. The time the work was started and completed

When the daily time ticket is completed, it is glued to the back of the job ticket. The second copy goes to the service supervisor, and the third copy is kept by the service employee.

Suggested Teaching-Learning Activities

1. Set up examples of work scheduling situations and have each student schedule the work to be done. Provide him with a service department floor plan to use as he works out the work schedule. Have the student consider the following when setting up the schedule:

   a. Number of service employees

   b. Space available in the service department to carry out the work to be scheduled

   c. Time requirements necessary to carry out the work to be scheduled

2. Set up examples of jobs which have been completed in the service department and have the students complete a job ticket on each job.

Suggested Instructional Materials and References

Instructional Materials

Work schedule forms and job tickets used by major agricultural machinery companies

References

1. Service Center Management, Scheduling Work and Job Tickets Sections.

2. Management Course in Dealer Service Operations, Section VII, pages 1-6.

Suggested Occupational Experiences

1. Supervise students in scheduling work to be done in the service department using required forms.

2. Assign each student a job to complete, such as installing new electric wiring on a tractor. Have him fill out a job ticket before starting the job, and a daily time ticket after completing it.

3. Send students on simple service calls. Have them complete field service reports upon return and give them to the service supervisor.

V. To understand service pricing

Teacher Preparation

Subject Matter Content

Two methods of pricing service work are used by agricultural machinery dealerships.

1. By the hour

2. By the job (flat rate)

Three factors are considered by agricultural machinery dealers in determining the price to charge for service work.

1. The costs involved in completing the job and the margin the dealer must charge to break even or show a profit on the job

2. The amount that should be charged to cover labor costs

3. The competition the dealer faces from other dealer service departments

Hourly service pricing is a predetermined charge per hour for the actual time to complete the work on the customer's machine.

1. This method requires a fixed hourly rate for services rendered.

2. The rate established by the dealer must cover the cost of the serviceman's time and operating and overhead costs. (See Farm and Power Equipment Retailer's Handbook, page 429, for examples of hourly rates.)

Flat rate pricing is based on the job instead of the time spent.

1. The price for the job is based on a time allowance predetermined for the job.

2. Job time is converted to service selling price by multiplying the average hours allowed by the service labor charge rate.

3. Pricing by the job encourages efficiency by emphasizing the number of jobs completed rather than the time to complete each of them.

Flat rate pricing has these advantages over hourly pricing:

1. Quick and easy estimating
2. One fair price for industrial jobs
3. Fairer prices on interrupted jobs
4. Jobs priced at their true value
5. Incentive to reduce job time
6. Recovery of tool investment
7. Fairer basis for paying service employees
8. Minimum supervision
9. Reduction of misunderstandings
10. Aid in promoting service
11. Aid in trade-in deals

12. Standardized basis for warranty

13. Increased shop earning capacity

Flat rate pricing schedules for use by agricultural machinery service departments in pricing service jobs have been developed and are available from Implement and Tractor Publications, Inc., and from the major line company offices. These sources of flat rate information give the following information:

1. The job number

2. A description of the job

3. Estimated time required to complete the job

4. Suggested price to charge the customer for work completed on each piece and make of machinery

The service employee should thoroughly understand when and how to use the flat rate manual when pricing service by flat rate.

Suggested Teaching-Learning Activities

1. Using a local dealership as an example, if possible, have students compute the total cost of operating a dealership service department and the hourly charge rate necessary to break even or make a profit. Use as reference page 6 in the Service Center Management Manual.

2. Have the student compare the cost of doing a job in the service department as computed by the hourly and flat rate methods.

Suggested Instructional materials and References

Instructional Materials

Implement and Tractor Flat Rate Manual

References

1. Farm and Power Equipment Retailer's Handbook, pages 427-435.

2. Service Center Management Manual, Flat Rate Section, pages 1-7.

3. Implement and Tractor Flat Rate Manual.

Suggested Occupational Experience

Have students price service jobs as they leave the service department. Have them compute the price both by the hourly and flat rate methods.

VI. To understand pre-delivery and delivery servicing

Teacher Preparation

Subject Matter Content

Pre-delivery and delivery servicing of agricultural machinery is a function of the agricultural machinery service department.

1. Proper pre-delivery and delivery service develops good customer relationships and builds customer confidence in the dealership.

2. The dealer has the satisfaction of knowing that each machine has been properly checked and is in top working condition when the machine is delivered to the customer.

3. Proper pre-delivery and delivery servicing prevents misunderstandings between the customer and the dealer that could arise because of incorrect operating and maintenance procedures on the farm.

It is important that service employees follow specific procedures when performing pre-delivery servicing and delivering new agricultural machinery. These procedures fall into specific areas of activity.

1. Receiving

2. Warehousing and storage

3. Preparing for delivery

4. Delivery

(See Service Center Management Manual for activities to be carried out in each area.)

Agricultural machinery is sent to the local agricultural machinery dealership in small units to lower freight costs, and to allow for limited storage space at the dealership.

Agricultural machinery dealers order their supply of tractors and other machinery well in advance of the time they are to be sold. When they arrive, they must be checked for damage in shipment and properly stored. Instructions for proper storage of each machine are provided in the operator's manual and storage instructions from the company branch house.

Special aids have been developed by some major-line agricultural machinery companies for carrying out pre-delivery and delivery service activities on new machines. These aids, supplied by the company, come in the form of a list of activities to be performed prior to and at the time of delivery of machines to customers.

1. This list identifies specific items that need to be checked at the dealership before the machine is delivered.

2. It notes specific maintenance and operative items to be discussed with the customer at the time of delivery.

3. It sets up a time for after-delivery inspection.

The operator's manual for each machine is the guide to proper pre-delivery service. The machine should be set-up and serviced according to the specifications prescribed in the operator's manual.

At the time the machine is delivered to the customer, the serviceman should try out the machine in the field. Any part of the machine that is not functioning properly can be identified and final adjustments made before leaving the customer's property. The serviceman delivering the machine must understand the machine and how it functions in order to avoid future problems arising from errors made in pre-delivery servicing and delivery of the machine.

State regulations should be carefully followed when hauling agricultural machinery to the farmer. These govern load-widths, total tonnage, speeds for traveling with a load, etc. These regulations, which vary from state to state, can be obtained from the state highway commission in each state.

<u>Suggested Teaching-Learning Activities</u>

1. Have students service a new tractor obtained from a local agricultural machinery dealership.

2. Have students set-up and service several agricultural machines, such as, corn planters, grain elevators, and hay balers. Require students to use the pre-delivery service forms and operator's manual for each machine.

Suggested Instructional Materials and References

Instructional Materials

1. Agricultural machinery pre-delivery and delivery check lists

2. Operator's manuals

3. A new tractor and several other new agricultural machines

References

1. Service Center Management Manual, Pre-delivery and delivery section, pages 1-5.

2. Management Course in Dealer Service Operations, Section VII, page 12.

Suggested Occupational Experiences

1. Have students pick up an order of new machines and machine parts at the company branch house.

2. Have students prepare for and store new machines received by the dealership.

3. Have students perform pre-delivery service and deliver new machines to the customer.

VII. To understand agricultural machinery warranty allowance

Teacher Preparation

Subject Matter Content

New and unused company machinery and parts are warranted to be free from defects in material and workmanship when they are sent to the agricultural machinery dealership by the company.

Under the warranty, the company is obliged to repair or replace any part or parts that prove to be defective because of defective material or workmanship at the factory.

As a representative of the company, the local agricultural machinery dealership replaces defective parts free of charge.

Warranty allowances are made by agricultural machinery dealerships on (1) parts, and (2) labor.

When a defect in materials and workmanship is found by the agricultural machinery dealer or by the customer, a warranty claim should be filed with the company branch house.

1. The agricultural machinery dealer must file the claim with the branch house.

2. The service employee must be able to detect unjust and unfair claims made by the customer.

3. The service employee must understand the function of the part in question thoroughly and be able to detect whether the defect is inherent in the part or was caused by improper maintenance or misuse by the customer.

The service supervisor is in charge of filing all warranty claims.

1. The claims must be filed within the time period allotted by the company for reporting all warranty claims.

2. Warranty claims should be filed on a daily basis to insure company consideration of the claim.

3. The warranty claim form should be filled out completely and details given whenever necessary.

4. The warranty claim and the defective part should then be sent to the company branch house.

5. When a freight bill and/or labor cost is involved, a copy of the freight bill and the job ticket signed by the customer must be attached to the warranty claim.

<u>Suggested Teaching-Learning Activities</u>

1. Have a service supervisor speak to the class on making warranty judgments.

2. Have students study parts with defects in materials and workmanship that have been returned to the company branch house for warranty adjustment.

3. Give each student a defective machine part and have him complete a warranty claim form for it.

Suggested Instructional Materials and References

Instructional Materials

1. Defective agricultural machine parts

2. Warranty claim forms supplied by the major-line agricultural machinery companies

References

1. Service Center Management Manual, Warranty Section, pages 1-9.

2. Management Course in Dealer Service Operations, Section VII, pages 7-10.

Suggestions for Evaluating Educational Outcomes of the Module

The following criteria should be used to evaluate the educational outcome of the module:

1. Student interest in the materials covered in this module

2. Changes in attitude on the part of the student toward his work

3. The extent of participation by each student in class activities

4. The ability of the student to perform the task assigned him on the job

5. The ability of the student to carry out assigned class activities

6. Evaluation of the quality of work done by the student on the job by the occupational experience supervisor and by his employer

Sources of Suggested Instructional Materials and References

1. Wilson, L.W. Farm and Power Equipment Retailer's Handbook, National Farm and Power Equipment Dealers Association, 2340 Hampton Avenue, St.Louis, Missouri, 1964. Price $8.

2. Implement and Tractor Flat Rate Manual, Implement and Tractor Publishers, Inc., 1014 Wyandotte Street, Kansas City, Missouri.

3. Management Course in Dealer Service Occupations, Indianapolis, Indiana: Massey-Ferguson Training Center.

4. Service Center Management Manual, Chicago, Illinois: International Harvester Company, 180 N. Michigan Avenue.

THE CENTER FOR RESEARCH AND LEADERSHIP DEVELOPMENT
IN VOCATIONAL AND TECHNICAL EDUCATION
THE OHIO STATE UNIVERSITY
980 KINNEAR ROAD
COLUMBUS, OHIO, 43212

INSTRUCTOR NOTE: As soon as you have completed teaching each module, please record your reaction on this form and return to the above address.

1. Instructor's Name_____

2. Name of school_____State_____

3. Course outline used: _____Agriculture Supply--Sales and Service Occupations
_____Ornamental Horticulture--Service Occupations
_____Agricultural Machinery--Service Occupations

4. Name of module evaluated in this report_____

5. To what group (age and/or class description) was this material presented?____
_____

6. How many students:
   a) Were enrolled in class (total) _____
   b) Participated in studying this module _____
   c) Participated in a related occupational work experience program while you taught this module _____

7. Actual time spent teaching module:

		Recommended time if you were to teach the module again:
_____hours	Classroom Instruction	_____hours
_____hours	Laboratory Experience	_____hours
_____hours	Occupational Experience (Average time for each student participating)	_____hours
_____hours	Total time	_____hours

(RESPOND TO THE FOLLOWING STATEMENTS WITH A CHECK (√) ALONG THE LINE TO INDICATE YOUR BEST ESTIMATE.)

	VERY APPROPRIATE	NOT APPROPRIATE
8. The suggested time allotments given with this module were:	___.___.___.___	
9. The suggestions for introducing this module were:	___.___.___.___	
10. The suggested competencies to be developed were:	___.___.___.___	
11. For your particular class situation, the level of subject matter content was:	___.___.___.___	
12. The Suggested Teaching-Learning Activities were:	___.___.___.___	
13. The Suggested Instructional Materials and References were:	___.___.___.___	
14. The Suggested Occupational Experiences were:	___.___.___.___	

(OVER)

15. Was the subject matter content sufficiently detailed to enable you to develop the desired degree of competency in the student? Yes_____No_____
Comments:

16. Was the subject matter content directly related to the type of occupational experience the student received? Yes_____No_____
Comments:

17. List any subject matter items which should be added or deleted:

18. List any additional instructional materials and references which you used or think appropriate:

19. List any additional Teaching-Learning Activities which you feel were particularly successful:

20. List any additional Occupational Work Experiences you used or feel appropriate:

21. What do you see as the major strength of this module?

22. What do you see as the major weakness of this module?

23. Other comments concerning this module:

_____ (Date)

_____ (Instructor's Signature)

_____ (School Address)

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AGRICULTURAL MACHINERY PARTS DEPARTMENT OPERATING PROCEDURES

One of Sixteen Modules in the Course Preparing for Entry in

AGRICULTURAL MACHINERY - SERVICE OCCUPATIONS

Module No. 3

The Center for Research and Leadership Development
in Vocational and Technical Education

The Ohio State University
980 Kinnear Road
Columbus, Ohio, 43212

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August, 1965

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M E M O R A N D U M

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
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FROM: (Person) James W. Hensel (Agency) The Center for Vocational and Technical Education

(Address) 980 Kinnear Road, Columbus, Ohio 43212

DATE: August 4, 1967

RE: (Author, Title, Publisher, Date) Module No. 3, "Agricultural Machinery Parts Department Operating Procedures," The Center for Vocational and Technical Education, August, 1965.

Supplementary Information on Instructional Material

Provide information below which is not included in the publication. Mark N/A in each blank for which information is not available or not applicable. Mark P when information is included in the publication. See reverse side for further instructions.

(1) Source of Available Copies:
Agency The Center for Vocational and Technical Education
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(quantity prices)

(2) Means Used to Develop Material:
Development Group National Task Force
Level of Group National
Method of Design, Testing, and Trial Part of a funded project of the USOE, OE-5-85-009; materials based on research from state studies; see preface material in the course outline.

(3) Utilization of Material:
Appropriate School Setting Post high school
Type of Program General post high school class in agricultural machinery
Occupational Focus Agricultural machinery service occupations
Geographic Adaptability Nationwide
Uses of Material Instructor course planning
Users of Material Teachers

(4) Requirements for Using Material:
Teacher Competency Background in agricultural machinery
Student Selection Criteria Post high school, mechanical aptitude, high school background, goal in agricultural machinery service occupation.
Time Allotment Estimated time listed in module. (P)

Supplemental Media --
Necessary x
Desirable ____ (Check Which)

Describe Suggested references given in module. (P)

Source (agency)
(address)

AGRICULTURAL MACHINERY PARTS DEPARTMENT OPERATING PROCEDURES

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AGRICULTURAL MACHINERY PARTS DEPARTMENT OPERATING PROCEDURES

Major Teaching Objective

To develop (1) an understanding of the operating procedures of an agricultural machinery parts department and (2) the ability to carry out the functions of a parts man.

Suggested Time Allotment

At school		
Class instruction	20 hours	
Laboratory experience	36 hours	
Total at school		56 hours
Occupational experience		78 hours
Total for module		134 hours

Suggestions for Introducing the Module

The parts department is an extremely important part of the agricultural machinery dealership. It is one of the main attractions to the dealership and is many times the only department within the dealership with which the customer does business regularly. The parts department is the hub around which the dealership operates. It supplies the parts needed in the service department. It provides the assurance needed by a salesman as he makes his sales. He knows that, should his sale result in a complaint from the customer because of faculty parts, the parts man can correct the situation. Finally, it provides the dealer with 30 per cent of his margin on sales during the year.

A person preparing for employment as a parts man must understand thoroughly the function of the parts department and the procedures employed in carrying out its business. He must understand inventory control, receiving and binning procedures, parts selling, and the needs of the customer he is to serve.

Following are some suggested techniques for use in creating interest in the module:

1. Use thought questions.

    a. What are parts and why are they important to the agricultural machinery dealer?

    b. What are the advantages of an agricultural machinery dealer supplying machine parts?

c. What is the parts department in the local agricultural machine dealership?

d. What kind of work does a parts man do in the local parts department?

2. Bring to class a part from a machine 15 years old and the same part from the same machine today. Show the class how these two parts have changed in terms of the number of parts involved in each. Example: A double disk opener on a corn planter 15 years ago and today. When these are presented to the class, show them in their original form and the torn down form.

3. Bring a new machine before the class. Have the class estimate the number of parts on the machine. Tear it down and count the actual number of parts. Emphasize the changes that have occurred in the number of parts on agricultural machinery and how this has effected the parts department in the local agricultural machinery dealership. Also stress the relationship of parts to each other as the machine is being torn down and reassembled.

4. Today a price tag is on everything. Secure an old parts catalogue and price list and compare prices of parts with those in a current parts price list and catalogue.

Competencies to be Developed

I. To develop an appreciation of the importance of the parts department and the role the parts man plays in the total dealership operation

Teacher Preparation

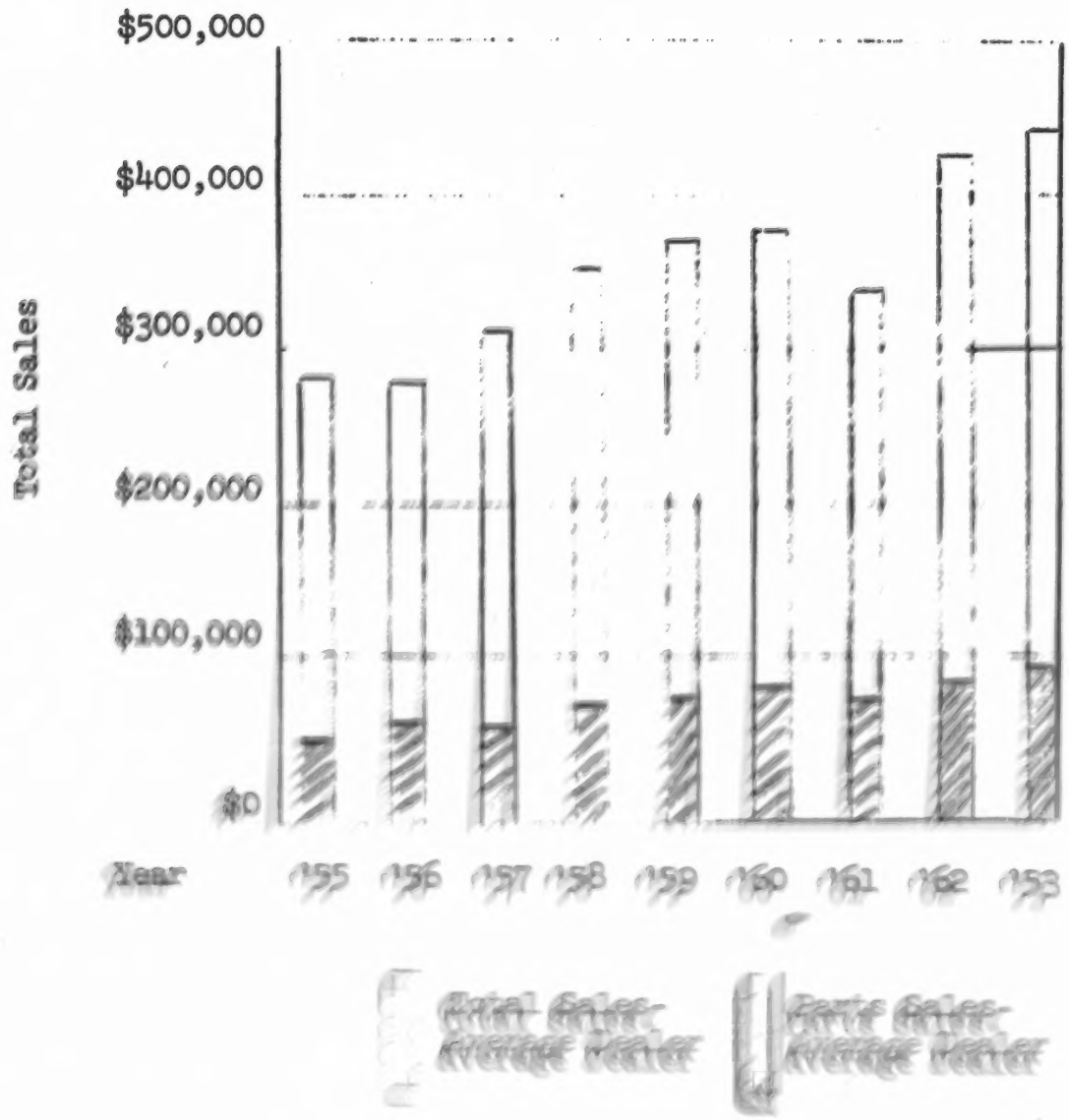
Subject Matter Content

Replacement of parts is big business for dealers in agricultural machinery.

a. The sale of parts contributes a greater portion to the total margin per hours of time than any other department in the dealership.

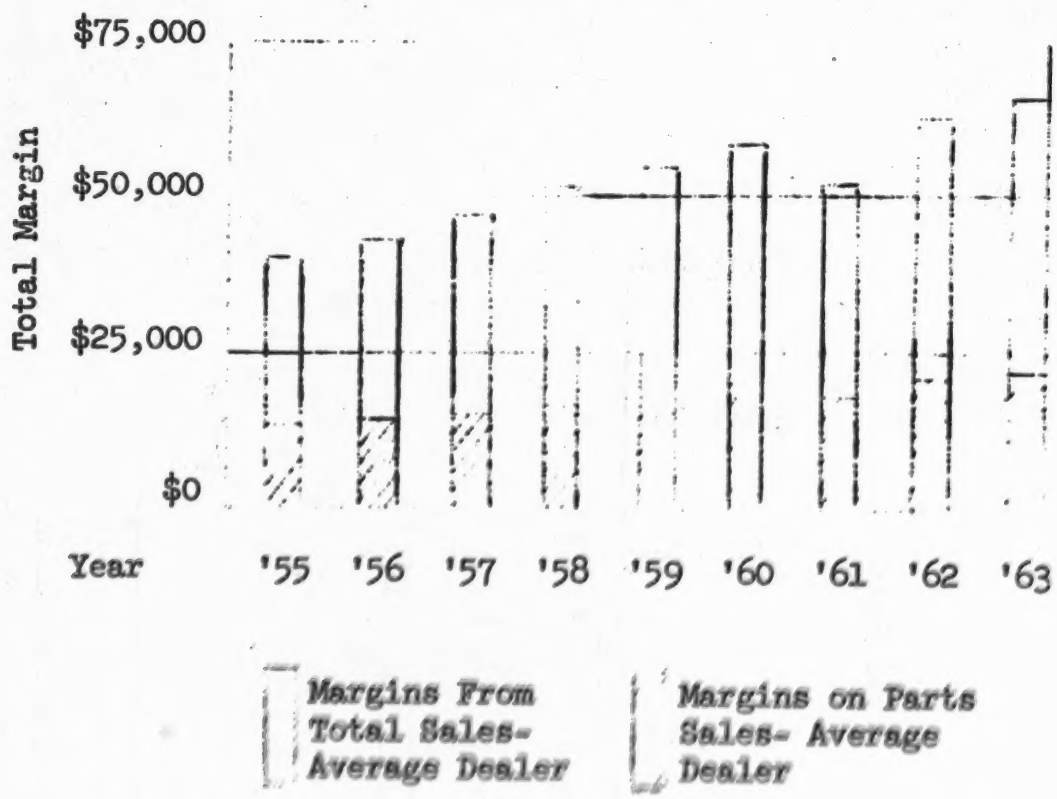
b. Approximately one third of the total sales of a dealership is derived from the sale of parts.

Parts Sales as Related to Total Sales



3. Returns on parts sales average 30 per cent over and above costs.

Parts Margins as Related to Total Operating Margins



The parts department increases business in other areas of the dealership.

1. Parts man identify potential sales for the dealer by keeping records of customers who are purchasing parts for old machines.

2. The parts department speeds up the work turned out by the service department by supplying parts when they are needed.

3. Through the sale of parts at the dealership, the parts department brings the customer in view of the machinery for sale by the dealer.

4. Competent parts men provide the customer with valuable advice on service and maintenance of agricultural machinery thus creating customer confidence in the dealer.

5. The dealer's hold on his trade and his ability to keep his customers depend more upon the manner in which he takes care of his parts department than upon any other single element of his business.

The parts man is one of the most important employees in the agricultural machinery dealership.

1. Because of his complete knowledge of the replacement part and its function in the complete machine, he is able to do a more effective job serving the customer.

2. He is able to convert a farmer's homespun language into a machine part or part number.

3. After identifying a part, he is able to locate a replacement quickly, either in the parts bins or in the parts catalogue.

4. A parts man must know that when a customer is asking for a new part, the associated parts on the machine may be worn also and may need replacing. He should suggest that the customer consider these replacements.

Suggested Teaching-Learning Activities

1. Using the agricultural census, have each student determine the number of agricultural machines on farms in the county and state in which the school is located.

2. Have each student interview several farmers in the community to determine the repair history of their farm machines. Determine the number and kinds of parts the farmer has purchased over the past two years.

3. Have a parts man from a local dealership speak to the class about the role of the parts department in the overall dealership operation.

4. Have a local owner or manager of a dealership talk on the importance and use of the parts department.

Suggested Instructional Materials and References

Instructional Materials

Transparencies of the graphs presented.

References

S*Farm and Power Equipment Retailers Handbook, pages 371-378.

*The symbol T (teacher) or S (student) denotes those references designed especially for the teacher or the student.

Suggested Occupational Experiences

Observe a parts man at work noting the functions, jobs, and services he performs.

II. To understand the job requirements and personal characteristics needed by a parts man

Teacher Preparation

Subject Matter Content

The parts department is practically a complete business unit within the agricultural machinery dealership.

The key person within this unit is the parts man.

1. He must keep a supply of fast-selling parts on hand at all times.

2. He must estimate future parts requirements and purchase these parts in the most economical ways.

3. He must check incoming parts and properly store them.

4. He must advertise and display parts to increase their sales.

5. He must sell parts, collect the money for his sales, and account for the money.

In order for the parts man to perform these tasks successfully, he must possess specialized knowledge.

1. He must have a thorough knowledge of the parts he is handling.

2. He must have a thorough knowledge of the machines for which he is supplying parts.

3. He must have a knowledge of agricultural machinery business operating and management procedures.

4. He must be well acquainted with farming methods and problems, and know how farmers think.

5. This specialized knowledge will be provided in future modules in this course.

In addition to a specialized knowledge of his product and the people he serves, the parts man should possess the following personal characteristics and carry out the following tasks.

1. He must be patient with particular customers or with those who question prices.

2. He must be able to handle the trade in rush season without getting overtired, irritated, and rebellious.

3. He must drop routine tasks to give customers immediate attention.

4. He should not argue with customers or discuss politics and religion.

5. He must treat all customers alike.

6. He must be a good housekeeper.

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5. He must treat all customers alike.

6. He must be a good housekeeper.

7. He must keep good written records. He should not try to keep the records in his head.

8. He should make the customers feel at ease.

9. He must develop a sense of selling.

10. He should report prospective buyers of implements and equipment to his employer.

11. He should report customers' complaints to the manager.

12. He should report competitive information that comes to him.

13. He should give new employees the advantage of his knowledge and experience, and not jealously guard it.

The parts man should continually increase his knowledge of the industry and people he serves.

1. He should subscribe to and read a good farm and a good trade magazine.

2. He should secure agricultural bulletins from the United States Department of Agriculture and state agricultural colleges when they relate to his job.

3. He should read newspaper and magazine articles on new methods of farming, new crops, crop conditions, feed and food supplies, and economic conditions.

4. He should talk to farm advisors, soil conservation service personnel, farm home administrators, vo-ag teachers, and agriculture specialists from various organizations.

5. He should observe the operation, whenever he has the opportunity, of machines in the field.

6. He should talk to owners of machines to secure information that cannot be obtained in any other way.

7. He should read advertising and operating literature.

8. He should study the operators' manuals for the machines the dealership is handling.

There are fundamental statistics and records associated with the parts business which are necessary to its successful and profitable operation. A parts man must have a thorough knowledge of these.

1. Parts purchases for the year to date compared with last year

2. Parts sales for year to date compared with last year

3. Parts inventory compared with same period last year

4. Parts turnover rate

5. Parts over-the-counter sales

6. Parts sales through service shop

7. Dollar parts sales by months for past five years to show seasonal sales pattern

8. Number of parts carried in stock

9. Number of active parts carried in stock

10. Premium transportation and communication expense incurred by not having parts in stock

11. Number and kind of machines in the trade territory to service

12. Number and kind of competitive machines being sold in the trade territory

13. Acreage and production of different crops grown in the trade territory or county

14. Farm income in the trade territory or county

Suggested Teaching-Learning Activities

1. Have students list those personal characteristics they feel a parts man should possess.

2. Bring an agricultural machinery dealer to the class to discuss what he looks for when hiring a parts man. Ask him to discuss what he expects of his parts men on the job.

Suggested Instructional Materials and References

Instructional materials

Overhead transparencies of the content included for this competency.

References

(See note to teachers in the final reference.)

Suggested Occupational Experiences

Have the student prepare for the dealer a written report on each of the following:

1. Comparison of purchases for the year to date with that of last year

2. Parts sales for the year to date compared with last year

3. Parts turnover rate to date

4. Number and kind of machines in the trade territory to service

5. Number and kind of competitive machines being sold in the trade territory

III. To understand inventory control

Teacher Preparation

Subject Matter Content

Inventory control means efficient stock parts keeping.

1. It reduces capital investment by making smaller stock do the work of a larger one.

2. It keeps a better balance between obsolete and fast-moving parts.

3. It facilitates receiving and stocking, and reduces errors in ordering.

4. It aids in reducing errors of judgment in ordering.

An accurate, up-to-date parts inventory control system is a basic element in a good parts department.

1. It provides efficient service to customers.

2. Parts sales increase due to a reduction of lost sales.

3. Freight charges are reduced due to better use of pre-paid freight orders.

4. It insures an accurate surplus of parts return.

5. From the inventory control, trends and patterns in parts sales are identifiable, making it possible to accurately order and stock parts.

6. It provides an accurate inventory at all times.

7. It keeps investment in line and assures a desirable turnover of parts.

Inventory control record cards show all parts transactions and keep the parts inventory up to date. Inventory control record cards show:

1. The machine on which the part is used.

2. The substitute part number which identifies a replacement part.

3. Parts replaced.

4. List and net price of each part.

5. The order number and the date the order was placed with the branch house parts depot. The order and date should be the same. For example, if the order is placed on June 4 the order number would be 604. If the order is placed on October 14 the order number would be 1014.

6. The quantity of parts ordered.

7. When the order was received from the district parts depot.

8. The quantity sold, showing sales against the inventory.

9. A brief description of part.

10. The part identification by number.

11. The type of packaging used in shipment from the parts depot.

12. The inventory on hand at a given date.

13. The annual closing on-hand inventory.

14. The return sales, to show item as being returned by the customer.

(Refer to references for examples.)

A key factor in controlling the parts inventory is determining what parts to stock.

1. Too many items of a certain part add to the obsolete stock surplus and tie up capital in non-saleable parts.

2. Only parts in sufficient demand to keep the inventory turning over should be stocked.

3. Only parts sold at an annual rate of two or more pieces should be stocked.

4. Parts selling less than two pieces annually are considered non-stock items and are ordered special when needed.

5. The parts history on the previous model should provide an order pattern for a new machine.

6. Inventory control cards for parts selling below the minimum rate are marked non-stock and are removed from the inventory control card file.

7. If the demand for a non-stock item increases, the card should be placed back into the inventory control stock-card file.

The parts man must know how many items of a specific part should be ordered in order to insure a rapid parts turnover and to have on hand the parts needed by his customers when they need them.

1. He must think in terms of seasonal and non-seasonal items.

2. Non-seasonal parts.

   a. The first step in determining the number of parts to order is that of setting maximum and minimum quantities of a part to maintain in stock.

   b. These limits are determined by the dealer and the parts man on the basis of past parts sales and the anticipated volume of business for the coming year.

   c. A 90-day maximum supply and 45-day minimum supply, a 120-day maximum and 60-day minimum, and a 60-day maximum and 30-day minimum supply are common limits set on quantities to maintain in stock by the dealer and parts man. (See International Harvester reference.)

   d. These limits apply to parts that sell over a given dealer price.

   e. Parts items which the dealer sells for less than this amount should be stocked in large quantities every four months.

   f. Following is an example of how one company handles their parts stock replenishing:

Supply Levels				
	60-day maximum 30-day minimum		90-day maximum 45-day minimum	
Past Annual Sales	Flag Points 45&15 Day Levels	Stock Order Qty.	Flag Points 60&15 Day Levels	Stock Order Qty.
84 Thru 89	11/4	7	14/4	10

From the past annual sales record on the inventory control record card the dealer and parts man found that a particular part sales for the last year was 86. They felt that (based on the anticipated sales),

they could increase the sale of this part to 95 during the present year. They decided to place this part on a 90-day maximum supply and 45-day minimum supply level. When their stock on hand reached a total of 14, the parts man knew he had a 60-day supply on hand and flagged the inventory record card indicating that on the next parts order he should purchase more of this part. Wanting to keep his supply from reaching the 15-day level, the parts man orders 10 new items to keep his supply at the 60-day level. (See reference - Dealer Development Manual, p. 56 & 57.)

g. Some major line agricultural machinery companies use minimum as a basis for ordering parts.

1) A minimum stock figure is the lowest quantity an item should be allowed to reach before immediate action is taken to replenish stock.
2) The minimum supply extablished by a dealership falls into two main categories.

a) Tractor
b) Harvesting, drying, seeding, and tillage parts

3) The number of parts to replenish is calculated on the basis of previous sales, (level of supply to maintain), and use of a time factor to establish the minimums. (Example - Parts Purchase Control Procedure, p.10)

h. The inventory control record card carries this information and at a glance the parts man can see when to reorder and can readily find the number to order.

3. Seasonal parts

a. The distribution of seasonal stock parts is determined by the company district office in the majority of the major line companies.

b. The quantity of parts to be ordered is determined by the on-hand quantity, the previous year's sales, and the anticipated demand.

The lost sales record reveals sales that could have been made if the parts were in stock. It shows

1. The time period when the sales were lost
2. The quantity of parts requested by the customer
3. The parts number
4. The customer's name
5. Whether the items called for were stock or non-stock items

DAILY LOST SALES RECORD

Location _____ Date _____

Quantity	Part Number	Customer's Name	Non Stock Stock

The rate of turnover of parts reveals how well the parts man is using capital invested in the parts department. Some major line companies figure turnover at the end of the year and others at the end of the month.

Yearly approach

1. Turnover is the number of times the total value of the parts inventory is sold in one year's time.
2. Too high a turnover rate indicates too small a parts inventory or poor service.

3. Too low a turnover indicates too much capital tied up in obsolete stock, selling too many different items, or slow-moving items.

4. Computing turnover

Inventory at the beginning of the year	$15,000
Inventory at the end of the year	$17,000
Average inventory	$16,000

$20,000 (sales) divided by
$16,000 (average inventory) equals
1.25 (rate of turnover).

Monthly approach

	Month	Year to Date (No. of Months)
1. PARTS SALES:		_____
(Counter)	_____	_____
(Internal)	_____	_____
TOTAL	_____	_____
2. COST OF SALES (65% of Sales):	_____	_____

Turnover Rate		
Cost of Sales, Last 12 Months	"A"	_____
Average Inventory, Last 12 Months	"B"	_____
Average Turnover Rate	(A÷B)	_____

Suggested Teaching-Learning Activities

1. Using the inventory control record cards received from the major line agricultural machinery companies, set up sample parts transactions having the students post these transactions on the record cards.

2. Set up an exercise using the various company systems of determining the number of parts to reorder.

Suggested Instructional Materials and References

Instructional Materials

Obtain from each major line handling agricultural machinery the following:

1. Inventory control

2. Lost sales records

3. Systems used by each company for determining how many parts to purchase.

References

1. Parts Sales Manual, pages M25-5-1 through M25-5-12.

T 2. Parts Purchasing Control Procedure, pages 4-30.

(See note to teachers in the final reference)

Suggested Occupational Experiences

1. Set up an inventory control record card for new machines.

2. Enter quantities of parts received by the dealer in the record cards.

3. Flag cards for ordering of new parts.

4. Post the lost sales record.

5. Using the company system, determine the number of non-seasonal parts to order.

IV. To understand parts ordering procedures

Teacher Preparation

Subject Matter Content

All parts or assembly of parts are identified by the company with a number.

1. Once a number has been assigned to a part or assembly of parts it is used to identify that particular part or part assembly in all company dealings.

2. It gives a positive identification and eliminates the necessity of writing out a long description on records, bins, orders, sales slips, invoices, etc.

3. Each major agricultural machinery company has its own parts numbering system with which the parts man must become thoroughly familiar before he attempts to use the system.

All parts or assembly of parts for each machine are listed in the company parts catalogue.

1. The machines are listed by model numbers. These numbers are the same as in the owners manual for the machine.

2. In some instances where a machine does not have a model number; serial numbers are given.

3. Each parts and its associated parts are generally shown in diagrams with the part number below it.

4. The number in the parts catalogue is used when ordering special or stock parts.

5. It is important that the parts man understand the nature of the part when ordering so as to order an assembly or a specific part as necessary.

6. The parts book should be consulted when listing each part on the order and ordering special parts not already stocked.

It is important that the parts man use proper ordering procedures in order to maintain satisfactorily his parts stock supply. The following steps should be observed when ordering:

1. Be sure the part or part assembly is properly identified.

2. Consult the parts catalogue to get the correct number for each part.

3. List the order number clearly in the proper place. Be certain that the number is stated accurately on the order form.

4. List the parts number in numerical sequence. (See International Harvester and John Deere references for examples.)

5. Enter the order number and quantity ordered on the inventory control stock record.

6. Indicate the group, section, and bin number on the parts order.

7. Be sure that the order is properly identified so that the parts depot can easily recognize the type of order.

   a. Stock order

   b. Emergency order

   c. Fill-in order

   d. Special merchandising order

   e. Quantity discount order

Suggested Teaching-Learning Activities

Set up sample parts orders. Have the students use the forms and parts books supplied by the major-line agricultural machinery companies to complete orders for the parts. When making out these sample orders require each student to follow the steps outlined in the content.

Suggested Instructional Materials and References

Instructional Materials

Obtain parts ordering forms and parts books from each of the major-line agricultural machinery companies.

References

S "What is a Parts Number," pages 1-27.

(Teachers may be able to secure operational procedure manuals from other manufacturers by working with local dealers, branch managers or district representatives of these companies.)

Suggested Occupational Experiences

1. Set up the order for a special part or group of parts for a customer using the parts book to identify the part and locate the part number.

2. Set up an order to be sent to the district parts depot.

3. Set up a stock order of seasonal parts to be sent to the district parts depot. Include experience in determining the best method of shipment.

V. To understand parts receiving and order verification procedures

Teacher Preparation

Subject Matter Content

Carefully planned procedures for receiving parts orders are essential in order to avoid many future parts problems.

The following procedures should be followed in order to insure the proper delivery of parts.

1. Visually inspect the boxes, cartons, bags, etc., for any damages caused in shipping.

2. Before acknowledging receipt of the parts shipment, check the loading tally and the freight bill in order to:

   a. Make sure the number of items received agrees with the number shown on the freight bill.

   b. Make sure the weight shown on the tally agrees with the weight shown on the freight bill.

   c. Check for correctness of name, address, and ship-to code.

3. Any discrepancies, shortages, or breakage should be noted on the freight bill before the parts man signs the shipment.

4. The dealers copy of the freight bill should be given to the bookkeeper for further audit and payment.

If damage occurred to the parts order in shipment, it requires immediate attention by the parts man.

1. The parts man should, after making a thorough inspection of the damaged merchandise, contact the carrier immediately and request the carrier to inspect the merchandise.

2. All items should be left just as they were when they arrived at the dealership.

3. After inspecting the damaged merchandise, the parts man should describe the damage and estimate its extent, in terms of dollars and cents.

4. The description of the damage and other delivery documents should be given to the dealer as evidence when filing a loss and damage claim with the company delivering the merchandise.

The contents of the order should be carefully checked before the parts are binned.

1. With every shipment of parts from the branch house there is a packing slip. The slip will be in a carton marked with a packing slip label.

2. The kind, quantity, and price of each item should be checked against the packing slip.

3. As the parts are checked against the packing slip, the section and bin number should be written on the parts identification tag.

4. The parts should then be placed in the bins and are ready for sale.

Immediately after the new shipment of parts has been binned, the receipts should be posted on the inventory control record cards.

1. Posting is done from the packing slip.

2. The total received is added to the quantity in the on-hand column.

3. The packing slip is filed and checked against the invoice when it arrives.

4. The packing slip and invoice are then filed for reference.

5. Any discrepencies in the packing slip and invoices should be reported immediately to the parts depot.

Suggested Teaching-Learning Activities

Set up example situations that will require the use of the forms listed under instructional materials. Require the student to work in different situations, using these forms.

Suggested Instructional Materials and References

Instructional Materials

1. Freight billing forms
2. Major-line agricultural machinery packing slips
3. Invoice forms
4. Loss and damage claim forms
5. Bill of lading

References

(See the note to teachers in the final reference.)

Suggested Occupational Experiences

1. Have students receive and verify shipments of parts from the parts depot following the procedures outlined.
2. Have students bin parts and post the inventory control record cards.

VI. To understand parts selling

Teacher Preparation

Subject Matter Content

The parts sales unit is small and the costs of selling parts should be held at a minimum.

1. The sale should be handled quickly and efficiently to reduce the cost and save the customer time.
2. Parts displays increase sales and cut costs.

3. Space in the parts department must be used in the most efficient manner.

4. Stocks should be no larger than necessary to serve efficiently.

The parts man must use a variety of tools to sell his product.

1. Displays

2. Advertising

3. Sales of service shop work

4. Telephone

5. Promotion of early repairing

6. Parts selling while canvassing the country

7. Parts selling at farm sales

8. Selling related parts

9. Selling equipment and accessories not sold with the machine

10. Selling improvement and changeover packages

11. Selling parts by direct mail

12. Selling toys

13. Flat rate pricing and estimating

The service department of the dealership provides a natural opportunity for a large sales volume.

1. Tractor parts make up almost half of the average dealer's parts sales.

2. The parts man should suggest shop overhaul when customers purchase parts which should be replaced in the shop rather than on the farm.

3. The service department and the parts department should work together to sell more parts as they realize that the farmer is a prospect for labor saving, comfort producing, improved parts, attachments, and accessories that his machines do not have.

The parts man has more actual contact with the customer than any other employee in the delaership.

In order to do an effective job of serving the customer, the parts must:

1. Have a thorough understanding of farming problems in the area.

2. Have a complete knowledge of the product he sells.

3. Pass this information to the customer.

4. Understand the application of equipment to the farmers' problems.

5. Have a good knowledge of farming practices in the area in which the dealership is located.

6. Be familiar with the services the customers require.

7. Have faith in the quality of merchandise he is selling.

8. Have confidence in the store he serves.

The parts man is also a salesman.

1. He sells what the product will do rather than the product itself.

2. He sells freedom from drudgery and a better life for the farmer and his family--not hydraulic equipment.

3. He sells riding comfort and safety--not tractor seats.

4. He sells engine care and lower upkeep costs--not hour meters.

5. He sells saving of power and fuel--not tractor tune-ups.

6. He sells continuous operation and saving of crops through the critical periods--not tractor overhauls.

7. He sells protection of engine and saving of repair bills--not oil filter elements.

8. He sells lower maintenance costs--not lubrication equipment.

9. He sells high-yielding, weed-free crops--not sweeps and shovels.

10. He sells accurate planting and higher yields--not seed plates.

11. He sells cleaner cutting and crop saving harvests--not cutting parts.

Suggested Teaching-Learning Activities

1. Bring a local parts man to the class to speak on parts selling.

2. Have each student develop a list of the undesirable and desirable characteristics of salesmen with whom they are acquainted.

3. Set up an example parts-selling situation and have each student indicate how he would approach and handle the situation.

4. Role play several parts-selling situations using members of the class to portray the characters in each situation.

Suggested Instructional Materials and References

Instructional Materials

Overhead transparencies to show the selling tools used by parts men and how the parts man sells his product.

References

(Teachers may be able to secure operational procedure manuals from other manufacturers by working with local dealers, branch managers or district representatives of these companies.)

Suggested Occupational Experiences

1. Have the student sell parts to the customer at the parts counter.

2. Have the student accompany the service man on service calls involving the supplying of parts.

VII. To display agricultural machinery parts effectively

Teacher Preparation

Subject Matter Content

Parts displays are an effective means of selling parts.

1. Displays impress the customer with the ability of the dealer to serve him.

2. Displays indicate the extensiveness of the parts department stocks.

3. Displays are inexpensive means of selling parts.

4. Customers have an opportunity to pick up items which they may need in addition to the specific part they are seeking.

5. Parts displays that feature an item and its associated parts are effective in satisfying the customer's needs.

6. Displays make the dealership more attractive to the customer.

7. Displays provide the dealer with an informal means of informing the customer concerning proper use of machines and machine parts.

When setting up effective parts displays, certain fundamentals should be followed.

1. Displays should feature rapid selling parts.

2. They must be attractive, arouse interest, and create a desire for ownership.

3. They must be coordinated with outside advertising and selling efforts.

4. The customer should have easy access to the parts on display.

5. Each display should be well lighted to attract as much attention as possible.

6. Each display should feature parts in quantity.

7. Displays should be set up so that they will not topple when parts are removed from them.

8. Parts sold from the display should be replenished daily.

9. Related parts should be displayed with the featured part and displayed in sequence.

10. The display area must be kept neat and clean at all times.

11. Seasonal parts should be displayed at least 30 days in advance of the season of use.

12. Displays should be timely.

13. When a display has spent its usefulness, it should be replaced with a display featuring new items.

14. Items should be placed in an attractive arrangement in the display.

15. If packaged items are on display, one package should be opened to show the contents of the packages.

16. Price information should be shown on all items on display.

Several types of displays lend themselves well for displaying agricultural machinery parts.

1. Islands and tables

2. Display boards

3. Window displays

4. Floor displays

5. Displays on machines

6. Wall displays

7. Displays on counters

8. Bin end and open counter displays

9. Service shop displays

A crucial factor in setting up effective parts displays is determining what parts to display. The following items should be considered when selecting those items to be displayed:

1. Parts for machines that will be used by the customer within the next four to six weeks

2. Related parts

3. Parts on which the dealer will receive a satisfactory sales margin

4. New items being introduced by the dealer

5. Machine accessories or other equipment

Suggested Teaching-Learning Activities

1. Use 35mm slides to show the types of displays. Good and poor displaying procedures should be emphasized as the slides are viewed by the class.

2. Using the display fixtures and parts identified under instructional materials, have each student set up parts displays. Have, if possible, several parts men from local dealerships constructively criticize each display. If parts men are unavailable, have the class do the criticizing.

3. Have each student visit local dealerships observing parts displaying procedures. After their visit, have them report both orally and in writing their observations.

Suggested Instructional Materials and References

Instructional materials

1. Teacher-made 35 mm slides of each of the types of displays identified in the content.

2. Island display table, display boards, window display materials, counter display materials.

3. Parts to be used in setting up displays.

References

1. Parts Sales Manual, pages M15-511 through M15-15-2.

(See the note to teachers in the final reference.)

Suggested Occupational Experiences

Have students set up each of the following displays in a local dealership.

1. Window display
2. Island and table displays
3. Floor displays
4. Display boards
5. Wall displays
6. Displays for special parts

VIII. To understand agricultural machinery parts advertising

Teacher Preparation

Subject Matter Content

One of the most effective means of parts selling is through advertising.

1. It makes calls on customers that the parts man does not have time to make personally.
2. It informs customers about new machines and parts available at the local dealership.
3. It increases a desire for ownership and, as a result, increases parts and new machinery sales.
4. It reminds the customer of the services available at the local dealership and suggests that he bring his machinery problems to the dealership for service.

Agricultural machinery parts are advertised through several media.

1. Direct mail
2. Newspaper ads

3. Radio spot announcements

4. Country road signs

5. Television advertisements

6. Handbills distributed to potential customers

The parts to be advertised by a dealer are generally the same as those displayed at the dealership.

Parts should be advertised well in advance of the season the item is to be used by the customer.

Advertising plans should be made well in advance of showing items to be advertised. Plans include media to be used and dates.

Suggested Teaching-Learning Activities

1. Have students list methods of advertising carried out by local agricultural machinery dealers.

2. Bring a member of a newspaper advertising staff to the class to speak on effective advertising.

3. Have each student select a parts item found in a parts department and lay out a series of advertisements using each of the media identified in the content.

Suggested Instructional Materials and References

Instructional Material

1. Local newspaper advertising of sales of agricultural machinery parts.

2. Sample letters and product information sent through the mail to customers

3. Sample radio and TV spot announcement scripts

4. Sample handbills to advertise agricultural machinery parts

References

Parts Sales Manual, pages M20-5-1 through M20-5-3.

Suggested Occupational Experiences

1. Select items to be advertised.

2. Develop an advertisement for a newspaper.

3. Set up and carry out the distributing of handbills advertising specific parts.

4. Plan an advertisement on a series of parts.

5. Select a series of parts to be advertised using the country road sign as the advertising media.

6. With a radio announcer and the dealer, plan a series of radio spot announcements advertising a particular part.

Suggestions for Evaluating Educational Outcomes of the Module

The following criteria should be used to evaluate the educational outcome of this module.

1. Student interest in the materials covered in this module

2. Changes in attitude on the part of the student toward his work

3. The participation by each student in class activities

4. The ability of the student to carry out assigned class activities

5. The ability of the student to perform the tasks assigned him on the job

6. Employers' evaluations of the quality of work done by the student on the job

Sources of Suggested References

1. Wilson, L. W. Farm and Power Equipment Retailers Handbook, 1964, National Farm Power Equipment Dealers Association, 2340 Hampton Avenue, St. Louis, Missouri. Price: $8.

2. Parts Purchasing Control Procedure, Massey-Ferguson Company, 2200 DeKoven Avenue, Racine, Wisconsin.

3. Parts Sales Manual, John Deere, Inc., Moline, Illinois.

4. "What is a Parts Number," International Harvester Company, 180 N. Michigan Avenue, Chicago, Illinois.

NOTE: Teachers may be able to secure operational procedure manuals from other manufacturers by working with local dealers, branch managers or district representatives of these companies.

THE CENTER FOR RESEARCH AND LEADERSHIP DEVELOPMENT
IN VOCATIONAL AND TECHNICAL EDUCATION
THE OHIO STATE UNIVERSITY
980 KINNEAR ROAD
COLUMBUS, OHIO, 43212

INSTRUCTOR NOTE: As soon as you have completed teaching each module, please record your reaction on this form and return to the above address.

1. Instructor's Name_____

2. Name of school_____State_____

3. Course outline used: _____Agriculture Supply--Sales and Service Occupations
_____Ornamental Horticulture--Service Occupations
_____Agricultural Machinery--Service Occupations

4. Name of module evaluated in this report_____

5. To what group (age and/or class description) was this material presented?____
_____

6. How many students:
   a) Were enrolled in class (total) _____
   b) Participated in studying this module _____
   c) Participated in a related occupational work experience program while you taught this module _____

7. Actual time spent teaching module:

		Recommended time if you were to teach the module again:
_____hours	Classroom Instruction	_____hours
_____hours	Laboratory Experience	_____hours
_____hours	Occupational Experience (Average time for each student participating)	_____hours
_____hours	Total time	_____hours

(RESPOND TO THE FOLLOWING STATEMENTS WITH A CHECK (√) ALONG THE LINE TO INDICATE YOUR BEST ESTIMATE.)

	VERY APPROPRIATE	NOT APPROPRIATE
8. The suggested time allotments given with this module were:	___ . ___ . ___ . ___	
9. The suggestions for introducing this module were:	___ . ___ . ___ . ___	
10. The suggested competencies to be developed were:	___ . ___ . ___ . ___	
11. For your particular class situation, the level of subject matter content was:	___ . ___ . ___ . ___	
12. The Suggested Teaching-Learning Activities were:	___ . ___ . ___ . ___	
13. The Suggested Instructional Materials and References were:	___ . ___ . ___ . ___	
14. The Suggested Occupational Experiences were:	___ . ___ . ___ . ___	

(OVER)

15. Was the subject matter content sufficiently detailed to enable you to develop the desired degree of competency in the student? Yes_____No_____
Comments:

16. Was the subject matter content directly related to the type of occupational experience the student received? Yes_____No_____
Comments:

17. List any subject matter items which should be added or deleted:

18. List any additional instructional materials and references which you used or think appropriate:

19. List any additional Teaching-Learning Activities which you feel were particularly successful:

20. List any additional Occupational Work Experiences you used or feel appropriate:

21. What do you see as the major strength of this module?

22. What do you see as the major weakness of this module?

23. Other comments concerning this module:

_____ (Date)

_____ (Instructor's Signature)

_____ (School Address)

Complimentary

I. R. D. 491

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AGRICULTURAL SALESMANSHIP

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

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One of Sixteen Modules in the Course Preparing for Entry in

AGRICULTURAL MACHINERY - SERVICE OCCUPATIONS

Module No. 4

The Center for Research and Leadership Development
in Vocational and Technical Education

The Ohio State University
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M A N D U M

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Users of Material Teachers

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Teacher Competency Background in agricultural machinery
Student Selection Criteria Post high school, mechanical aptitude, high school background, goal in agricultural machinery service occupation.
Time Allotment Estimated time listed in module. (P)

Supplemental Media --
Necessary x
Desirable ____ (Check Which)

Describe Suggested references given in module. (P)

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(address)

~~YOR~~

AGRICULTURAL SALESMANSHIP

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AGRICULTURAL SALESMANSHIP

Major Teaching Objective

To develop the abilities needed to begin selling agricultural supplies and services effectively

Suggested Time Allotments

At school		
Class instruction	30 hours	
Laboratory experience	0 hours	
Total at school		30 hours
Occupational experience		36 hours
Total for module		66 hours

Suggestions for Introducing the Module

This module is designed to develop the abilities needed by employees to sell all types of agricultural supplies and services required by farmers, ranchers, and homeowners. The following suggestions are offered for introducing the module.

1. Explain to the students that every agricultural employee who deals with customers is, in a real sense, a salesman and needs the qualities of a good salesman. Becoming a good salesman can only be developed through experience. This module is intended to acquaint students with the fundamentals of salesmanship.

2. Have the students identify the firm or firms they or their parents like to do business with because of good sales practices. Avoid naming particular individuals but have the students list the sales practices and human or personality traits which bring satisfaction to the customers when they do business with particular firms. It will be natural for the class to recall instances of poor sales practices and the teacher should tactfully caution the students that, while "true to life" examples are desired, it is better to concentrate on the good sales practices than list the poor sales practices or human shortcomings which cause dissatisfaction when doing business with any certain firm.

3. Ask students to observe salesmen in a farm supply and service center, garden center, or agricultural machinery dealership and attempt to identify those characteristics which apparently are common to successful salesmen. Don't attempt to analyze these characteristics at this point.

4. Have students role-play the selling of a product in class. From the role-playing demonstration, identify with the students the

problems and questions which will be studied. Emphasize the difficulties likely to be encountered by an inexperienced salesman. An alternative procedure would be to have a tape recording of a person making a sale instead of having the students participate in role-playing.

5. Develop with the students the list of competencies to be studied. List these competencies on the chalkboard so students can get a general overview of the content of the module. The competencies included in this module are:

   To learn how to meet the customer
   To learn how to present supplies and services to the customer
   To learn how to overcome resistance
   To learn how to close the sale

Selling is the key function of all business activity. This is as true in agriculture as in other areas. Selling is the act of assisting and persuading individuals or groups to make a buying decision which is to the mutual advantage of both the buyer and the seller.

Selling is really explaining to, persuading, and reminding the public of a particular business concern and of the opportunities and values to be gained from doing business with this concern.

The retailer's function is that of selling goods and services to the ultimate consumer. This is the final step in the distribution of agricultural goods and services.

Producing efficient salesmen is the purpose of this module. Efficient salesmen realize that customers are lost because of:

1. Poor service rendered

2. Discourteous treatment received

3. Indifferent attitude exhibited on the part of the salesman

The salesman must know the psychology of selling if he is to become a successful salesman. In other words, he knows that a customer buys primarily because of <u>need</u> and <u>desire</u>. These are influenced by reason, by emotion, or by a combination of these. A person may <u>need</u> something, but does not buy it until he <u>desires</u> it, i.e., he feels the need.

In summary, to be successful, the agricultural salesman must know the selling process, the merchandise itself, and the firm, as well as understand himself, his relations to the customer, and the customer.

Here is an opportunity for a salesman to (a) deal directly with the public, (b) help other people make decisions, (c) face something new everyday, (d) know that his worth is quickly recognized in terms of advancement, and (e) enjoy the prestige of big business. This big business is made up of

over 1,700,000 retail stores where Americans spend 70 per cent of the family income each year.

Good selling does not happen incidentally but is the result of sound training.

Successful selling produces a satisfied customer who in turn becomes the best form of advertising.

The good salesman must realize that everyone benefits from efficient selling. High sales volume not only insures the salesman's position, but also lowers the price of products or services to the customer.

Good selling awakens and satisfies human wants. Selling is a challenge and every customer is an opportunity for a salesman to get a positive reaction from the customer on five basic buying decisions, namely; the need, the thing, the source, the price, and the time. Selling is helping the customer to buy intelligently.

The customer will gain the most personal satisfaction from his purchase if the salesman makes sure that the product will best fit the customer's need. When the salesman demonstrates courtesy and a sincere interest to be of service, the result is a permanent customer.

Competencies to be Developed

I. To learn how to meet the customer

Teacher Preparation

Subject Matter Content

The impression of the agricultural business that the customer carries away often results from his first contact with the salesman. Appearance and actions play an important part in forming this impression.

A well-groomed salesman attracts customers and inspires their confidence. Undivided attention on the job is essential to good salesmanship.

A good approach presupposes a proper attitude toward the job. Love for one's work is expressed in the enthusiasm with which it is carried out. Enthusiasm is shown through words, actions, and expression. If the salesman is not interested in and enthusiastic about the merchandise, how can the customer be expected to develop much interest?

Salesmanship is demonstrated through promptness, alertness, and interest in the customer's problem.

Treat the customer like a guest. This means that good manners and courtesy are practiced at all times; that the house is in order, neat and clean; that the merchandise is conveniently located; and that the salesman is trained in the fundamentals of selling to maximize the opportunity of being of service to customers.

Points to be considered when meeting the customer:

1. The Preapproach Preparation

   a. Information needed about the customer

      1) Name - Address
      2) Personal characteristics
      3) Mental make-up
      4) Hobbies and interests
      5) Common interests
      6) Buying habits or policies

   b. Sources of this information

      1) Participation in community activities and events
      2) Chamber of Commerce information
      3) Comments made by other members of civic clubs
      4) A personal notebook on customers
      5) Past sale records, credit department records
      6) Interview with people in the community
      7) Local newspaper

   c. Check of facilities and surroundings

      1) General appearance of the store
      2) Lighting
      3) Equipment
      4) Merchandise arrangement
      5) Personnel

   d. Knowledge of benefits the customer will receive from merchandise sold

      1) Design or appearance
      2) Quality of the source - trade name
      3) Composition and construction
      4) Special features
      5) Assortment of sizes, colors, and styles available
      6) Service available

e. Preparation by the salesman

1) Neatness of appearance
2) Preparation of an appealing display arrangement
3) Knowledge of contents of the merchandise in stock
4) Knowledge of the contents of newspaper advertising being circulated
5) Knowledge of names, background, and interests of customers
6) Preparation of a few selling sentences
7) Knowledge of the competitor's product
8) Preparation of a record of common customer objections and development of methods of meeting them

2. Timing the Approach

a. Importance of the impression created by the salesman's appearance and actions

b. Suggestions for:

1) Promptness - clues for failure in being prompt:
   a) Involved group conversations of salesmen
   b) Stock duties
   c) Timidity in approaching customers
   d) Indifference to the needs of the customers

2) Alertness - based on accurate and careful observation; look for clues on:
   a) How and when to greet the customer
   b) When to present merchandise
   c) How to talk about merchandise

3) Interest in customer's problem
   a) Take all the time necessary to understand his problem
   b) Probe to determine if problem is what customer first says that it is
   c) Determine the procedure to be followed to assist the customer with his problem

3. The Proper Approach - Greeting the Customer

a. Types of salutations

1) Conventional
2) Question
3) Stating a fact about the merchandise

b. Elements of a salutation

1) Courteous
2) Short
3) Requires no mental decision
4) Affirmative
5) Emphasizes the desire to serve

c. Tone of voice - pleasant, enthusiastic, distinct, articulate, ordinary

d. Facial expressions

1) A pleasant smile
2) Cheerful expression

Explain what motivates customers to buy. Different physical and psychological factors, operating alone or together, motivate a customer to buy a product. Among them are comfort, pleasure, appetite, possession, fear, devotion, curiosity, ornamentation, imitation, construction, and loyalty.

Developing the proper attitudes necessary for success in meeting a customer is important if the student is to develop effective sales abilities. Among them are:

1. Developing professional feeling toward selling

2. Constant courtesy

3. Enthusiasm for selling

4. Interest in customer's problem

5. Willingness to develop self-confidence

6. Developing integrity

7. Developing sincere attitude of service

8. Appreciating proper psychology such as gaining the customer's attention and interest, creating a desire, and ending with desired action on the part of the customer

Suggested Teaching-Learning Activities

1. Arrange for the class to observe a successful agricultural salesman in action meeting a customer.

2. Develop with the students a list of personal appearance attributes of a good salesman in a farm supply or service center, garden center, or agricultural machinery dealership. (See page 301, Fundamentals of Selling.)

3. Develop with the students a list of the attitudes and actions of a good agricultural salesman.

4. Develop with the students a list of characteristics of an agricultural center or machinery dealership that attract customers.

5. Engage in role-playing, having students act out roles of salesmen and customers and demonstrate how to meet customers. Review each demonstration with the class as to what was done correctly or incorrectly.

6. Using role-playing, demonstrate how a salesman should greet a customer on a telephone.

7. Invite the manager of a successful agricultural business to discuss with the class the attitudes and actions exhibited by salesmen which have been observed to be most effective in meeting potential customers as well as those attitudes and actions which are detrimental to success when meeting customers.

8. Develop with the students a list of the types of customers they are likely to meet (decided customers, undecided customers, casual lookers) and bring out tips as to what would be the best way to meet each type. (See Fundamentals of Selling, pages 324-338.)

9. Prepare a list of greetings to use with customers.

Suggested Instructional Materials and References

Instructional Materials

1. Demonstration telephones-local telephone companies will often supply these for instructional purposes.

2. "The Approach," 10 minute film

References

T*1. Fundamentals of Selling, Chapters 13 and 14.

2. Store Salesmanship, Chapter 2.

*The symbol T (teacher) or S (student) denotes those references designed especially for the teacher or for the student.

Suggested Occupational Experiences

1. Observe the salesmen in the training center and list the appearance, attitudes, and action attributes they have that make them an asset or liability to the business. If you have students in varying types of agricultural training centers, elaborate on common characteristics of successful sales employees in agricultural businesses.

2. Have the students analyze themselves regularly to see if they are developing desirable appearance and attitudes. Use the instruments available from each state's division of vocational guidance and testing.

3. See that the students have opportunities to serve customers at the training center. In the classroom, discuss difficulties the students have encountered in serving customers and discuss methods for correcting them in the future.

4. Have the student answer the telephone at the place of business.

II. To learn how to present supplies and services to the customer

Teacher Preparation

Subject Matter Content

Successful selling requires a careful presentation by the seller. A salesman must recognize the importance of each of the psychological steps in a sale. He must gain the attention, develop interest, kindle desire, and induce action on the part of the customer.

Attracting attention is one thing; developing interest is quite another thing. Attention is more or less involuntary.

Almost anything can attract attention; interest is the result of voluntary reaction on the part of the customer. Interest comes only when attention is prolonged voluntarily and is accomplished by concentration.

Next, one must combine the merits of the article with the needs or wants of the customer to kindle desire. Then, by demonstrating a complete understanding of the interest, needs, desires, and motivating factors that cause a customer to buy, the salesman will be able to make a successful sale. Sales are made by showing the farmer how to increase yields, make more profit, or reduce the labor required, etc. The teacher and the class can readily expand this list.

Draw attention of customers to a supply or service. It can be achieved in many ways.

Reading an advertisement about a beef concentrate
Seeing a new herbicide on a TV commercial
Talking to a neighbor about his new 5-plow tractor
Mailing a circular on early fertilizer purchase discount
Meeting a new petroleum delivery truck on the road
Hearing from a friend about the good service on baler repairs
Reading in the newspaper about a new bulb shipment received at the garden center
Viewing an attractive display of seed at the supply center

Developing interest in a product can be initiated by the customer, the salesman, or serviceman.

Customers can move from the attention, interest, and desire steps very rapidly at times with little or nc encouragement. Example - the customer sees a new field sprayer just the size and kind for which he has a preference--the desire is developed. Often, however, the customer's interest in a product needs to be kindled. This can be done by:

Talking to him about the new features on this planter
Inviting him to a field day where the effectiveness of newly developed herbicides will be shown
Showing him the results of this product in test trials
Demonstrating how simple it is to mount this new corn picker
Pointing out to the customer the number of people in the community who are already using this feed, lawn seed, or grease

Desire for a product may be obtained by relating it to a need of the customer.

Explain how this feed will increase net income by improving an animal's rate of gain.
Show him, with proof from variety trials, how the new oat variety will stand, thereby reducing all those combining problems.

Show him that the chemical weed spray will reduce cultivation, allowing time to get the hay harvested, go fishing, etc.
Sell the merits of the tractor seat, not its cost.
Provide appointments for the customer to try the product on a trial basis.

To be able to present items effectively, you will need to:

Know the features of the item
Be able to answer all questions about the item
Demonstrate its use, operation, value, advantages, and disadvantages

Suggested Teaching-Learning Activities

1. Have the students make a display of agricultural items in the classroom, or possibly make an attractive display of a product on a bulletin board.

2. Have students describe an attractive display to which they have recently been exposed. Try to list those features that made the displays attractive.

3. Visit an agricultural supply center, garden center, or machinery dealership and observe how they use displays, banners, etc., to attract attention.

4. Have the students give a presentation or demonstration that could be used to obtain interest in an agricultural business.

5. Through role-playing, have students show how they would relate a supply or service to a customer's needs. (Desire) This could also be effectively accomplished through demonstrations.

Suggested Instructional Materials and References

Instructional Materials

Gather needed supplies, wall charts, supply information sheets, empty product cartons, product bulletins, and samples so that the students can do the above activities effectively.

References

T 1. Fundamentals of Selling, Chapter 16.

2. Store Salesmanship, Chapter 3.

Suggested Occupational Experiences

Have students observe how effective salesmen show, explain, and demonstrate supplies or services.

Students should gain experience at the training centers by showing, explaining, and demonstrating supplies or services to customers.

III. To learn how to overcome resistance

Teacher Preparation

Subject Matter Content

It is natural for people to have sales resistance. Most of them did not come by the money in their possession easily. It is perfectly natural for people to want to get all that they can for the money spent.

Each sale has two sides. The customer must sacrifice something in order to get something else. Since one cannot have everything, each sale means a choice between one product and another product or one product and another form of pleasure.

The customer must decide which of the choices will give the most satisfaction or pleasure.

It is the salesman's job to convince the customer that his product or service will provide this pleasure, satisfaction, or need. If this cannot honestly be done, perhaps he should not make the sale at all. Anything else is high pressure selling that is unethical and cannot be classified as salesmanship. It will invariably lead to ill will and dissatisfaction.

There are several reasons why customers are resistant to purchasing. The first objection is rarely the actual objection. Identify the real reason for such resistance and try to explain away the objection. To do this you are going to need to be well informed on the supply or service. Types of objections are:

1. Need - Objections to need are overcome by stressing the usefulness and benefits of the product.

2. Quality - Objections to quality are overcome by:

   a. Showing a better quality

   b. Pointing out a specific feature

3. Source - Objections to the source are met by:

   a. Providing names and experiences of satisfied customers

   b. Providing information about the company or by reference to national advertising

   c. Courteously straightening out misunderstandings

   d. Asking for a fair trial of this new firm or by offering something another firm does not carry

   e. Others correcting the shortcomings of the salesman if he is at fault

4. Price - Objections to price are overcome by:

   a. Revealing hidden values - building up values

   b. Emphasizing the quality or usefulness

   c. Providing an article that is not as expensive and doesn't have as many selling points

   d. Knowing competitor's products so that any question on different values can be explained

5. Time - Objections to time are overcome by:

   a. Making a future appointment

   b. Inviting the customer to look at additional merchandise

   c. Continuing to show a positive interest in the customer whether the salesman is busy or not

   d. Trying to handle objections promptly as they arise

e. Not trying to close a sale until all bonafide objections have been satisfied. Make feelers during the sales presentation to preclude objections to a reasonable closing of the sale because of the time.

6. Thing - Objections to the thing are overcome by:

a. Showing more suitable goods

b. Admitting the validity of objection but showing another feature to offset the objection

c. Admitting that the objection is reasonable but showing that it does not really apply

d. Changing the objection into a selling point in favor of the article

e. Avoiding:

Generalizations which mean nothing
Contradiction of a customer's statement
Display of a negative or discouraging attitude

Again, do not pressure customers to purchase; they are not likely to return if pressured.

Suggested Teaching-Learning Activities

1. Ask students to recall experiences of refusal to purchase an item a salesman was attempting to sell. List these on the board, then assign probable reasons for the refusal to buy (need - thing - quality - source - price - time). Have them suggest methods the salesman might have used to try and eliminate this resistance.

2. Have students list objections they would have to purchasing some of the supplies or services they are trying to sell in their occupational experience training centers. Work out methods of correcting these deficiencies or objections.

3. Have students visit neighborhood stores to find out what are the most common objections or items of sales resistance encountered.

4. Have students role-play the sale of a familiar product, emphasizing the overcoming of resistance exhibited by the student playing the part of the customer.

Suggested References

T 1. Fundamentals of Selling, Chapter 17.

2. Store Salesmanship, Chapter 4.

Suggested Occupational Experiences

The student should have experience in attempting to overcome the sales resistance of customers at the training center. Suggest that he report in class how he handled it. Discuss if he used the correct approach. Have his supervisor in the training center critique his performance.

IV. To learn how to close the sale

Teacher Preparation

Subject Matter Content

To learn when to close a sale
To learn methods of closing a sale
To learn why salesmen fail
To learn to stimulate buying
To successfully complete the transaction

Obviously, closing the sale is the most important of all the steps in the buying process. Everything that has been done so far comes to naught, if the customer leaves without making a purchase. Closing starts at the beginning of the sales presentation and "trial" closes are appropriate as it proceeds.

Customers resent being hurried into making a purchase. The salesman must take an active part in inducing a favorable action on the part of the customer, but his attitude must be one of helping the customer in making a wise decision.

Sales are lost because the salesman fails to tailor the sales presentation to the individual needs and requirements of the customer.

A salesman is performing a useful service by offering suggestions to customers who are not aware of their needs or to customers who rely upon displays to remind them of what they came to purchase.

Anybody can sell a customer something he wants. It takes a salesman to sell the customer needed items of which he was unaware.

Closing the sale will be more or less automatic if the need for the article has been definitely established. One of a salesman's functions is to help the customer decide by making "trial" closures.

Don't trip on the last step. The time to close the sale is just after the customer has decided to buy.

Indications that the customer is making up his mind occur when the customer asks the salesman to repeat the advantages of each item and when he wants unwanted goods removed. This is when the salesman should repeat the advantages of the item in which the greatest interest was shown by the potential customer.

The decision to buy occurs after the following conditions have been met:

1. The customer has exhibited attention, interest, and desire in the product.

2. A relationship between need and the merchandise has been established.

3. All important objections have been overcome.

4. The price is low in comparison with value.

5. The product meets the customer's approval.

6. The customer has the power to make the purchase.

The above decision is reached by taking steps during the presentation to make buying "action" easy. Such steps include leading the customer to make a number of small favorable decisions himself, making these decisions progressively more forceful, seeking agreement more frequently as the presentation progresses, and narrowing the selection. This is done by concentrating upon items in which the customer is interested, by removing merchandise in which the customer is not interested, by repeating demonstrations in more detail, and by soliciting the opinion of others. Always ask for the order. Use the "choice" method in beginning the closing phase, i.e., 2 or 3 dozen.

Failure to close the sale may be due to:

1. Assuming that the customer is not going to buy

2. Hurrying the customer

3. Failing to help the customer decide

4. Stumbling over sales obstacles

5. Stressing the wrong selling points

6. Trying to force action

7. Being discourteous when the customer does not buy

When engaged in suggestion selling, the salesman must:

1. Make definite suggestions to the potential customer.

2. Give an acceptable justification for the suggestion made.

3. Demonstrate the merchandise thoroughly and unhurriedly.

4. Not overwhelm the customer with more facts, decisions, etc., than he can face comfortably

Sales are often increased by displaying related merchandise, handling larger quantities, comparing with higher priced merchandise, introducing new merchandise, developing "special" sales, demonstrating new uses for merchandise, and specializing in merchandise for special occasions.

When recording the sale, the salesman, in preparing the sales check, should:

1. Write legibly.

2. Be accurate with items, amounts, and price.

3. List the complete name and address if needed for files or for delivery.

4. Write down any special directions needed to help the customer.

When operating a cash register, make change accurately. Never put a bill away until the customer is satisfied that he has received the correct change. Use the right compartment for paper money and change. Also, learn to count out change properly.

Just because the register bangs shut does not mean that the sale is completed. A proper, courteous farewell often means repeat visits by the customer.

Give the customer a friendly farewell whether or not he makes a purchase and invite him back soon.

Suggested Teaching-Learning Activities

1. Demonstrate, by role-playing, the closing of a sale including:

   a. Packaging or wrapping

   b. Making out sales slips neatly and accurately

   c. Operating the cash register

   d. Making change (using real money is most effective)

   e. Closing remarks

   Considerable time should be allowed to do this until all students are able to do it correctly every time. Shortchanged customers do not return; undercharging customers costs salesmen their jobs.

2. Make tape recordings of all sales conversations of students; play the recording back to point out errors in technique and grammer which need to be corrected.

Suggested Instructional Materials and References

Instructional Materials

1. Standard cash register
2. Tape recorder
3. Books of sales slips
4. Money
5. Telephone

Reference

T 1. Fundamentals of Selling, Chapter 18.

2. Store Salesmanship, Chapters 5, 6, and 7.

3. "Making the Sale," film, McGraw-Hill

Suggested Occupational Experiences

Have the students gain experience at the training center in closing sales, wrapping, making out sales slips, operating cash registers, and making change.

Suggestions for Evaluating Educational Outcomes of the Module

In the final analysis, the best evaluation of the module is the ability that the students exhibit in selling agricultural supplies and services. Different techniques may be used to determine this.

An evaluation check list completed by the cooperating supervisor in the occupational experience center may be used. Self-rating by the students may be used. Evaluation check lists completed by the former student's first employer upon follow up by the teacher may be used.

Such check lists should emphasize each of the competencies included in this module.

Sources of Suggested Instructional Materials and References

Instructional Materials

"Salesmanship Series," 16mm film, B and W, 1959. New York: McGraw-Hill Book Company Inc., with titles as follows:

"The Approach," 10 minutes, $65.00 purchase price.
"Making the Sale," 17 minutes, $100.00 purchase price.

Note to Teachers: These films may be available for loan from libraries or audio visual centers. Other titles in the series which may be desirable to show after previewing but are not particularly applicable for this module are:

"Prospecting," 10 minutes, $65.00 purchase price.
"The Pre-Approach," 10 minutes, $65.00 purchase price.

References

1. Ernest and DaVall. Salesmanship Fundamentals, Second Edition, New York: McGraw-Hill Book Company, Inc.

2. Richert, Meyer, and Haines. Retailing Principles and Practices, Fourth Edition, New York: McGraw-Hill Company, Inc.

3. Robinson, Blackler, and Logan. Store Salesmanship, Fifth Edition, Englewood Cliffs, New Jersey: Prentice Hall, Inc., 1959.

4. Rowse and Nolan. Fundamentals of Advertising, Sixth Edition, Cincinnati, Ohio: Southwestern Publishing Company, 1957.

5. Wingate and Nolan. Fundamentals of Selling, Seventh Edition, Cincinnati, Ohio: Southwestern Publishing Company, 1959.

6. Wingate and Weiner. Retail Merchandising, Fifth Edition, Cincinnati, Ohio: Southwestern Publishing Company, 1957.

THE CENTER FOR RESEARCH AND LEADERSHIP DEVELOPMENT
IN VOCATIONAL AND TECHNICAL EDUCATION
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INSTRUCTOR NOTE: As soon as you have completed teaching each module, please record your reaction on this form and return to the above address.

1. Instructor's Name_____

2. Name of school_____State_____

3. Course outline used: _____Agriculture Supply--Sales and Service Occupations
_____Ornamental Horticulture--Service Occupations
_____Agricultural Machinery--Service Occupations

4. Name of module evaluated in this report_____

5. To what group (age and/or class description) was this material presented?____
_____

6. How many students:
   a) Were enrolled in class (total) _____
   b) Participated in studying this module _____
   c) Participated in a related occupational work experience program while you taught this module _____

7. Actual time spent teaching module:

		Recommended time if you were to teach the module again:
_____hours	Classroom Instruction	_____hours
_____hours	Laboratory Experience	_____hours
_____hours	Occupational Experience (Average time for each student participating)	_____hours
_____hours	Total time	_____hours

(RESPOND TO THE FOLLOWING STATEMENTS WITH A CHECK (✓) ALONG THE LINE TO INDICATE YOUR BEST ESTIMATE.)

	VERY APPROPRIATE	NOT APPROPRIATE
8. The suggested time allotments given with this module were:	___.___.___.___	
9. The suggestions for introducing this module were:	___.___.___.___	
10. The suggested competencies to be developed were:	___.___.___.___	
11. For your particular class situation, the level of subject matter content was:	___.___.___.___	
12. The Suggested Teaching-Learning Activities were:	___.___.___.___	
13. The Suggested Instructional Materials and References were:	___.___.___.___	
14. The Suggested Occupational Experiences were:	___.___.___.___	

(OVER)

15. Was the subject matter content sufficiently detailed to enable you to develop the desired degree of competency in the student? Yes_____No_____
Comments:

16. Was the subject matter content directly related to the type of occupational experience the student received? Yes_____No_____
Comments:

17. List any subject matter items which should be added or deleted:

18. List any additional instructional materials and references which you used or think appropriate:

19. List any additional Teaching-Learning Activities which you feel were particularly successful:

20. List any additional Occupational Work Experiences you used or feel appropriate:

21. What do you see as the major strength of this module?

22. What do you see as the major weakness of this module?

23. Other comments concerning this module:

_____ (Date)

_____ (Instructor's Signature)

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THE OHIO STATE UNIVERSITY
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HUMAN RELATIONS IN AGRICULTURAL OCCUPATIONS.

One of Twelve Modules in the Course Preparing for Entry in

AGRICULTURAL ~~SUPPLY~~ Machinery - SALES AND SERVICE OCCUPATIONS

Module No. 5

The Center for Research and Leadership Development
in Vocational and Technical Education,

The Ohio State University
980 Kinnear Road
Columbus, Ohio, 43212

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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Describe Suggested references given in module. (P)

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HUMAN RELATIONS IN AGRICULTURAL OCCUPATIONS

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HUMAN RELATIONS IN AGRICULTURAL OCCUPATIONS

Major Teaching Objective

To develop in the student an understanding of the qualities necessary for employment advancement in agricultural occupations

Suggested Time Allotments

At School		
Class instruction	24 hours	
Laboratory experience	0 hours	
Total at school		24 hours
Occupational experience		12 hours
Total for module		36 hours

Suggestions for Introducing the Module

This module may be introduced by viewing the 35mm sound filmstrip, "Your Attitude is Showing."

Teachers, in preparing to teach this module, cannot "rush" through it. Competency III, especially, cannot be hurriedly taught.

The students need to understand how relations with people influence the selling process. Good selling is also "top notch" educating. Selling remains the most tangible link in the chain of supplying agricultural products to customers. Each link in the merchandising process depends on the ability of people to communicate and thus coordinate the business operations. The efficiency of a business enterprise is largely determined by the effectiveness of the relations existing between people in contact with the business or occupation. This is the reason why human relations in a business are so important. These relations depend on the sincerity and attitude of the persons employed in that business. Some companies find that two-thirds of all people fired are fired because of disloyalty to the firm or its managerial personnel.

A student who desires to become competent in an agricultural business needs to realize that his personal traits and ability to work effectively with others will determine his value to the business. This in turn will determine how well he will be paid for his duties and how rapid he will advance in his position.

There are four basic types of human relation situations that an employee in an agricultural occupation will encounter. They are:

1. Employer-employee relations
2. Supervisor-employee relations
3. Employee-employee relations
4. Customer-employee relations

The relationships between employees and employers will differ from business to business. Give the students an opportunity to suggest the human relationship characteristics that employers desire in employees. Do these give any clues as to why employees might be dismissed from their occupations? Does this suggest reasons why employees may terminate their employment voluntarily? Prepare for classroom distribution, the following table on which students may categorize their responses.

Reasons Why Employees Leave Their Jobs

Student Reasons	Employer Reasons
Employees Quit	
1.	1.
2. etc.	2. etc.
Employees Dismissed	
1.	1.
2. etc.	2. etc.

After the students have compiled their ideas on why employees are dismissed or have quit, invite local employers to speak to the class and have them give their reasons why employees are dismissed or why employees terminate their employment. A panel of employers will be more effective than a single employer.

When both lists are complete, note the number of instances in which the reason had to do with the personal relations of the employee. Discuss the symptoms of dissatisfied employees and employers. Relate these symptoms to real causes of personal problems in a business. The employers might be willing to relate incidents of personal problems that employees of their businesses might have experienced.

Supervisor-employee relations might be identical to employer-employee relations. Indeed, the supervisor might be the employer. In many businesses, however, employees are responsible for their activities to an individual who is not the employer. Discuss with the class how these relationships might differ from those with the employer. What are some of the problems that can develop when the employer and the supervisor are two different individuals? What should the supervisor expect from the employees for whom he is responsible?

Point out to the students that they must develop a harmonious working relationship with employees as well as with the employer or supervisor. Some employees can work with everyone; others cannot work with anyone. Identify with the class those human traits found in people that make them easy or difficult to work with. Successful employees may be invited to the class to discuss the problems they have encountered in working with other employees and the techniques they have discovered to be effective in helping them to "get along" with all employees. Do all employees need

the same kind of human relation traits? Would employees tend to have different reasons for dismissing employees than would employers or supervisors?

Employee-customer relations are important to anyone employed in agricultural business occupations. The salesman's dealings with the customer are the most critical link in the chain of merchandising products. Ask the class to give reasons why their parents purchased one product over another, or at one business rather than another. Point out that many products are purchased because the buyer appreciates the salesman's personal traits and abilities. These traits and abilities involve knowledge of the product sold, personal honesty, integrity, and courtesy.

Ask the class, "What agricultural commodities tend to be sold on the strength of the dealer's reputation? Why?" Suggest factors which influence the need for strong personal commitment between the buyer and the seller of the product. How does the salesman's age and knowledge of the product affect the personal relations between the sales employee and the customer? Why?

If two products have almost identical technical properties, the reason one sells and the other does not may be due to the salesman.

Product information and sales are beamed toward the personal needs of customers. During a sale, product information should be made directly applicable to the personal needs of the potential customer. Ask the students to list human needs of every person.

A. H. Maslow, as a "preface to motivation theory," has listed human needs from the most biological to the most social:

1. Those needs which are essential to sustaining life itself: needs for air, food, water, warmth, etc.

2. Those needs which are related to maintaining the physical safety of the individual, such as the need for defense against physical attack

3. The need to be loved, cherished, and aided by others

4. The need for esteem: the need to have worth and value as an individual, to respect and value oneself because one is respected and valued by others

5. The need for self-realization: the need to be creative and productive, to cope with life effectively, to work for and attain worthwhile objectives

Competencies to be Developed

I. To identify particular occupations which offer the most promising employment opportunities for a particular person

Teacher Preparation

Subject Matter Content

Develop the idea that understanding people means being able to differentiate among the many beliefs, attitudes, and abilities which different persons have. People may look alike, but their thoughts and actions differ.

Discuss with the students the personal attributes needed by employees before they will be accepted as suitable individuals by their employers. What is meant by such terms as honesty, loyalty, cooperation, etc.? Have them develop in their minds individuals they know who possess these qualities. Are these qualities lacking in certain business employees with whom they are familiar?

In addition to being able to identify various degrees of characteristics in people, prospective agriculture business employees need to understand that all behavior is caused by something. Why do persons cheat? Steal? Why do people help their neighbors?

We should defer judging other people's behavior until we have some understanding of the reasons for their behavior. A direct application of this principle would be an employee who has difficulty getting along with another employee. An employee should attempt to understand why the other person behaves as he does. Once the employee has this understanding, he will be more capable of adjusting to the individual.

As an individual considers his environment and himself, he begins to make plans for the future. A person who does not plan his career can expect to be more directly influenced by his environment than the person who examines the various directions for his future and sets a goal. Many times a student can set his goal and change the environment to fit his objective more directly.

Consequently, we see students beginning to form habits and taking on definite personality characteristics. Teachers are in key positions to assist their pupils in evaluating their past experiences and present attitudes, and in projecting changes in them toward career development.

Test information provides a guide to career decision-making. It is only one of several sources of information. Others include parents' attitudes and personal considerations. Discuss the purpose of giving the following tests when planning a career:

The Aptitude Test
Tests of Skills and Abilities
Interest Inventory
Personality Tests
Intelligence Tests

Consult with the guidance counselor in the school system. Compile a folder for each student which contains test results and prepare an interview for each student with the guidance person.

After helping each student evaluate himself, the next step is the identification of occupations which offer prospective employment for that particular student.

Several films are listed in the references which offer a general description of career opportunities in agriculture.

Career information pamphlets are available from colleges of agriculture, which describe opportunities for young persons in agriculture. These pamphlets are listed in the references.

Place the following information in chart form on the chalkboard. The relationship between education and income is a dramatic one.

Median Annual Income for Male Persons, Fourteen Years Old and Over
(Based on 1961 earning levels)

Amount of Education	Median Income
Less than 8 years	$2,090
8 years	3,452
1-3 years of high school	3,865
4 years of high school	5,052
1-3 years of college	5,246
4 years of college	7,261
5 or more years	7,691

Present an outline of an occupational brief to the students. The following is an example:

Job title
Basic qualifications (sex, age, marital status, military status)
Physical qualifications (health, travel, etc.)
Personal qualifications (interests, abilities)
Skills, knowledge, and abilities required
Wage, hours, conditions of work, employee benefits
Avenues of entry and promotion
Educational and training requirements

Several of the listed references provide forms for evaluating careers in agriculture.

Information about careers is available from several sources:

1. Your public or school library
2. Interviews with friends, relatives, neighbors
3. Personal visits to place of work
4. Observation of the jobs around you
5. Newspaper ads
6. Classes in occupations or social studies
7. Interviews in public employment offices
8. Vocational films
9. Government bulletins

Suggested Teaching-Learning Activities

Invite the local employment security officer to speak to the class to give information about the characteristics of people they place who are successful, about his own duties, and the kinds of information which may be secured from his office.

Ask the students in what ways the following factors could affect employment opportunities:

Physical condition (health and age)
Personal and home life (attitudes and beliefs)
Past experiences (school and work)
Mental abilities (recall and memory, ability to reason, ability to make decisions, rapidity of thought, and creativity)
Motor abilities (coordination, dexterity, reaction speed)
Knowledge and skills
Education
Character

Have students rate themselves on the following personality traits. Have the students ask themselves if they always, usually, or never have these personality traits:

Desirable Personality Traits

Accurate	Conscientious	Loyal
Agreeable	Dependable	Mature
Appreciative	Energetic	Patient
Alert	Enthusiastic	Realistic
Careful	Efficient	Responsible
Confident	Honest	Tactful
Cooperative	Kind	Tolerant

Objectionable Personality Traits

Antagonistic	Greedy	Sensitive
Argumentive	Inattentive	Sulky
Artificial	Militant	Timid
Boastful	Moody	Untrustworthy
Critical	Rebellious	Vague
Defensive	Sarcastic	Vulgar
Domineering	Selfish	Vicious

Have students report on the qualities they like in other people. Ask the students to evaluate themselves accordingly.

Ask students how their hobbies and outside interest can affect their success in working with people on the job they hold.

From these activities, students should be able to make up a "Personal Data Sheet." Forms for a data sheet vary from reference to reference. General categories might be:

Personal information
Job objective
Education
Work experience
References

Develop a list with the students of what employees want from a job, i.e., recognition, a feeling of being useful, adequate wages, security, etc., and stress the point that much of this depends on their relations with others.

Discuss with the students how the personality traits and characteristics listed can influence their employment and chances for success. Point out that he, the student, is the only person

who can change these traits and characteristics. Such a personality profile should delineate those factors that will help or hinder the student in seeking employment.

Present the following on the chalkboard. Show how employee satisfaction is a direct result of matching employee needs with occupational expectations.

An Employee's Disposition and Needs + The Job Expectations	result ---------- in	Employee	Satisfaction or Dissatisfaction

For example, a person who likes to be with people, who is friendly and likes to discuss ideas, should not plan to become a truck driver. Why not?

Ask the students to list occupations that would be acceptable to an extrovert or to an introvert.

Ask the group to rate various volunteer members in the class on some personality test items. Compare the group's rating with the individual member's score. Point out that friends, relatives, and associates evaluate one's personal traits and characteristics. What other people think of you is going to have more influence than what you think of yourself. This has implications for ways to maintain morale in a work force.

Discuss the meaning of a person's "need-disposition." Do you think that a person who has always wanted to be a bookkeeper would be happy being a salesman in a feed store? Why?

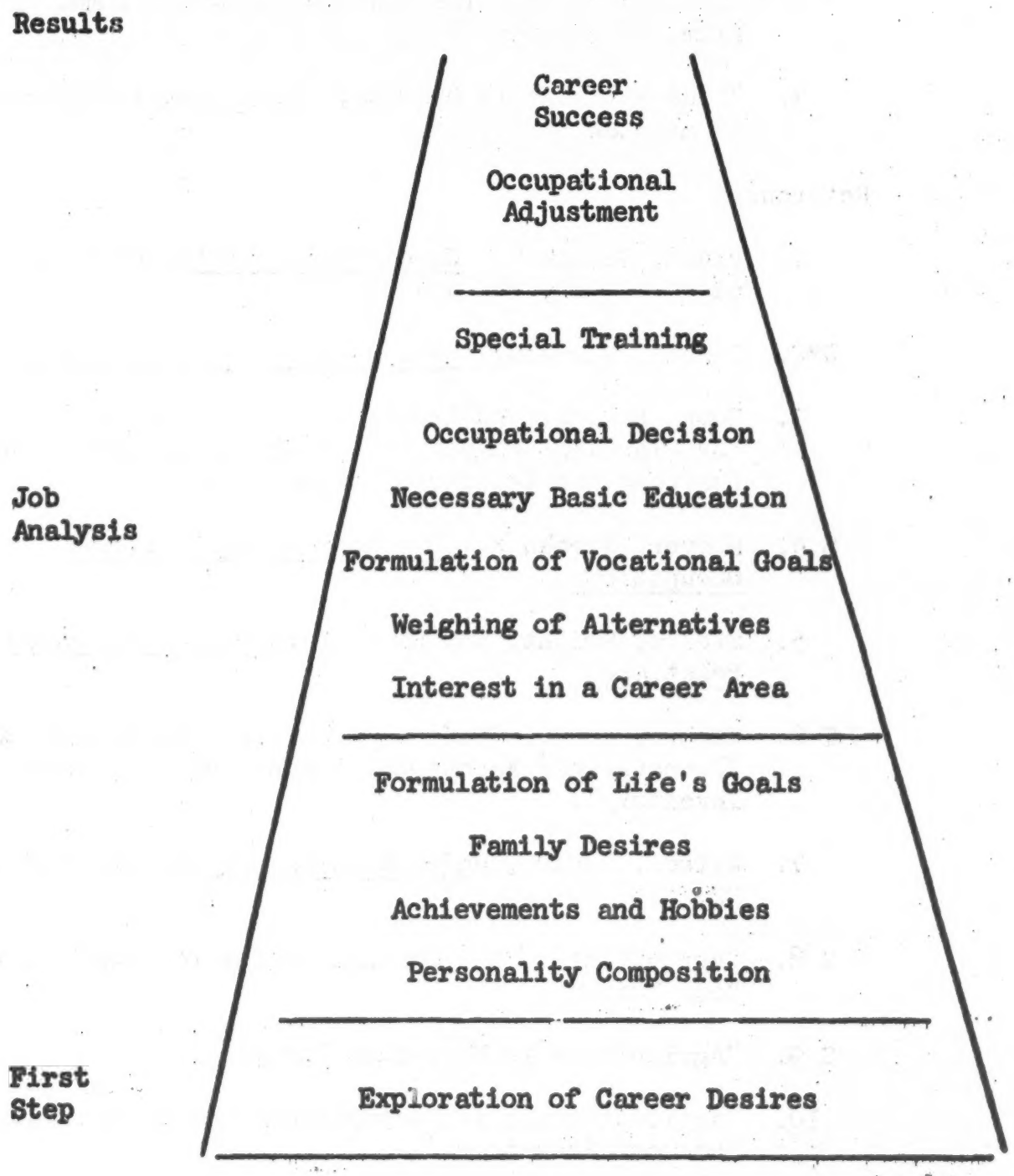
Before the students go out on their occupational experiences, ask them to select occupations which are most likely to require their most outstanding abilities. These should be the job descriptions which offer prospective employment.

After the occupational experience on the job is completed, classify the discrepancies found between the requirements of the job and the student's qualifications for the job.

Ask the students to write a personality sketch of themselves and a job description of the position that they would like to be in ten years from now.

Below is a pyramid on building career success. It is suggested that this chart be duplicated, drawn on the chalkboard, or shown to the class with an opaque projector. Discuss with the class the sequence of events that lead to career success.

Building Career Success



Suggested Instructional Materials and References

Instructional Materials

1. "A Step Ahead--In Careers in Agriculture," 16mm. color film, 14 minutes

2. "Dynamic Careers Through Agriculture," 16mm. film, 28 minutes

3. "Your Attitude is Showing," 35mm. sound filmstrip, 12 minutes

References

1. Blume, George T. Career Exploration, Unit I, pages 11, 12, 24, and 28.

S*2. Duncan, Clyde H. Find a Career in Agriculture.

3. Hemp, Paul E. and Krebs, Alfred H. "A Study Guide for Placement--Employment Programs in Agricultural Business and Industry," pages 17-20.

S 4. Hoover, Norman K. Handbook of Agricultural Occupations.

5. Sferro, Wright, and Rice, Personality and Human Relations.

T 6. Walker, R. W., Stevens, G. Z., and Hoover, N. K. "Pennsylvania Vocational Agricultural Interest Inventory".

7. Wilson, Howard, Understanding People, pages 27 and 32.

S 8. "Agriculture," The Sextant Series for Exploring Your Future.

S 9. "Agriculture is More Than Farming".

10. "Aptitude Tests for Occupations and an Occupational Interest Inventory."

* The symbol T (teacher) or S (student) denotes those references designed especially for the teacher or for the student.

S 11. "Careers Ahead" bulletin.

S 12. "Challenge in Agriculture" bulletin.

S 13. "Choosing Your Occupation."

14. "Jobs in Agriculture."

15. "Kuder Preference Record."

S 16. "There's a Future in Your Farm Background."

Suggested Occupational Experiences

Ask students to prepare a detailed job description of the occupational position they are holding as a student trainee. Fill out in detail a list of the expected requirements of the job. Have them fill out the list at the close of the cooperative occupational experience. The cooperating employer should evaluate this list with the student.

Build into the program a variety of experiences for the student trainee on the job. For example, the student could spend one day with a selected employee from several different kinds of positions. The student trainee would then make out an occupational brief for that position.

Have the student do an occupational brief on a position in the business and compare the brief with the data sheet of the employee on the job.

II. To communicate effectively with a prospective employer

Teacher Preparation

Subject Matter Content

It doesn't do much good for the student to identify his strongest personal characteristics and to describe the job which would make maximum use of these characteristics unless he is successful in obtaining the position. Consequently, this section of the module concentrates on the employment interview. The employment interview is discussed in a number of references.

Perhaps the most fundamental of all human skills is the ability to communicate ideas, attitudes, and beliefs. This skill becomes

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critical during an employment interview when time is short and the interviewee wants to make maximum use of all available means of communication.

During a conversation such as an employment interview, the communications process goes two ways. When words do not mean the same thing to the interviewer that they do to the interviewee, misunderstandings occur. Be precise with words!

Another opportunity for misunderstanding in an employment interview is the inattention of the receiver. To carry on an effective conversation, the listener must listen to what the speaker is saying. Many times during an employment interview, the interviewee will want to respond to what the interviewer is saying. Ask the students to list the number of ways a person might respond when wanting to agree with his prospective employer.

Example: A raised eyebrow, smile, nod of the head, etc.

Verbal communication is not the only important way to communicate with a prospective employer. A firm handshake can tell a lot about a person.

Preceding the employment interview, the student will write a letter of application. Discuss the purpose of a letter of application.

The letter of application is a personal sales letter. Its purposes are to:

1. Establish contact by indicating how the job became known to you.

2. Create interest by stating your personal qualifications, interests, and achievements.

3. Convince the employer that you are the man to fill the position by indicating that the job is interesting to you as a career or by indicating that you feel this is a stepping-stone to earning greater responsibility in the company.

4. Interest the employer to sufficiently generate action by including a list of references who know of your work and ability and who could vouch for your qualifications.

5. Interest the employer by requesting an interview to personally relate your qualifications.

6. Supply the prospective employer with enough information for him to arrange the all-important interview with you.

Letters of application should be typewritten, if possible; if not, write in ink. The letter should be written on a good grade of standard $8\frac{1}{2}$ x 11 bond stationery. Check the letter for mispelled words and grammatical errors. Neat and ligible copy with no noticeable erasures or blots can create a good impression. Be sure to fold the letter correctly and to place it in an envelope of correct size.

The question of salary should be avoided until a prospective employer specifically requests you to state it. Your response could then be, "While it is difficult for me to say what salary I should receive, I would consider _____ per month a fair starting salary."

People communicate ideas and attitudes in a number of ways. How we look and dress reflects our attitude. A pair of shoes in need of a shine communicates much to a prospective employer.

How do we acquire the personal and social skills necessary for success?

The process of maturing and growing up has left its mark on each of us. A person once said, "We are a part of every person we meet." In a very real sense this is true. As we share experiences with others, we understand them better, and we learn what is expected of us. What is expected of us varies from place to place.

An employer hiring an individual to pick tomatoes by hand would not expect the same personal characteristics as he would in a prospective employee selling tomatoes and representing his business to customers.

The salesperson, representing the business and product to the customer, is the last link in a chain of employees. This customer-oriented employee, who automatically becomes associated with the business product, must be pleasing and acceptable to the buyer.

Impress upon the students that there are some personal characteristics which everyone demands--cleanliness as opposed to dirtiness, for example.

Invite the home economics teacher or other qualified persons to discuss with the students proper grooming, eating habits, how to make an introduction, etc.

Introductions are a means of making people feel comfortable. One person is introduced to the other such as, "Phyllis Lewis, have you met Bob Jones," or "Father, this is Bill Smith."

Rules for introductions are:

1. Present a younger person to an older person.

2. Present a boy to a girl or a man to a woman.

3. Present a less prominent person to one of greater importance.

Suggested Teaching-Learning Activities

Invite a student from whom you expect to receive a mediocre handshake to role-play being introduced to a prospective employer. Discuss the importance of a handshake in communicating an individual's personality.

Introductions can be important. For example, a prospective customer might want to meet the new school principal who happened to be in your store. The ability to introduce the prospective customer to the principal could mean a future sale.

After discussing the suggestions for writing a letter of application, ask the students to write a letter for a particular job description. Analyze the student letters and suggest changes for improvement.

Have each student prepare a personal data sheet describing his personal characteristics, job objectives, education, work experience, and references.

Set up a role-play phone conversation of a student requesting an appointment for an employment interview. Ask one student to be the employer and another to be the prospective employee. The class should "listen in" on the conversation and analyze the roles of the two persons. Rate them on politeness, articulateness of voice, comments, etc.

Role-play employment interviews with the students dressed appropriately. Tape record the sessions and play them back to the class. Discuss methods of improving the interviews.

Compare the effectiveness of a phone interview with that of a face-to-face interview in conveying impressions of personal characteristics, such as voice inflection, dress, use of English, etc.

Ask students to list items that they will want to learn from an employment interview.

List items the employer will want to know during an interview that a prospective employee should be prepared to discuss.

List the personal attributes that each channel of communication can best convey to a prospective employer.

Communicating Abilities and Attitudes

	Personal	Social
A written letter	(List characteristics you would want to convey. Example: accuracy, neat appearance, etc.)	
A face-to-face interview		
Indirectly through a reference		
Telephone conversation		

Ask students to list a number of different ways they can communicate their past experiences to an employer. Example: Letter of Application, Recommendations of Past Employers, etc.

Ask the class what factors influence the selection of a person for an employment reference?

Ask the students to rate themselves on the personal characteristics checklist. The list below was compiled from the results of hundreds of answers to the question: What physical traits keep people from presenting a good appearance and hence hurt their personalities? Place a check mark before each trait that applies to you:

_____ Dirty fingernails
_____ Dirty hands
_____ Beard
_____ Yellow or unclean teeth
_____ Pimples on face
_____ Dirty face
_____ Greasy hair
_____ Dandruff
_____ Hair too long
_____ Soiled clothes
_____ Baggy trousers
_____ Unshined shoes
_____ Bad breath
_____ Too few baths
_____ Inappropriate clothes
_____ Awkward posture
_____ Hair not combed
_____ Broken shoestring
_____ Buttons missing
_____ Clothes fitting poorly
_____ Dirty handkerchief
_____ Run-over heels

Number of checks _____

Even one check may be the difference between employment and unemployment.

If you checked more than six, you are in pretty bad shape. Drastic action is necessary.

Look over the items that you checked. Each one is a personality defect in the eyes of other persons. Each defect can be eliminated.

Suggested References

1. Blume, George T. Career Exploration, Unit II, pages 36 and 37.

2. Hemp, Paul E. and Krebs, Alfred H. "A Study Guide for Placement--Employment Programs in Agricultural Business and Industry," pages 28-36 and 107.

3. Keily, Helen J. and Walters, R. G. How to Find and Apply for a Job, pages 48-51 and 76-82.

4. Richert, G. H., Meyer, W. G., and Haines, P. G. Retailing Principles and Practices.

5. Weyant, J. Thomas, Hoover, Norman K., and McClay, David R. An Introduction to Agricultural Business and Industry.

6. "Getting Ahead in Retail Selling."

Suggested Occupational Experiences

After preparing students in the classroom, send them for an interview with their prospective employment cooperators "on their own." Ask for a report on the interview from the cooperating employer. Timid students may require more attention before they are willing to "go it alone" during an interview.

Ask the students to report to the class on their general impressions of the interview.

During the cooperating employment experience, each employer should analyze the student's work record with the student trainee and teacher present. Note any improvements made in personal and social skills.

III. To understand complex problems of human relations found in a business by identifying the problems, analyzing the situations, and formulating possible solutions

Teacher Preparation

Subject Matter Content

Suggest to the class that there are two main categories of factors which affect their interpersonal relations on the job. The first is the kinds of tasks they are asked to do. Early in the module, emphasis was placed on identifying job skills which were compatible with the individual's wants or needs.

The second group of factors affecting personal relations on the job pertain to the environment. The attitudes of the other employees, the time requirements of the job, the freedom to be your own boss, etc., all affect an employee's relation to other persons. Although we study these categories of factors separately, in practice, they are almost impossible to separate.

One way to study interpersonal relations within agricultural businesses is to examine relationship among employees, between employees and customers, and between the employee and the supervisor.

If a student develops a concept, an idea, or expectation of the relationship which should exist within a business, he or she should be better prepared to cope with any eventuality when he or she actually becomes employed.

Consequently, this section of the module presents concepts of loyalty, honesty, etc. Invite student responses to the descriptions given, and suggest solutions or role-play the cases that follow a description of the concept.

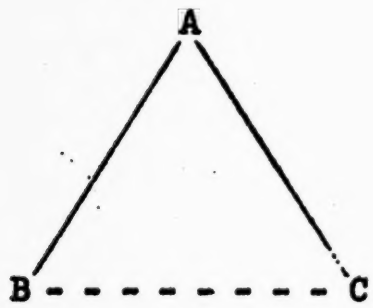
Suggested Teaching-Learning Activities

Ask the students what factors would affect an employee's ability to get along with his supervisor. Discuss the effect of age, tenure, education, etc., on human relations in an agricultural business.

Ask students what a "boss" should expect from his employees. Ask students what an employee should expect from his boss. Use the case studies described on pp. 19-30 to illustrate the points brought out. Stress the completed involvement of human relations in these expectations.

The structure of a business (the line-staff relationship) has an effect on employees. Present the following diagram and ask the class to compare the relationships between employees A and B with those between B and C.

Line-Staff Relationships



_____ = Direct command relation

- - - = Informal communications

Present the following table to the class at the beginning of this section of the module. These are examples of human relations concepts that could be duplicated and passed out for class discussion:

Implications of Human Relations Concepts in Three Different Occupational Relationships

	Relations with		
Concepts	The Customer	The Supervisor	Another Employee
Loyalty Respect for Authority Willingness to Learn Cooperation Honesty Responsibility Leadership Morale		Ask members of the class to describe the meaning of the concepts in these three different frames of reference. Most students will want to give an example of what the terms mean. Ask students to describe the negative dimensions of the concepts. Examples: A disloyal employee.	

The following material in this module may be duplicated by the teacher and passed out to the students for discussion.

LOYALTY

An employee faithful to the supervisor and business firm who employ him will always be an asset. Many situations will occur which are difficult to anticipate. An employee will find it very difficult to hide his feelings about the people and organization for which he works. If he respects his superior and enjoys working for the agricultural business firm, he is likely to convey this attitude to his friends and prospective customers. Obviously, loyal members are highly desirable. The real problem comes in trying to define "loyalty" and to develop it in people.

Loyalty implies support of a cause, ideal, practice, or custom. It includes an element of faithfulness to a person or organization.

People live by faith and confidence in other people and organizations. As you drive down a street approaching an intersection, you believe the car on your right will stop at the stop sign. You expect the car to stop.

Loyalty in an agricultural business operates in much the same way as in faith on a highway. The supervisor or other person representing management expects employees to perform the tasks assigned to their specific occupation. In return, the business agrees to pay employees a salary. The employees become agents of the business during the working day. Whether or not this obligation to support the business extends into other parts of the day depends on how the employee feels about the business. If he has been treated fairly and honestly, he probably will continue to support the organization after working hours.

Loyalty takes time to mature and grow. It is the product of continued contact with a person or business over a length of time. New employees should not expect to receive it before proving themselves worthy of their supervisor's faith and confidence. Likewise, business firms must earn loyalty from their employees. The good will and loyalty which develop between a supervisor and employees or among employees are valuable commodities, which are not to be treated lightly.

The Case

Norman Jones, an employee in a farm supply store, has sold goods in this store for a number of years. He has come to know and to appreciate his co-workers and the manager of the business office. As far as he knows, the store has always attempted to give good service to its customers.

This afternoon, Wayne Wilson, ordinarily an intelligent and mild-mannered local farmer, came into the store very upset. An insecticide which he had purchased at the store and applied to his alfalfa had seriously damaged the crop. Wayne believed the store manager deliberately sold him the wrong kind of insecticide.

Wayne and a group of neighbors have been going together and ordering their protein supplement directly from a soybean processing plant. By ordering a carload and splitting it among the group, they can purchase the supplement much cheaper than the store can afford to sell it to them. Wayne believes this is the reason the store manager sold him the wrong insecticide for his alfalfa.

Wayne came up to the counter and demanded in a loud voice to see the manager. Norman looked for the manager but couldn't find him. Wayne did not want to wait, so he left the store mumbling to himself. When the manager came in, Norman related the story to him. They found the sales slip which gave the name of the insecticide which was sold to Wayne Wilson. It was appropriate for alfalfa. They read the instructions and decided that Wayne must have made the spray mixture too strong.

Since the agricultural business didn't want to offend a customer, the manager asked Norman to drive out to Wayne Wilson's farm and explain the situation to him. When Norman arrived at the farm, he found a neighbor of Wayne's helping him assemble some machinery. Norman carefully explained what must have happened, showing Wayne the sales receipt. Like most of us, Wayne did not want to admit the damage to his alfalfa was his fault. Wayne was critical of the store, and said, "The store manager deliberately gave me wrong information."

Assuming Norman is a loyal employee, what should he do?

Discuss the statement, "A loyal employee should endorse all business policies at all times." To what extent is this true?

RESPECT FOR AUTHORITY

Authority in agricultural businesses usually rests in administrative positions which are responsible for production processes. For example, in large businesses there may be a vice-president for sales, one for production, another for personnel, and so forth. Each man has the right to make decisions for his area of the business. Each person in an administrative position is usually responsible to the manager or president of the company. The top management position answers to the Board of Directors who have final control of the organization. Each person in a business forms part of a chain.

Authority is the power or right to give commands, take actions, or make final decisions.

In some businesses these lines of authority may be closely drawn with each person carefully guarding his own domain. Large-scale organizations controlling many sub-parts sometimes becomes bureaucratic. Much valuable company time and effort may be lost by employees fearful of petty jealousies and status-hungry co-workers. Most agricultural businesses are relatively small and uncomplicated. Yet, the concept of respecting your superior is an important one, even in a small business. Consider the following case.

The Case

Mr. Renolds is the owner and operator of a poultry farm. The largest enterprise on the farm is a flock of 25,000 laying hens. He produces, grades, packs, and delivers eggs under his own farm brand. He retails some eggs to customers who are willing to drive out to his farm, but most of his eggs are delivered to grocery stores and restaurants in an urban area.

Mr. Renolds spends most of his time delivering and selling eggs. He seldom directly oversees the work of five employees on the farm. Instead, he has appointed as foreman an employee who has been with him a long time, Tom Curtin. Tom makes all of the work assignments.

One of the men who had been working on the farm took another job. Mr. Renolds contacted the local vocational agriculture teacher and asked if any of the June graduates would like temporary or permanent work. He interviewed and consequently hired Bob Mix, an energetic young man with impressive grades and a desire to get ahead. After the interview, the vocational agriculture teacher congratulated him and told Mr. Renolds that he had hired someone with a great deal of initiative. Mr. Renolds replied that he was looking for that kind of person, because he was very dissatisfied with the amount and quality of work produced by his farm crew. He hoped Bob could improve the work output.

Bob had been working about a week when he discovered the problem mentioned by Mr. Renolds. He was hauling wood chips from a nearby sawmill. By 2:30 p.m. he had hauled three truck loads and was planning to get another when the foreman, Tom Curtin, came over to the truck and complimented him on his good day's work. Bob explained that he had time to get another load before 5 o'clock and planned to do so.

"Now, Bob, you are new on this job," was Tom's reply, "and out here on the farm we work with each other. Mr. Renolds leaves these kinds of decisions up to me. Nobody works too hard and

nobody accomplishes so much that he causes others to get fired. You are not going to haul another load of wood chips today!"

If you were Bob, what would you do?

WILLINGNESS TO LEARN

One of the few certainties of life is the likelihood of change. Everywhere we see new products and new techniques taking the places of old ones. Business firms spend a great deal of money on research to find new and better products.

Car manufacturers can change a design for a new model rather easily; people are much more difficult to change. Once ideas are entrenched and attitudes established, it is very difficult for individuals to accept new ones. Fixed patterns and habits always take precedence over new ones.

Since "things" change more easily than people, employers usually investigate a prospective employee's willingness to learn new ideas. A person who accepts inevitable changes that occur during the process of living will not spend as much time worrying about them as the individual who does not. Previously held assumptions need constant re-evaluation. Much energy is expended by frustrated dissatisfied employees. A willingness to change and learn new ways of doing things is a characteristic which we should all cultivate.

The Case

The Quick-Trim Landscaping Company is a large agricultural business which employs various teams of men to perform a variety of duties. The company has contracts for maintenance of cemeteries, parks, etc. It also establishes new lawns. Within each work team, some job tasks are more specialized than others. Alvin Myers, the foreman of one six-man work crew likes each man to be familiar with a variety of skills. When an individual is absent or is sick, another person from the same group can take over his responsibilities. These new skills are taught to the men during slack periods in certain seasons of the year.

Last week, Alvin asked Jake Hanson, one of the older employees in his group, to learn how to operate a surveyor's level. The instrument is used in determining field grades, drainage ditch routes, and selecting and checking the level of the seed bed on an area to be landscaped. Jake is a 35-year-old employee who is married and has two school-age children. He has very little initiative; in fact, he has had trouble keeping a job. He has been with the landscaping company for six months. So far, he hasn't had much to say, keeping to himself and doing only what

was asked of him. When Alvin asked Jake to use the level, he replied, "I'm not getting paid to run that thing and do that kind of work. I don't want anything to do with it."

How do you feel about Jake's comment?

COOPERATION

Whenever one human being finds himself in contact with another, either on the job, at school, or in the home, personal relations become a factor between the two personalities. Feelings and attitudes between persons affect the goals of the social group. In many cases, the goals of the social group--the church, the family or the business--can be attained only with the help of individual members. Agricultural businesses operate to make a profit for their stockholders and provide services to customers. Employees should accept these goals and work toward their accomplishment. Whenever you engage in a cooperative enterprise with others, you expect to lose a certain amount of individual freedom in order to benefit the group.

Cooperation means joint action with others in pursuit of common well being.

Cooperation in an agricultural business is similar to the activities of a football team. Each individual has a job to do. Without the efforts of the linemen, the quarterback or fullback could do little to advance the ball. Likewise, the salesmen must sell the products before a manager can show a profit. It takes the cooperation of all employees for a business to operate smoothly and efficiently.

The need for cooperation extends into every business firm. Each employee is a member of a team--a business team. He has responsibilities to fulfull which contribute toward the team goals. Many occupations in a business, such as the quality control personnel in a milk processing plant, are key positions. If the employees in these positions neglect their jobs, the entire business suffers because the quality of the product is lowered. To a greater or lesser extent, the business is affected when any employee does not perform his job adequately.

Cooperation doesn't just happen; it has to be encouraged. An employee who feels rejected by his employer or believes the business is taking advantage of him, is not likely to give up many personal privileges to contribute to company goals or policy. Fortunately, most people desire to belong to groups and want to get along with their fellow employees. Some of the most satisfying employment experiences come from the warm

personal friendships which develop between customers and employees, between the employee and the employer, or among employees. These feelings can be so strong that employees dislike being transferred from one location to another even within the same company.

Before two employees can cooperate on a mutual project, each person must respect the other. If this respect does not extend to the personality of the other individual, it must at least extend to the other person as a fellow employee. Any agricultural business employee should see himself and others as members of a team working toward a common goal.

A person exhibiting a cooperative attitude will contribute much as an employee to an agricultural business. He will not only aid the company directly by enthusiastically giving of himself, but he will inspire confidence in the company and cooperativeness in other employees.

The Case

The East Coast Farm Supply Company is a cooperative organization which has several branch offices throughout the state. These branch offices supply feed and fertilizer to commercial farms in their respective areas.

Mike Hanna is a high school student, who is working for the Long Valley branch office of the cooperative during the summer between his junior and senior year. He has performed several different jobs around the cooperative. This week he was driving a truck and spreading lime on a nearby farm. He had worked hard all week and was looking forward to the weekend, when he was approached by the manager of the cooperative and asked to continue spreading lime on Saturday. Mike checked with the other four truck drivers and discovered only two others had been asked to work during Saturday. In Mike's judgment, he was asked to work because he was the youngest and the newest employee in the business.

If you were Mike, what would you do?

HONESTY

All of us have an idea of what we mean by the word "honesty." If we were to ask each person in the room to give his definition of the term, we are likely to have as many definitions as people. Each definition would reflect the past experiences of the person. Since we have all had different experiences, each person's concept of honesty would be different. Sometimes we use different

standards to arrive at a definition of "honesty." Honest behavior for some persons means doing whatever works. A person who successfully gives a false statement in defending a friend, has a completely different belief about honesty than an individual who would never tell a lie, regardless of the situation. The same person may use a different standard for honest conduct depending on the situation.

Honesty is straightforwardness of conduct; it requires a sincere effort from each of us to maintain integrity, fairness, and truthfulness in all situations.

Since we do not always know other persons' past experiences and beliefs, we have to be tolerant of their actions. A person may commit a dishonest act unknowingly and be sorry for it later. American people have emerged from the peoples of many nations. Consequently, our society contains persons with vastly different values and ideals. When we see an act committed which we dislike or do not understand, we must try to comprehend why the person did it and attempt to persuade him to change.

The Case

The Cox Implement Company has been located in a small rural community of 2,550 population for about ten years. They sell a nationally advertised brand of agricultural tractors and machinery. Many times they are asked to service the machinery of other makes both in their shop and out on farms. To do this work, the owner and manager, Mr. Cox, employs five other persons in addition to himself.

Ron Thomas is a young man who has been employed by the company for only two weeks. He is a good mechanic. He has had five years' experience with an automobile garage in another town. It had been an unwritten policy among the employees at his previous place of employment to take company supplies if they needed them for their personal use. As far as Ron knew, no one had ever taken supplies or equipment to sell to other persons.

One day another employee, who had become a friend of Ron, saw him put a handful of bolts and nuts in his lunch box, apparently to take home. If you were the employee who saw Ron do this, what would you do?

RESPONSIBILITY

Like "honesty" and "loyalty," the term "responsibility" defies any kind of comprehensive and precise description. The actions of a "responsible" person vary with different situations. Many

factors influence the "total" personality: a person's previous experience, his attitude toward his supervisor, and so forth. It is difficult to predict responsible behavior because it varies with the motives and aspirations of persons.

A responsible person determines his own acts by carefully considering the consequences of his decisions.

An effective business organization must hire trustworthy and reliable employees, persons who feel some obligation to their job and desire to complete work assignments. Such "responsible" behavior is necessary for efficient operation of a business.

A responsible person is one who is capable of determining his own actions. Responsibility implies an ability to foresee the consequences of actions. When an employee is consistently late for work, or takes a "don't care" attitude toward his job, or behaves inconsistently so that he cannot be counted on to complete work assignments, we say he is irresponsible. A person who is not responsible for himself will be a liability to any business, regardless of the menial tasks he performs.

This instructional material is designed to develop responsibility in the reader by asking him to consider the consequences of his decisions. Learning how to make decisions will go a long way toward developing responsible employee behavior in an agricultural business.

A business firm hiring a large supervisory staff to make certain employees are doing their jobs is maintaining an expensive administrative structure.

The Case

Warren Smith is an employee at a feed store in a rural community. Many farmers in the area buy feed on credit. There are three employees in the office who do most of the sales work. The customers like the informal atmosphere of the business.

Warren usually locks the doors at closing time. This evening he noticed two sacks of feed to be on the loading dock next to the storage room. The storage room is locked and the other employees have left for the day. Warren examined the feed without finding any reasons for it to be outside.

What would a responsible employee do?

LEADERSHIP

In a democratic organization, members of a group select the persons to lead who best represent the majority's feelings and beliefs. The majority of the FFA members elect a chapter president. The person elected becomes an identified leader of the local FFA chapter. Members expect him to make suggestions and keep the FFA chapter moving toward its group goals. If he does this well, the leader is admired and respected. Sometimes group leaders are appointed to positions of responsibility. This often happens to committee chairmen. An appointed leader may act just as effectively as an elected leader.

Leaders are expected to act in behalf of the group they represent. For example, the person elected by FFA members to represent them on the student council should maintain the interests of the FFA organization. If a leader's personal interests conflict with the interests of the group he represents, he should resolve the problem. A group does not have the right to expect its representative to act against his own wishes. Many times, leaders will exhibit responsibility and seek to change the group's view. In fact, this is the value of leadership; to influence the group to action which they would not do without a leader. Some of our most important leaders in history have not agreed with the ruling majority. Columbus believed the world was round, but he had to sail across the ocean to prove it.

Leadership is exhibited by a person who directs, commands, or guides a group or activity. A leader often exerts influence by persuasive techniques rather than by force.

An important quality of leadership is accuracy. Few groups of individuals will follow a person with false ideas. If you desire to influence others, concentrate on facts and make definite statements only when you are certain you are right. A leader must accept responsibility for influencing other people. If a leader directs a group to take certain action, he is more responsible for the consequences of that action than are other members of that group. Many persons do not like to accept responsibility and shrink from tasks of leadership.

On the other hand, leaders are in the limelight and are usually respected. This characteristic of leadership draws some people who are self-centered. The self-centered individual usually does not make a good leader because he is more interested in himself than in the people he represents. Persons being led soon realize this and turn to someone who respects their interest.

A position of leadership satisfies the need for belonging in a human being. What can build more self-confidence than people asking you for help? Pcsitions of leadership are likely to be held by people who are interested in serving others.

Leaders are often classified into two different groups--formal and informal. Formal leaders are those who are chairmen of committees, or presidents of organizations. Persons who hold office automatically have authority to influence other persons. Informal leaders usually come from members of the group. They are selected by other members and act to sanction or "O.K." proposals suggested by the group. Sometimes in a meeting you will notice other persons asking a particular individual to express his opinion on a proposal. If he agrees it is a good idea, the members are for it; if he does not, they are likely to turn it down. Informal leaders are present in every group. They are a very important influence in human relations, because they gain their good will not by the office they hold but by the willingness of the members to accept their advice. Sometimes the formal and informal leaders of a group are the same persons.

Leaders are found in all types of organizations. A group of businessmen in a civic organization directing a charity drive has leaders; so does a street gang in a large city. Qualities of leadership are varied and many, depending upon the kind of group being led. In the previous example members of the charity drive may respect law and order; a street gang usually does not.

Leaders of both groups, however, must know the members they lead. The leaders are aware of the goals and aspirations of the group. Persons who are successful directing groups soon develop skill in approaching individuals with requests. If the task is difficult or unpleasant, a leader must use all his knowledge about an individual to select an approach which will result in the person's agreeing to the request. Leaders who can gain members' consent on actions and retain the good will of the members are the most effective. To do this, a person must acquire a knowledge and understanding of human relations. This is one reason we are asking you to read this unit--to make you more effective in leading members of your group. By extending your influence with other people, you should be able to accomplish your goals.

The Case

Ron Thomas is an employee of the Cox Implement Company which sells tractors and farm machinery in a rural community. Ron is

the newest member of the five-man implement company employee team. He has been an employee for only one week. Naturally he wants to make a favorable impression on Mr. Cox and the other men working for him. Ron knows that his actions during the first few weeks on the job will establish his reputation at the business. He is eager to contribute to the employee team effort.

In order to get better acquainted with the men, Ron eats his lunch at the implement company. During a recent noon break, the employees and Ron were discussing a lift which one of the men was constructing to fit behind a tractor and operate off the hydraulic system of the tractor. The man responsible for the job was not present. The lift was half finished and the men were discussing how to brace it for maximum strength. Ron's past experience told him that one brace on the lift was incorrectly placed. The horizontal brace should have been a diagonal brace. This is an opportunity to exhibit leadership and show his fellow employees how much he knows about lift-construction.

What should Ron do?

MORALE

People act from their hearts as well as from their minds. Some persons are inclined to let their feelings decide issues rather than make a judgment on logical and careful thought. We sometimes characterize persons who let their feelings and emotions rule their actions as "impulsive" and "emotionally immature."

Morale is the prevailing mood and spirit which permits dependable performance and steady self-control. Someone has paraphrased it as "how I feel about my job at any given time."

Morale is a state of mind of employees, growing out of their work conditions. It includes employee feelings toward supervisors, the company, and other employees.

Each employee can contribute to the morale of the group by paying attention to good human relations principles. Fair and honest treatment of persons as individuals promotes trust and confidence in a group. If you inform people of decisions affecting them, it will dispel doubts and fear of the unknown. Abrupt treatment of groups of people creates suspicion and disregards individual differences.

Whenever possible, employees should be asked to help management plan business programs. It gives employees a feeling of belonging to the group. An orientation program ordinarily helps employees become familiar with their environment and gives them

a feeling of security. A counseling program which considers the talents of the employee and matches them with the position available, usually results in a satisfactory work experience for the company and the individual. A happy and satisfied person builds morale in the group. A bright and cheerful physical environment can set the tone for attitude in the group. When you are employed in an agricultural business, show other employees your appreciation by complimenting them for work well done. Sometimes a free and easy flow of informal communication can contribute more to good morale than any number of policy statements.

Morale is very difficult to talk about, because it can only be inferred from other persons' actions. You cannot see it, touch it, or taste it. But you can determine if it is present in a large quantity or in a meager amount. Consider the following case:

The Case

Mr. William Bond is owner and operator of a large rural feed and grain elevator. This elevator does considerable grinding, mixing, and selling of feed to the farmers in the area. In addition, farmers market their surplus grain through Mr. Bond's elevator. Mr. Bond has two supervisors working for him, one in charge of the feed activities and the other responsible for the grain operations. Four months ago, Joe Johnson, the feed supervisor, retired, and Mr. Bond hired a young man, Jess Smith, to replace him. Jess Smith was a farm boy who was an outstanding vocational agricultural student and had just recently graduated as the top student from a two-year post-high-school course in agricultural business.

Mr. Bond has been hearing comments that the men working under Jess Smith are dissatisfied. They feel that one of them should have been promoted to the position of supervisor, that Jess Smith is making too many changes in the operations, and they don't like the fact that this relatively inexperienced young man is receiving a higher salary than they are.

How should Mr. Bond view this dissatisfaction? What should Jess Smith do to improve the relations with his men?

Suggested Instructional Materials and References

Instructional Materials

"Getting Along with Others," 16mm film, 29 minutes

References

1. McLarney, William J. Management Training, Cases and Principles.

2. Serif, Ned (Editor). How to Manage Yourself.

3. Wilson, Howard. Living With Yourself.

4. Wilson, Howard. Understanding People.

Suggested Occupational Experiences

Whenever the opportunity presents itself, the cooperating employer should invite the trainee to analyze incidents occurring on the job and relate them to the expectations of management.

Suggestions for Evaluating Educational Outcomes of the Module

Evaluation of the instruction in this module can only come when the student actually applies for a job, is successful in the employment interview, and becomes a profitable employee. However, teachers must use more tangible short-term goals. Consequently, most of the time we resort to paper and pencil tests and demonstrations.

Each competency has been stated in a manner which can be demonstrated by the student. For example, competency number one may be tested by presenting the student with a particular set of personal abilities and asking him to select and justify a job which will make maximum use of those personal skills.

Hopefully, students have gained some insight into reasons for behavior. They should be able to answer the following questions:

Why do some customers purchase a new car every other year when their used one has less than 12,000 miles on it?

Why do some employees insist on going to your supervisor with problems that you could handle?

Why do some supervisors follow rules and regulations more closely than others?

The best criterion for competency two is a successful employment interview. Many check lists may be used for neatness of dress, evaluation of letters of application, personal data sheets, etc. If the instructor has concentrated on etiquette, perhaps a "formal" lunch is the best way to evaluate this instruction.

Competency three presents a problem for evaluation because it deals with the student's ability to solve problems. Perhaps the best way to test this ability is to present the student with a problem-situation, and ask him to solve it carefully, indicating each phase of the process. He should be able to:

Identify the problem
Formulate possible solutions
Select the answer which best fits the situation
Justify the selection of the solution

Sources of Suggested Instructional Materials and References

Instructional Materials

1. "A Step Ahead--in Careers in Agriculture," 16mm color film, 14 minutes. Your local New Holland Machinery dealer.

2. "Dynamic Careers Through Agriculture," 16mm film, 28 minutes. Farm Film Foundation, 1425 H Street, Northwest, Washington, D. C., 20005.

3. "Getting Along With Others," 16mm film, 29 minutes. Business Education Films, 5113 16th Avenue, Brooklyn, New York.

4. "Your Attitude is Showing," 35mm sound filmstrip, 12 minutes. Charles Steadman, Teacher-Trainer in Distributive Education, University of Pittsburgh, Pittsburgh, Pennsylvania.

References

1. Blume, George T. Career Exploration, Units I and II, Circular 864, 1962, V.P.I., Agricultural Extension Service, Blacksburg, Virginia.

2. Byram, Harold M. Guidance in Agricultural Education, Danville, Illinois: The Interstate Printers and Publishers, 1959. Price: $4.50.

3. Duncan, Clyde H. Find a Career in Agriculture, 1961: G.P. Putmans Sons, 200 Madison Avenue, New York, New York. Price: $2.50.

4. Hemp, Paul E. and Krebs, Alfred H. "A Study Guide for Placement--Employment Programs in Agricultural Business and Industry," Danville, Illinois: The Interstate Printers and Publishers, 1964.

5. Hoover, Norman K. Handbook of Agricultural Occupations, Danville, Illinois: The Interstate Printers and Publishers, 1963. Price: $4.75.

6. James, Gerald B. "Vocational and Technical Education," Using Current Curriculum Developments, Washington, D. C.: Association for Supervision and Curriculum Development, National Education Association, 1963.

7. Keily, Helen J., and Walters, R. G. How to Find and Apply for a Job, Second Edition (paperback), Cincinnati: South-Western Publishing Company, 1960.

8. McLarney, William J. Management Training, Cases and Principles, Homewood, Illinois: Richard D. Irwin, Inc., 1959.

9. Phipps, Lloyd J. Your Opportunities in Vocational Agriculture, Danville, Illinois: The Interstate Printers and Publishers, 1962. Price: $3.25.

10. Richert, G. H., Meyer, W. G., and Haines, P. G. Retailing Principles and Practices, Fourth Edition, New York: Gregg Publishing Division, McGraw-Hill Book Company, Inc., 1962.

11. Serif, Ned (Editor). How to Manage Yourself, Volume I (paperbadk), 1961. Cities Service Oil Company, Business Research and Education Division, Marketing Training Department, 60 Wall Street, New York, New York.

12. Sferro, Wright, and Rice. Personality and Human Relations, Second Edition, Text-Workbook, Hightstown, New Jersey: Gregg Publishing Division, McGraw-Hill Book Company. Price: $3.95.

13. Walker, R. W., Stevens, G. Z., and Hoover, N. K. "Pennsylvania Vocational Agriculture Interest Inventory," Danville, Illinois: Interstate Printers and Publishers, Specimen Set. Price: $1.00.

14. Weyant, J. Thomas, Hoover, Norman K., and McClay, David R. An Introduction to Agricultural Business and Industry, Danville, Illinois: Interstate Printers and Publishers, 1965. A student's text of approximately 200 pages, and a teacher's guide.

15. Wilson, Howard. Living with Yourself, (paperback), 1962. Administrative Research Associates, Box 3, Deerfield, Illinois. Approximate price: $1.00

16. Wilson, Howard. Understanding People (paperback), 1962. Administrative Research Associates, Box 3, Deerfield, Illinois. Approximate price: $1.00.

17. "Agriculture," The Sextant Series for Exploring Your Future. Milwaukee: American Liberty Press, 1962. Price for copy with soft cover is $4.00.

18. "Agriculture is More than Farming," The Future Farmers' Supply Service, P. O. Box 1180, Alexandria, Virginia.

19. "Aptitude Tests for Occupations and an Occupational Interest Inventory," 1956, California Test Bureau, 206 Bridge Street, New Cumberland, Pennsylvania. Price of specimen set: 75¢.

20. "Careers Ahead" and "Challenge in Agriculture." These two bulletins may be ordered from your local land-grant College of Agriculture.

21. "Choosing Your Occupation," 1962. The Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. Price: 15¢ per copy.

22. Education, an Investment in People, Education Department, Chamber of Commerce of the United States, Washington, D. C. Price: $1.50.

23. "Getting Ahead in Retail Selling," The National Cash Register Company, Dayton, Ohio, 17 pages.

24. "Jobs in Agriculture," 1960. Science Research Associates, Inc., 259 Erie Street, Chicago, Illinois. Price: $1.00.

25. "Kuder Preference Record," 1954. Science Research Associates, Inc., 259 Erie Street, Chicago, Illinois.

26. "There's a Future in Your Farm Background," 1958. The National Sales Executives, Inc., 630 Third Avenue, New York, New York. No charge.

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INSTRUCTOR NOTE: As soon as you have completed teaching each module, please record your reaction on this form and return to the above address.

1. Instructor's Name_____

2. Name of school_____State_____

3. Course outline used: _____Agriculture Supply--Sales and Service Occupations
_____Ornamental Horticulture--Service Occupations
_____Agricultural Machinery--Service Occupations

4. Name of module evaluated in this report_____

5. To what group (age and/or class description) was this material presented?____
_____

6. How many students:
   a) Were enrolled in class (total) _____
   b) Participated in studying this module _____
   c) Participated in a related occupational work experience program while you taught this module _____

7. Actual time spent teaching module:

		Recommended time if you were to teach the module again:
_____hours	Classroom Instruction	_____hours
_____hours	Laboratory Experience	_____hours
_____hours	Occupational Experience (Average time for each student participating)	_____hours
_____hours	Total time	_____hours

(RESPOND TO THE FOLLOWING STATEMENTS WITH A CHECK (√) ALONG THE LINE TO INDICATE YOUR BEST ESTIMATE.)

	VERY APPROPRIATE	NOT APPROPRIATE
8. The suggested time allotments given with this module were:		
9. The suggestions for introducing this module were:		
10. The suggested competencies to be developed were:		
11. For your particular class situation, the level of subject matter content was:		
12. The Suggested Teaching-Learning Activities were:		
13. The Suggested Instructional Materials and References were:		
14. The Suggested Occupational Experiences were:		

(OVER)

15. Was the subject matter content sufficiently detailed to enable you to develop the desired degree of competency in the student? Yes_____No_____
Comments:

16. Was the subject matter content directly related to the type of occupational experience the student received? Yes_____No_____
Comments:

17. List any subject matter items which should be added or deleted:

18. List any additional instructional materials and references which you used or think appropriate:

19. List any additional Teaching-Learning Activities which you feel were particularly successful:

20. List any additional Occupational Work Experiences you used or feel appropriate:

21. What do you see as the major strength of this module?

22. What do you see as the major weakness of this module?

23. Other comments concerning this module:

_____ (Date)

_____ (Instructor's Signature)

_____ (School Address)

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

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METAL FUSION
AND
FABRICATION WELDING

One of Sixteen Modules in the Course Preparing for Entry in

AGRICULTURAL MACHINERY - SERVICE OCCUPATIONS

Module No. 6

The Center for Research and Leadership Development

in Vocational and Technical Education

The Ohio State University
980 Kinnear Road
Columbus, Ohio, 43212

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August, 1965

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MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
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FROM: (Person) James W. Hensel (Agency) The Center for Vocational and Technical Education

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DATE: August 4, 1967

RE: (Author, Title, Publisher, Date) Module No. 6, "Metal Fusion and Fabrication Welding," The Center for Vocational and Technical Education, August, 1965.

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Supplemental Media --
Necessary x
Desirable ____ (Check Which)

Describe Suggested references given in module. (P)

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(address)

METAL FUSION AND FABRICATION WELDING

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THE CENTER FOR RESEARCH AND LEADERSHIP DEVELOPMENT
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THE OHIO STATE UNIVERSITY
980 KINNEAR ROAD
COLUMBUS, OHIO, 43212

INSTRUCTOR NOTE: As soon as you have completed teaching each module, please record your reaction on this form and return to the above address.

1. Instructor's Name _____

2. Name of school _____ State _____

3. Course outline used: _____Agriculture Supply--Sales and Service Occupations
_____Ornamental Horticulture--Service Occupations
_____Agricultural Machinery--Service Occupations

4. Name of module evaluated in this report _____

5. To what group (age and/or class description) was this material presented? ____
_____

6. How many students:
   a) Were enrolled in class (total) _____
   b) Participated in studying this module _____
   c) Participated in a related occupational work experience program while you taught this module _____

7. Actual time spent teaching module:

		Recommended time if you were to teach the module again:
_____hours	Classroom Instruction	_____hours
_____hours	Laboratory Experience	_____hours
_____hours	Occupational Experience (Average time for each student participating)	_____hours
_____hours	Total time	_____hours

(RESPOND TO THE FOLLOWING STATEMENTS WITH A CHECK (✓) ALONG THE LINE TO INDICATE YOUR BEST ESTIMATE.)

	VERY APPROPRIATE	NOT APPROPRIATE
8. The suggested time allotments given with this module were:		
9. The suggestions for introducing this module were:		
10. The suggested competencies to be developed were:		
11. For your particular class situation, the level of subject matter content was:		
12. The Suggested Teaching-Learning Activities were:		
13. The Suggested Instructional Materials and References were:		
14. The Suggested Occupational Experiences were:		

(OVER)

15. Was the subject matter content sufficiently detailed to enable you to develop the desired degree of competency in the student? Yes_____No_____
Comments:

16. Was the subject matter content directly related to the type of occupational experience the student received? Yes_____No_____
Comments:

17. List any subject matter items which should be added or deleted:

18. List any additional instructional materials and references which you used or think appropriate:

19. List any additional Teaching-Learning Activities which you feel were particularly successful:

20. List any additional Occupational Work Experiences you used or feel appropriate:

21. What do you see as the major strength of this module?

22. What do you see as the major weakness of this module?

23. Other comments concerning this module:

_____ (Date)

_____ (Instructor's Signature)

_____ (School Address)

METAL FUSION AND FABRICATION
"WELDING"

Major Teaching Objective

To develop (1) an understanding of welding equipment and supplies and (2) the ability to perform welding skills required of agricultural mechanics.

Suggested Time Allotment

At school		
Class instruction	12 hours	
Laboratory experience	36 hours	
Total at school		48 hours
Occupational experience		0 hours
Total for module		48 hours

Suggestions for Introducing the Module

History shows that the ability of a country or race of people to progress depends upon their ability to use and fabricate (fasten or put together) metals. A country's standard of living, and even its survival, depends upon how well its craftsmen can fabricate metals. In modern agriculture metal products are commonly used. Their fabrication is necessary to protect and maintain our high standard of living.

A person preparing for employment as an agricultural machinery mechanic must have an understanding of welding equipment and supplies, and be able to weld and fabricate metals. Welding may be used to repair broken machinery, to rebuild surfaces that have been worn or battered in use, and to make new parts to replace parts damaged beyond repair. Welding may also be used to fabricate many articles of general or special character.

Following are some suggested techniques for use in creating interest in the module:

1. Thought questions

   a. What is welding?

   b. What are the different methods of welding?

   c. What are the advantages of the agricultural mechanic's possessing welding skills?

2. Demonstrate to the class the strength of a strong weld as compared to the strength of a poor weld.

3. Observe a piece of farm machinery and count the number of welds used in its construction.

4. Films

Magic Wand of Industry

Arc Welding at Work

Competencies to be Developed

I. To understand the fundamentals and safe practices of welding

Teacher Preparation

Subject Matter Content

A knowledge of fundamental welding terms is necessary for selecting equipment and materials and for learning welding skills.

Welding is not a hazardous operation. In most instances personal injuries and property damage resulting from welding are caused by negligence on the part of the operator. Weldors can best protect themselves by acquiring a thorough knowledge of the operation of equipment when they first learn to weld.

This competency is intended to increase knowledge of fundamental welding terms and to develop an awareness of potential hazards of welding.

1. Fundamental terms of welding

a. Arc blow
b. Arc length
c. Arc voltage
d. Backing
e. Back-step welding
f. Base metal
g. Butt weld
h. Crater
i. Direct current
j. Alternating current
k. Face of weld
l. Fillet weld
m. Flux
n. Gas pocket
o. Lap joint
p. Pass
q. Peening
r. Penetration
s. Porosity
t. Pre-heating
u. Puddle
v. Reversed polarity
w. Root of weld
x. Slag inclusion
y. Spatter
z. Straight polarity
aa. Tack weld
ab. Throat of fillet weld
ac. TIG welding
ad. Toe of weld

ae. Undercut
af. Weaving
ag. Welding rod
ah. Welded metal
ai. Duty cycle
aj. Bead
ak. Ferrous
al. Helmet
am. Welder
an. Weldor
ao. Electrode
ap. Electrode holder
aq. Brazing
ar. Cone
as. Hardfacing
at. Neutral flame
au. Welding tip
av. Welding torch
aw. Cylinder
ax. Carburizing flame
ay. Oxidizing flame
az. Acetylene
ba. Whipping
bb. Butt joint
bc. Tee joint

2. Safe practices in welding

A properly installed welder will give safe, trouble-free service if a reasonable amount of care is used in its operation. However, very serious injuries are likely to occur unless safe practices are followed carefully.

a. Avoid shock hazards.

1) Be sure both arc welders and the power supply system are grounded. Do not ground the ground terminal to the welder frame.
2) Always open the main power switch before working on the welder.
3) Turn off the welder to adjust the current setting.
4) Do not operate arc welders in wet locations.
5) Keep cables, electrode holders, and connections in good condition.
6) Turn off machines when the job is finished.

b. Protect the eyes and skin. The intense light of the electric arc is very injurious, as are flying pieces of hot slag and metal.

1) Use a face shield with a suitable density color lens; never look at an electric arc with the naked eye.

a) A welding glass of shade 10 density is suitable for most arc welders.
b) A welding glass shade density of 4 or 5 is suitable for oxyacetylene welding.

2) Before striking an arc, make sure fellow workers are shielded or are looking the opposite direction.

3) Keep helmets and shields in excellent condition.
4) Use clear goggles to protect eyes when chipping slag.
5) Wear leather gloves to protect hands from rays and spatter.
6) Wear long-sleeved shirts or jackets to protect the skin from arc-burn.

c. Provide good ventilation.

1) Always ensure an adequate supply of fresh air. Use an exhaust fan.
2) Do not inhale fumes from zinc or lead-coated metals. Weld these meterials out-of-doors.

d. Prevent burns from hot metal.

Mark hot welds so that others will know they are hot.

e. Prevent fires and explosions.

1) Keep combustible materials away from the welding operation.
2) Keep heat away from gas cylinders.
3) Do not weld on materials which have contained combustible materials.
4) Use soap suds to check for oxygen and acetylene leaks. The soap used should not contain petroleum bases.
5) Always keep oxygen and acetylene cylinders in an upright position. Keep them fastened to prevent being knocked over.

f. Practice good housekeeping.

1) Electrode and rod stubs should not be allowed on the floor.
2) Welding cables and gas hoses should be coiled neatly after each job.

<u>Suggested Teaching-Learning Activities</u>

1. Have students define fundamental welding terms.

2. Require students to become familiar with safety precautions pertaining to welding.

3. Demonstrate the proper electrical hookup of a welder.

4. Demonstrate the proper hose hookup of a gas welder.

5. Demonstrate proper handling of fire extinguishers.

Suggested Instructional Materials and References

Instructional materials

1. Charts on safety precautions
2. Arc welder
3. Gas welder
4. Fire extinguishers

References

S*1. Hobart Vest Pocket Guide, pp. 26-30.

S 2. Smith's Short Course for Gas Cutting, Welding, Brazing, p. 20.

S 3. Arc Welding Lessons, pp. 96-104.

S 4. The Farm Shop, pp. 135-136, 167-168.

S 5. Farm Mechanics Text and Handbook, pp. 244-245, 282.

*The symbol T (teacher) or S (student) denotes those references designed especially for the teacher or for the student.

II. To select and care for welding equipment

Teacher Preparation

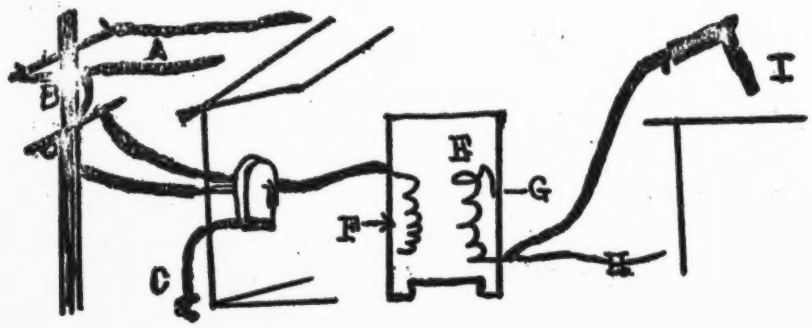
Subject Matter Content

To qualify as an agricultural machinery mechanic and welder, one must know how to select and care for welding equipment and accessories.

Arc Welders are of two basic types: those that provide alternating welding current (AC) and those that provide direct welding current (DC).

The AC welder has a step-down transformer which steps the 240-volt-line voltage down and the amperage up so that the heat can be safely used for welding. The control for stepping up the

amperage, which varies on different makes of welders, is necessary to provide different degrees of heat for welding various thicknesses of metals.



A. Power line, B. Transformer, C. Ground, D. Wall outlet, E. Welder, F. Primary winding, G. Secondary winder, H. Ground cable, I. Electrode

The transformer-welder is popular for several reasons:

1. Low initial cost
2. Low operation and maintenance cost
3. Convenience to use
4. Lack of moving parts
5. Use of single-phase current
6. Quiet operation
7. No arc blow

The DC welder has some advantages over the AC machine: it may be used with a wider variety of electrodes; it is better for welding thin metal; and gas-engine-driven models furnish welding current where there are no electric power lines.

The source of DC welding current is usually a generator. The electric-motor generator welder is a self-contained machine that requires three-phase current. The line current runs the motor, which turns a generator to produce DC current. Portable DC welders have the generator powered by an engine.

Another type of DC welder does not use a generator but converts 240-volt AC line current into DC current by the use of a rectifier. The rectifier is made of silicon or selenium.

Still another type of welder is the universal welder, which combines both AC and DC. This type operates on single-phase 240-volt-line current and provides either AC transformed welding current or DC rectified welding current, thus providing the current best suited to the particular job.

The UL mark of the Underwriters Laboratory should appear on the name-plate of any welder purchased, showing that it will deliver its rated current and meet adequate safety standards.

All welders should be kept in a dry area, since dampness is harmful to transformer generator windings. Whenever a welder is installed, help or advice should be sought from the power-supplier or a competent electrician.

Standard accessories for the arc welder include a wire brush, an electrode holder, a head shield, and welding cables.

Other accessories are

1. Cable lugs
2. Ground clamps
3. Arc torch
4. Electrodes
5. Gloves
6. Aprons
7. Safety goggles
8. Chipping hammer
9. Tongs and pliers

Oxyacetylene welders are divided into two general classes, depending upon the level of acetylene pressure used. The injector type can use acetylene at pressure under one pound per square inch, whereas the medium-pressure type requires that acetylene be supplied at pressures from one to 15 pounds per square inch.

Pieces of equipment and accessories making up an oxyacetylene welder are

1. Oxygen cylinder
2. Acetylene cylinder
3. Oxygen regulator
4. Acetylene regulator

5. Blowpipe (torch)
6. Blowpipe tips (torch tips)
7. Hose
8. Hose connections
9. Friction lighter
10. Goggles
11. Wrenches
12. Gloves
13. Pliers

Some general maintenance precautions of the oxyacetylene welder are as follows:

1. Use no oil on regulators under any circumstance.
2. Have equipment inspected at frequent intervals by a competent operator.
3. Do not use blowpipes, regulators, or other equipment in need of repair.
4. If orfices in the tips of nozzles become clogged, clean them with the proper size of twist drill tip cleaner or a soft brass or copper wire.
5. If leakage develops around the blowpipe stem, tighten the packing nut, and repack it if necessary.
6. If a valve does not shut off completely, clean the seat.
7. If a regulator creeps, have it repaired at once.
8. If the safety relief disk of the regulator ruptures, have a new one installed immediately.
9. Always maintain a gas-tight connection between regulators and cylinders.
10. When regulators are not to be used for several weeks or longer, relieve the pressure on the delivery-pressure valve seat.
11. Test hose frequently for leaks.
12. Do not repair hose with tape.

Suggested Teaching-Learning Activities

1. Have students identify major parts of an oxyacetylene welder.

2. Have students become familiar with welding equipment through reading assignments.

3. Have the class visit a local dealer or welding shop to identify different welding equipment.

4. Demonstrate the proper hookup of an oxyacetylene welder. Then have students demonstrate and practice hookup.

Suggestion Instructional Materials and References

Instructional materials

1. Overhead transparencies of oxyacetylene equipment

2. Oxyacetylene welder

3. AC welder

4. DC generator-type welder

5. AC-DC transformer-rectifier welder

References

S 1. The Oxyacetylene Handbook, pp. 49-72.

S 2. Modern Arc Welding, pp. 187-229.

3. Arc Welding Lessons, pp. 10-25.

4. The Farm Shop, pp 128-133, 166-169.

III. To identify metals commonly welded

Teacher Preparation

Subject Matter Content

To use the welding procedure best suited to a job, the welder must first identify the metal to be welded, since procedures

vary with different metals. A practical identifying test must be simple and easy to make with ordinary equipment in the shop.

Metals can often be identified by their use or appearance, or by the spark test on a grinding wheel, the fracture test (observing if the metal bends prior to breaking), or the magnetic test.

The spark test is both simple and commonly used. Different kinds of iron and steel make different spark patterns when they are touched lightly to the grinding wheel. Cast iron gives off red sparks that travel in a straight line with clublike sparks at the ends. Mild steel gives off yellow sparks otherwise similar to those made by cast iron. Medium carbon steel gives off larger quantities of yellow sparks with explosive bursts or stars at the ends. High carbon steel gives off brighter and more explosive sparks.

When making spark tests, use a clean grinding wheel and touch each part of the metal to the wheel with approximately the same pressure. The metal being tested should be compared with known samples and the operator should stand to one side of the grinding wheel to see the spark pattern most easily.

Chart I

Kinds of Iron and Steel Used in Farm Machinery

Mild and medium carbon steel	High carbon steel	Cast iron	Malleable iron
Blacksmith iron Pipe Machinery frames Forgings Bolts Rivets Sheetmetal Fenders	Plowshares Cultivator sweeps Harrow disks Rake teeth Gears Axles Shafts Springs Bearing races	Rough gears Sprockets Bearing brackets Mower wheels Cylinder heads Transmission cases	Beam brackets and castings subject to shock

Tool or part

The common nonferrous (not containing iron) metals used in farm machinery are aluminum, brass, copper, and pot-metal. With the exception of copper, they are difficult to weld unless the TIG process is used. Aluminum can be identified by its white color and light weight. Copper, which is for plumbing, gas lines, etc.,

is rust red in color and can be brazed with silver solder or bronze-welded. Brass which is used chiefly in the form of castings is yellow in color and is used to make valves and small plumbing fittings; it can be welded by the oxyacetylene process. Pot-metal resembles aluminum, but it is darker in color and heavier and very difficult to weld.

Suggested Teaching-Learning Activities

1. Have students clean and dress a grinding wheel.
2. Demonstrate metal identification by the spark test.
3. Have students identify metals by the spark test.
4. Have students identify metals by appearance only.
5. Have students identify ferrous from nonferrous metals by the magnetic test.
6. Have students identify nonferrous metals by color.
7. Have students identify high carbon metals from low carbon metals by the sound method.

Suggested Instructional Materials and References

Instructional materials

1. Grinder
2. Selection of known and identified metals (ferrous and nonferrous)
3. Selection of unknown metals to be identified
4. Metal identification charts and transparencies
5. Magnet
6. Tools necessary for dressing grinder and making test
7. Safety goggles

References

1. The Oxyacetylene Handbook, pp. 117-118.

2. Hobart Vest-Pocket Guide, pp. 12-13.

3. Arc Welding Lessons, pp. 64-89.

IV. To select the proper electrode

Teacher Preparation

Subject Matter Content

Matching arc welding electrodes with materials begins by identifying the metal to be welded. There are many different alloys of steel. The welder using Chart I can classify most of the iron or steel materials he welds, but he should check some metals further by the spark test and a known sample of metal. It may also be advisable to compare the spark from a weld bend of a particular welding electrode with the metal to be welded. If the sparks are identical, the metals should be alike.

Electrodes for Low and Medium Carbon Steels

Ten basic kinds of electrodes are available for welding low-to-medium carbon steel. All are shielded electrodes with heavy coatings of flux over a core wire of low carbon steel, but they differ in the type and combination of chemical substances in the coating.

Each substance in the flux has a particular function for the arc welding process, but the main objectives are (1) to stabilize the arc and (2) to protect the molten metal from the atmosphere. After the arc is started, current flows across the gap between the end of the electrode and the work. It does not jump the gap like a high-voltage ignition spark but is conducted by a mass of ionized gas coating which are vaporized by the heat of the arc. The nature of this gas determines the stability of the arc, or the ease of striking and maintaining it.

Arc stability is generally good when welding with DC current, which flows steadily in one direction. It is more a problem with AC welding, as the arc tends to be extinguished and restarted 60 times per second as the current alternates. Sodium compounds are generally used in the flux of DC electrodes; whereas potassium compounds are common in the flux of AC electrodes because potassium compounds ionize more easily. The arc stability problem is more acute with a farm-type AC welder that

may have a lower open-circuit voltage than an industrial-type AC welder. It is also troublesome when using low amperage to weld thin materials.

Classification of Electrodes

Even though the sparks from the bead of one type of electrode match the work, several other types may also be suited to the work. Choosing the electrodes most often used for farm welding is not difficult because almost all manufacturers make rods of the same types and use a standard numbering system. Because these types have been defined by the American Welding Society (AWS) and the American Society for Testing Materials (ASTM), the letters AWS followed by a number such as AWS-ASTM E6013 appear on every package of rods. The E stands for electrode and the 60 shows the tensil and strength of the rod. If the third number were 2, the rod could be used in flat and vertical welding, but not for overhead. The number 3 signifies that the rod is designed for flat position only. If the third number is a "1" the rod can be used for all positions. The last digit quite often indicates the approximate penetration and 0 maximum. The last two digits, however, may be used in combination to mean entirely different things; therefore the manufacturer's recommendations for his rod should be referred to.

Identification by Color Code

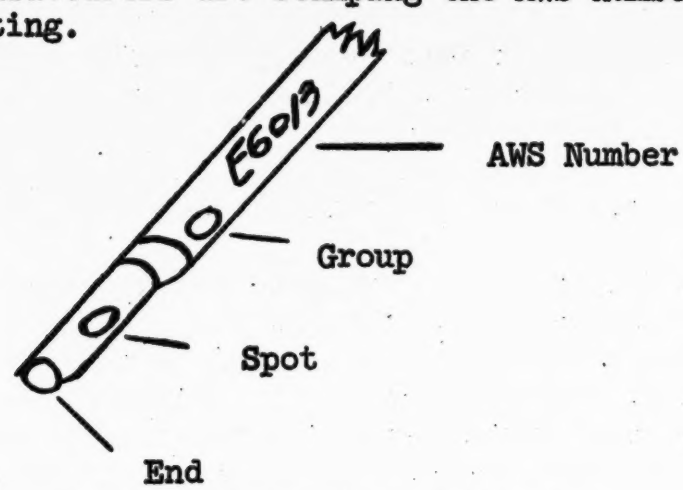
Almost any manufacturer who sells an AWS E6013 rod also identifies it by a color code written by the National Electrical Manufacturing Association. The E6013 rod, for example, is marked with a brown dot of paint, called spot color, which is located on the side of the end which is gripped by the electrode holder.

1. Primary color is located on the end of the bare part of the electrode.

2. Secondary color is located on the side of the bare part of the electrode.

3. Group color is located on the flux coating near the bare end of the electrode.

4. Some manufacturers are stamping the AWS number on the flux coating.



Color Spots for Identifying Electrodes

In recent years rods with iron powder in the coating have been much used, but for farm use smaller amounts of iron powder actually make for better welding rods. Welding rods with considerable amounts of iron powder in the flux coating are not suitable for most farm-type AC welders because of the low open-circuit voltage design of the welding machine. Heavy coated (iron powder) E-6014 or E-6024 electrodes do not have the penetration or arc force compared to an E-6011, which has very little coating but a forceful arc. An E-6011 electrode is excellent for farm use because it will weld through paint, rust, light dirt, etc. It is easy to use for vertical or overhead welding.

Electrodes for Cast Iron Welding

Cast iron, because of its high carbon content and relative brittleness, requires special electrodes for welding. Two common types of cast-iron-welding electrodes are available, machinable and non-machinable.

Machinable cast iron electrodes have a high nickel content and produce a soft weld that can be drilled, filed, or otherwise machined after it cools. They are classified as E Ni and have an orange end, a blue spot, and a white group color. E Ni electrodes are relatively expensive in price per pound.

Non-machinable cast iron electrodes have a steel core wire with a special flux coating. During cooling, carbon migrates from the deposit, which becomes hardened in the cooling process. The weld, therefore, cannot be cut with a drill, a file, or any ordinary machine tool. These electrodes are classified E St and have an orange end, no spot, and no group color.

Comparing Electrodes from Various Manufacturers

A comparison chart with AWS numbers and brand names of electrodes made by various manufacturers aids in recognizing and comparing electrodes and reveals that manufacturers often have several electrodes for each AWS number. Specific information from a manufacturer should be obtained for detailed use characteristics.

In addition to this information, choice of the electrode should be finally determined by experience in working with different materials and actually trying different rods for different situations. Practice beads with any rod should be run before making the weld to see how it performs and to check the four fundamentals for getting a good weld. Good technique is just as important as matching the electrode with the material.

Ferrous Oxyacetylene Welding Rods

All-purpose mild-steel welding rods are used for welding all kinds of mild and low-carbon steel. They are satisfactory and probably better than other kinds for most farm machinery and shop welding. Flux is not needed in fusion welding steel.

Alloy-nickel cast-iron rods made strong, high-quality machinable welds on cast iron. Flux is needed for this welding process.

Nonferrous Welding Rods

These include, among others, the bronzes, copper, silver alloys, and aluminum. A suitable flux is required for each.

Bronze welding rods are used for steel, malleable iron, and cast iron. A good bronze rod has smooth-flowing qualities, makes deposits that are non-porous, and does not fume excessively during the welding operation.

Silver alloy rods are made of silver, copper, and phosphorus. They make strong welds in steel, copper, and brass. Sometimes they are called low-temperature rods because they melt at lower temperatures than other kinds of rods.

Welding Flux

When welding with cast iron and nonferrous rods, a welding flux must be used. For good quality work, always select a reliable flux recommended for the kind of work being done. The most commonly-used fluxes are bronze, cast iron, brazing, and aluminum.

Suggested Teaching-Learning Activities

1. Have students study reading assignments on electrode identification and selection.

2. Have students identify welding rods and fluxes and give uses of each rod or flux.

3. Demonstrate cross-reference charts and have students use them.

4. Have students explain the AWS classification system of electrodes.

5. Have students explain the NEMA color code system of electrode indentification.

Suggested Instructional Materials and References

Instructional materials

1. Examples of electrodes, rods, and fluxes

2. Electrode-usage charts from manufacturers

3. Arc Welding Electrode Selection

4. Factors to Consider in Selecting Electrodes

5. Cross-reference charts from manufacturers

References

1. Modern Arc Welding.

2. Hobart Vest Pocket Guide, pp. 32-65.

3. Arc Welding Lessons, pp. 42-54.

4. The Oxyacetylene Handbook, pp. 505-514.

5. The Farm Shop, p. 134.

V. To become proficient in striking an arc, carrying a puddle, and re-starting the arc

Teacher Preparation

An experienced welder always checks the condition of his equipment before beginning to weld. The bench top must be clean, dry, and free from rust, grease, and paint to insure a direct flow of current.

To strike an arc, the electrode is moved at an angle to the plate in a striking motion similar to that used when striking a match. For the proper arc length, it should be drawn slowly to a height of about 3/16 inch. This should give a sharp egg-frying sound. A too-short arc will cause the electrode to freeze to the metal and a too-long arc will give a humming sound and cause spatter and will finally go out.

The electrode is tipped about 15 degrees in the direction of travel, and held at 90 degrees to the metal being welded. Correct speed of travel is indicated by the size of the bead which should be about twice the diameter of the electrode being used.

The correct amperage setting must be made to obtain a proper bead with penetration and very little spatter. It depends upon thickness of the metal, size of the electrode and type of electrode being used. Always refer to electrode manufacturer's recommendation for correct amperage setting for the electrode and job.

To re-establish a bead, first strike the arc; then move the electrode to the crown of the crater and resume forward travel.

Suggested Teaching-Leaning Activities

1. Familiarize the student with welding machines and equipment.

2. Demonstrate striking an arc, proper arc length, correct speed of travel, and width of bead.

3. Have students run several beads with correct arc length, current setting, speed of travel, and electrode angle.

4. Have students study reading assignments; then have them correct their errors.

5. Demonstrate the effects of various arc lengths, current settings, and speed of travel.

Suggested Instructional Materials and References

Instructional materials

1. Welder AC or DC
2. Protective clothing
3. Helmet
4. Chipping hammer
5. Wire brush

} Hereafter referred to as welder and equipment

6. Steel plate 3/16 inch thick
7. E-6013 or E-6012 electrodes of 18 inch size

References

S 1. Good and Bad Weld Plastic Replicas.

2. Arc Welding Lessons, pp. 121-129.

3. Modern Arc Welding, pp. 309-314.

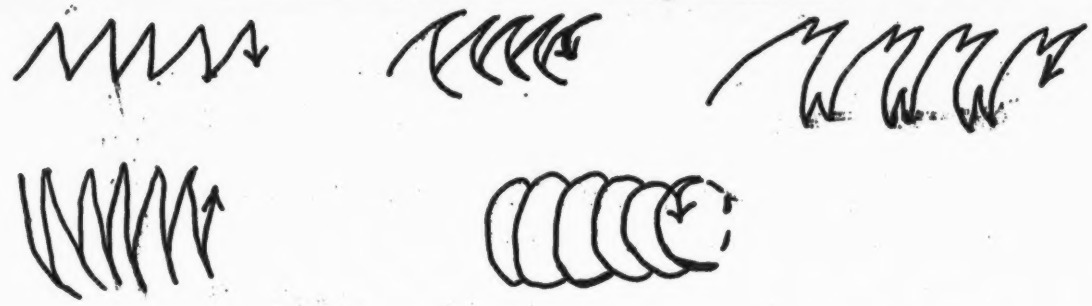
4. Hobart Vest Pocket Guide, pp. 6-7.

VI. To run a bead in a weaving motion

Teacher Preparation

Subject Matter Content

Running a bead with a weaving motion has many uses. It is used where a wider bead is desired than normally can be laid when running a straight bead and where finish passes are needed on flat welds and in padding or built-up repair jobs. The following are some different types of weaving motions:



Always remove slag when depositing a weld on top of another weld. The shape of the weld is determined by the closeness of the weaves.

Suggested Teaching-Learning Activities

1. Have students study text assignments.

2. Demonstrate different types of weaves to students.

3. Have students practice weaves.

Suggested Instructional Materials and References

Instructional materials

1. Welder and equipment

2. Steel plates 3/16 inch thick

3. E-6013 or E-6012 electrodes of 1/8 inch size

References

1. Arc Welding Lessons, pp. 131-134.

2. Modern Arc Welding.

3. The Farm Shop, pp. 138-142.

VII. To make a butt weld

Teacher Preparation

Subject Matter Content

Butt welds are one of the easiest kinds of welds to make. They are used in sheet steel (steel up to 1/8 inch thick) and in plate steel up to 1/4 inch. (Plate steel is thicker than 1/8 inch.) Beveling is required on plate thicker than 1/4 inch to ensure full penetration.

When welding two pieces together, always tack both ends prior to starting to weld to avoid metal expansion that pulls the pieces of metal apart. Long pieces should be tacked at 4-to-6 intervals.

Always make closely-fitted joints. Never space parts more than one-half their thickness. Always use a steel backing-strip when a joint cannot be closely-fitted. Weld on both sides of a joint for resistance to bending stresses.

Suggested Teaching-Learning Activities

1. Have students study text assignments.

2. Demonstrate butt welding to students.

3. Have students practice butt welding in flat and horizontal positions.

Suggested Instructional Materials and References

Instructional materials

1. Welder and equipment

2. Steel plates 3/16 inch thick

3. E-6013 or E-6012 electrodes of 1/8 inch size

References

1. Arc Welding Lessons, pp. 137-146.

2. Modern Arc Welding.

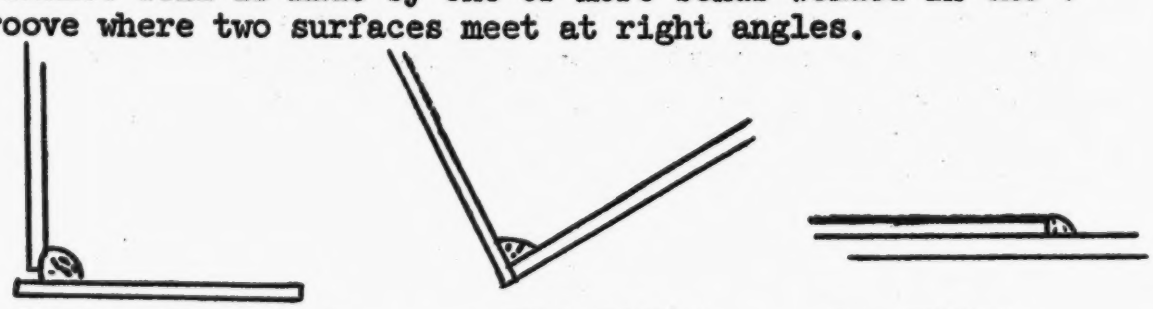
3. The Farm Shop, pp. 142-143.

VIII. To fillet weld in the flat and horizontal position

Teacher Preparation

Subject Matter Content

A fillet weld is made by one or more bends welded in the V groove where two surfaces meet at right angles.



Horizontal Fillet Flat Fillet Lap Fillet

Fillet welds may be used in any position. They are easiest to make when the metal is in the flat or horizontal position.

Suggested Teaching-Learning Activities

1. Have students study reading assignments.
2. Demonstrate fillet welding.
3. Have students practice fillet welding.

Suggested Instructional Materials and References

Instructional materials

1. Welder and equipment
2. Mild steel plates 3/16 inch thick
3. E-6013 or E-6012 electrodes of 1/8 inch 5/32 inch size

References

1. Arc Welding Lessons, pp. 150-158.
2. Modern Arc Welding.
3. The Farm Shop, pp. 142-143.

IX. To weld in the vertical position

Teacher Preparation

Subject Matter Content

Two methods are used to weld joints in the vertical position: welding up and welding down.

Vertical Up-Welding

Vertical up-welding is used whenever a strong, dependable weld with a deep penetration is desired on something that has to be welded with the joint running vertically in relation to the ground.

The problem, when welding vertical up, is to put the molten metal where it is wanted and make it say there. Because gravity pulls the molten metal downward, making it drip, certain techniques must be followed:

1. Use a fast-freezing electrode (example: E-6011).

2. Put the electrode in the holder so that it sticks straight out the end.

3. When welding, have the electrode-holder slightly lower than the tip of the electrode.

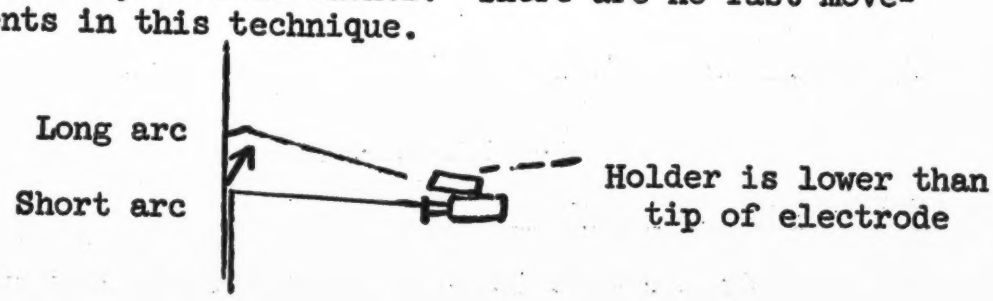
4. Deposit the metal at the bottom of the two pieces to be welded together, working upward toward the top.

5. Before too much metal is deposited, move the arc 3/4 inch upward with a slight wrist movement. This takes the heat away from the molten puddle and allows it to solidify.

6. During this entire process, look at the molten puddle, not the arc.

7. When bringing the arc down to deposit metal, make it very short in order to deposit metal as fast as possible; when lifting the arc, make it long or metal will be deposited all up and down the plate.

8. Make very slow movements. There are no fast movements in this technique.



Vertical Down-Welding

Vertical down-welding can be learned rapidly because there are only a few requirements.

1. Use an E-6011 electrode.

2. Put the electrode straight out of the holder.

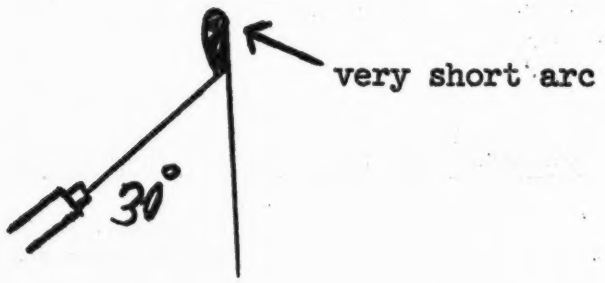
3. Use thin (14 or 16 guage) metal.

4. Hold the electrode in a 30-degree angle pointing upward.

5. Hold a short arc, but do not touch the metal.

6. Use up-and-down whipping motion to help prevent burning through on very thin metal.

7. Carefully watch the molten metal.



It is important to continue lowering the entire arm as the weld is made, so that the angle of the electrode does not change; and to move the electrode so fast that the molten slag does not catch up with the arc. Vertical down-welding gives thin, shallow welds. It should, therefore, never be used on heavy materials, where strong welds are required.

Suggested Teaching-Learning Activities

1. Have students study reading assignments.

2. Demonstrate vertical up-welding in various positions.

3. Demonstrate vertical up-welding in various position welds.

4. Have students practice vertical up-welding.

5. Have students practice vertical down-welding.

Suggested Instructional Materials and References

Instructional materials

1. Welder and equipment

2. Mild steel plate 3/16 inch thick

3. Metal of 14 or 16 guage thickness

4. E-6011 electrodes of 1/8 inch size

References

1. Modern Arc Welding, pp. 339-351.

2. Arc Welding Lessons, pp. 162-171.

3. The Farm Shop, pp. 142-143.

X. To weld in the overhead position

Teacher Preparation

Subject Matter Content

Welding in the overhead position is difficult because the molten metal must be carefully controlled. Observe the following:

1. Use suitable electrodes (E-6010, E-6011, E-6012, E-6013).

2. Use small electrodes (1/8 inch) for most welding.

3. Use a short arc to make the metal hold. A long arc will cause molten metal to fall.

4. Take precautions to avoid injury from falling bits of hot metal and slag.

Suggested Teaching-Learning Activities

1. Have students read and study reading assignments.

2. Demonstrate overhead-welding.

3. Have students practice overhead-welding.

Suggested Instructional Materials and References

Instructional materials

1. Welder and equipment

2. Mild steel 3/16 inch thick

3. E-6010, E-6011, E-6012, E-6013 electrodes of 1/8 inch size

References

1. Modern Arc Welding, pp. 355-363.

2. Arc Welding Lessons, pp. 176-183.

XI. To operate and maintain a carbon-arc torch

Teacher Preparation

Subject Matter Content

The carbon arc torch is an accessory to the arc welder and is useful in applying heat through radiation rather than by an arc formed when an electrode is used. It is used for brazing, hardsurfacing, and soldering, and in jobs requiring bending and shaping.

Arc torches are commonly equipped with carbon centers coated with copper. The sizes most frequently used are those with 1/4, 5/16, and 3/8 inch diameters. Carbons burn slowly while in use, but a good supply of each size should be kept on hand.

The carbons are held in the torch so that the tips meet on an angle. The carbons may be moved laterally through the holder-clamp and should extend through the clamp 2 inches. A means of bringing the tips together to start the arc is provided, and the space between the tips can be varied to produce a desirable flame.

Carbon life expectancy can be as much as $1\frac{1}{2}$ hours on properly-adjusted carbons with correct amperage setting. Always refer to manufacturer's recommendations for amperage settings for the size of carbons being used.

Pointers for selecting and operating carbon-arc are

1. Follow recommended current settings for the size of carbons used.

2. Keep carbons in good condition by occasionally dressing the tips to the original shape.

3. Keep cables and other parts of the torch in good condition.

4. Do not use carbons less than 2 inches in length.

5. Make sure cable connections fit properly to the welder as recommended by the manufacturer.

Suggested Teaching-Learning Activities

1. Have students read and study reading assignments.

2. Explain how the carbon arc operates.

3. Use carbon with high heat setting to demonstrate effects of overheating.

4. Operate a torch, demonstrating the effects of narrow and wide tip settings.

5. Install a set of carbons in a holder, making the proper adjustments.

6. Demonstrate procedures of heating metal for bending.

7. Have students practice using and adjusting the carbon arc torch.

Suggested Instructional Materials and References

Instructional materials

1. Welder and equipment

2. Carbon arc torch

3. Carbons with 1/4, 5/16, and 3/8 diameters

4. Metal for bending

References

1. Arc Welding Lessons, pp. 57-62 .

2. Modern Arc Welding, p. 435.

XII. To operate and maintain an oxyacetylene torch, and to fusion-weld

Teacher Preparation

Subject Matter Content

An oxyacetylene welder is a precision piece of equipment. Safe habits in handling and using it should be established to protect the weldor and the equipment.

1. Attach regulators to cylinders.

   a. Crack cylinder valves to blow out dirt.

   b. Wipe valves with a dry, clean cloth.

   c. Attach regulators and tighten them.

2. Connect hoses and turn on gases.

   a. Connect green hose to oxygen regulator and torch.

   b. Connect red hose to acetylene regulator and torch. (Oxygen has right-hand threads, acetylene has left-hand threads.)

   c. Open cylinder valves slowly (oxygen all the way; acetylene $\frac{1}{2}$ turn).

3. Select the welding tip.

   a. Select a tip according to the manufacturer's recommendation for the job.

   b. Adjust tip on torch so that valves are on lower side of torch.

   c. Tighten tip with wrench.

4. Adjust working gas pressure according to manufacturer's recommendation for the tip used.

5. Locate all gas leaks.

   a. Locate gas leaks by using soap suds, or holding a finger over end of tip and submerging torch into water. Never use oil.

b. Tighten leaking connections.

c. Replace or repair any items which persist in leaking.

6. Light the torch.

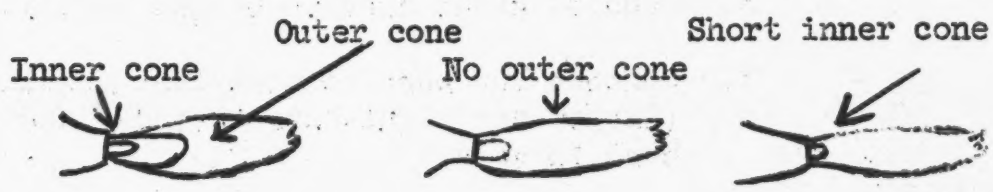
a. Follow manufacturer's recommendations.

b. Incorrect working pressures cause most difficulties in handling the torch.

7. Adjust the flame.

a. Adjust the flame by opening and adjusting the oxygen valve.

b. Too little oxygen gives a carbonizing flame; too much oxygen gives an oxidizing flame. A neutral flame is desired



Carbonizing flame Neutral flame Oxidizing flame

8. Avoid backfires and flashbacks.

a. Improper handling of the torch causes backfire (flame going out with a loud snap).

b. Ways to prevent backfires:

1) Operate torch at proper pressures.
2) Keep tip cool.
3) Keep tip clean.

c. Flashbacks is burning of the flame back into the torch. It may be followed by a hissing or squealing. Flashbacks are serious and endanger the safety of operators and equipment.

1) If continued, return torch to manufacturer for repair.
2) In case of flashback, turn off cylinders immediately to prevent an explosion.

Always shut down equipment when the job is completed. When equipment is left with gases turned on, leaks may develop and result in a fire or an explosion.

1. Shut off torch.

   a. Close acetylene valve first.

   b. Close oxygen valve last. This will extinguish any fire in torch.

2. Shut off gases.

   a. Close acetylene valve on cylinder.

   b. Close oxygen valve on cylinder.

   c. Open acetylene torch valve and drain pressure.

   d. Release acetylene regulator adjusting screw.

   e. Close acetylene torch valve.

   f. Open oxygen torch valve and drain pressure.

   g. Release oxygen regulator adjusting screw.

   h. Close oxygen torch valve.

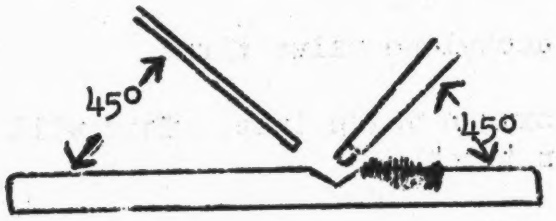
Note: The above steps must be followed in the order listed to insure safety.

Fusion Welding with the Oxyacetylene Torch

In fusion welding, the metal edges are heated to the melting point and flowed together. A welding rod is used to add metal to the joint to strengthen it.

Forming and maintaining a molten pool is the first step in fusion welding. After this is mastered, the next step is to add metal from a welding rod. To carry a molten pool, one must first hold the torch at approximately 45 degrees with the surface of the work and inner cone about 1/8 inch from the metal and move the torch in a circular motion. The welding rod is added with the

other hand and held at approximately 45 degrees to the surface of the metal and directed toward the flame.



After maintaining a molten pool and forming a bead by carrying the molten pool and adding the welding rod, the pieces of metal are ready to be welded together.

1. Butt welds

   a. Make plain butt joints in steel up to 1/8 inch thick; bevel edges on thicker pieces.

   b. Space pieces 1/2 thickness of metal apart to allow for heat expansion, and tack ends together.

   c. Arrange work so an air space is under the metal.

   d. Keep molten puddle running to both pieces and add rod to fill crack.

   e. Weld joints in metal thicker than 1/4 inch by two beads made progressively 1 inch at a time.

2. Fillet and lap welds

   a. The biggest errors in making these welds can be avoided by holding the torch at proper angles. The flame must be directed so that equal heat is applied on each piece of metal.

   b. Heat the lower plate almost to the melting point. Then weave torch to direct flame from one piece to the other, bringing both pieces to a molten pool at the same time.

3. Welding in the vertical and overhead position

   a. Start at bottom and weld upward for a vertical weld.

b. Use a shallow puddle and lift flame at regular intervals to allow lower edge of puddle to solidify.

c. Use less heat in overhead position than for similar job in the flat position.

d. Always use correct angles of torch and rod, both always at 45 degrees with the surface of the work.

Suggested Teaching-Learning Activities

1. Have students study reading assignments.

2. Demonstrate proper setting-up of oxyacetylene equipment.

3. Demonstrate tip sizes and their uses.

4. Demonstrate proper setting of gas pressures.

5. Demonstrate proper flame adjustments.

6. Demonstrate various welding exercises.

   a. Carry a molten puddle.

   b. Add a rod to puddle.

   c. Show various welds in various positions.

7. Demonstrate shutting down equipment.

8. Have students demonstrate some of the above exercises in class.

9. Have students practice all the above exercises.

Suggested Instructional Materials and References

Instructional materials

1. Oxyacetylene welder complete with all equipment

2. Mild steel rods 3/32 inch thick

3. Metal 1/8 inch thick

References

1. The Oxyacetylene Handbook, pp. 75-91, 187-210.

2. Smith's Short Course for Gas Cutting, Welding, Brazing.

3. The Farm Shop, pp. 168-174.

XIII. To hardsurface metals (ferrous)

Teacher Preparation

Subject Matter Content

Hard surfacing is overlaying a softer base metal with another metal of a high hardness characteristic to give the softer metal a longer usable life. Hardsurfacing metal provides durability of the base metal because of its hardness, abrasion resistance, impact resistance and decreased friction.

Using hardsurface powder is recommended for hardsurfacing of very thin edges, such as cultivator sweeps, where heat from electrode or flame using a rod might burn through.

1. The edge to be surfaced must be ground bright.

2. Apply surfacing powder.

3. Use a carbon arc torch, carbon in the electrode holder, or an oxyacetylene flame with a carbonizing flame (outer cone twice the length of the inner cone).

4. Melt the powder and sweat it to the metal. This is not a fusion process.

5. Be careful not to warp the metal.

Using Hardsurfacing Rods and Electrodes

Select the proper hardsurfacing rod or electrode; clean the metal to be surfaced, and apply surface with a long arc so that penetration will be shallow and the bead will be wide and thin. Deep penetration will reduce hardness of deposit.

Suggested Teaching-Learning Activities

1. Have students study reading assignments.

2. Demonstrate hardsurfacing with powder.

3. Demonstrate hardsurfacing with electrodes.

4. Have students practice hardsurfacing.

Suggested Instructional Materials and References

Instructional materials

1. Oxyacetylene welder and equipment

2. Arc welder and equipment

3. Hardsurfacing powder

4. Hardsurfacing electrodes

5. Metal to be hardsurfaced

References

1. The Oxyacetylene Handbook, pp. 355-372.

2. Modern Arc Welding, pp. 459-460.

3. Hobart Vest Pocket Guide, pp. 56-59.

4. Arc Welding Lessons, pp. 258-275.

5. Smith's Short Course for Gas Cutting, Welding, Brazing, p. 17.

6. The Farm Shop, pp. 157-158, 184-185.

XIV. To cut metal with an arc welder and an oxyacetylene welder

Teacher Preparation

Subject Matter Content

It is often necessary to cut metal. The hack saw, arc welder, or oxyacetylene torch is used for this job. The arc welder does not do a smooth job of cutting, but it is satisfactory in many cases since the rough areas may be ground off by a grinder. Cutting may be used also as a means of beveling a piece of iron for welding, gouging, chamfering, or piercing a hole.

Cutting with the Arc Welder

Usually an amperage setting of 140 and a 1/8 inch mild steel electrode will cut 1/4 inch plate. A 5/32 inch electrode and an amperage setting of 180 will cut steel over 1/4 inch thick. The electric arc actually burns away the metal.

Cutting is usually accomplished in the vertical or flat position. The arc is struck and the molten metal is raked away with the electrode.

To pierce a hole, hold a long arc with the electrode perpendicular over the spot where the hole is to be. When the metal is molten, push the electrode through the puddle Give the molten metal a chance to fall through the hole, then circle around the edge of the hole until the desired diameter is reached. To pierce a hole through a heavy piece, place the metal in the vertical position to allow the metal to drip away freely while the electrode is bored through the metal.

Cutting with the Oxyacetylene Torch

Cutting is severing of metal with a torch through heating and the rapid oxidation of the metal with pure oxygen. This is a chemical process involving the chemical affinity of oxygen-heated metals. In addition, there is a noticeable mechanical eroding produced by the energy of the oxygen stream which washes away metal in the form of slag.

Adjust the oxygen and acetylene pressures according to the manufacturer's recommendations. Start the cutting torch like any other torch, but adjust it to a neutral flame by using the preheat oxygen valve. Heat the metal to a bright orange, then open the oxygen lever, and travel the torch in the direction or angle desired. To pierce a hole, heat metal to a bright orange, lift the torch slightly to prevent clogging the tip and open the oxygen lever, thus piercing a hole.

<u>Suggested Teaching-Learning Activities</u>

1. Have students study reading assignments.

2. Demonstrate cutting and piercing with the arc welder.

3. Have a student demonstrate hooking up a torch and lighting and adjusting the flame.

4. Demonstrate cutting with the torch.

5. Have students practice cutting and piercing with both welders.

Suggested Instructional Materials and References

Instructional materials

1. Arc welder and equipment
2. Mild steel electrodes
3. Oxyacetylene welder and equipment
4. Cutting torch
5. Metal to cut

References

1. Arc Welding Lessons, pp. 215-221.
2. Modern Arc Welding, pp. 403-406.
3. The Oxyacetylene Handbook, pp. 411-444.
4. Smith's Short Course for Gas Cutting, Welding, Brazing, p. 8.
5. The Farm Shop, pp. 186-188.

XV. To weld nonferrous metals and braze ferrous metals

Teacher Preparation

Subject Matter Content

Working and welding nonferrous metals with the arc welder is limited to brazing with the equipment studies in this module. Nonferrous arc welding is best accomplished with TIG arc welding equipment.

Aluminum, copper, and brass may be welded by the oxyacetylene process.

Welding Aluminum

Aluminum may be fusion-welded by using aluminum rods and flux. The metal must be clean and bright with no grease or oil present. Chemical cleaning or a 5% caustic soda cleaning may be necessary. Then rinse the metal in hot water, and dip it into a 10% solution of nitric acid and then a hot water bath.

Use a slightly carbonizing flame since oxygen is not wanted on aluminum because it interferes with the fusion process. Flux is used on the rod and the welding process is similar to that of ferrous metals. After the weld cools, remove flux with hot water.

Welding Copper and Brass

Copper and brass are most easily fastened by the soldering or brazing process. The fusion process is best used in TIG welding. The silver alloy and soldering methods are accomplished by using only enough heat to melt the silver alloy and flux or solder onto the joints to be fastened.

Brazing Ferrous Metals

Brazing is a process of joining metal by using a filler of nonferrous metal (brass), which has a lower melting point. Flux or a flux-coated rod is necessary for this process. The first step in brazing is to heat the base metal to a temperature which expands the pores. freeing impurities. The joint is then tinned by using the flux and rod, and the two pieces may be joined by bridging them together with the rod used for tinning. Heat for this process may be furnished by the carbon arc torch, a carbon in the electrode-holder, or the oxyacetylene flame. The important fact is not to overheat the metal; a bright orange to cherry-red color is enough heat.

Welding cast iron is discussed in The Farm Shop, pp. 153-155, 182-184.

Suggested Teaching-Learning Activities

1. Have students study reading assignments.

2. Review identification of

3. Demonstrate aluminum fusion process.

4. Demonstrate silver alloy brazing process of copper and brass.

5. Demonstrate soldering of brass and copper.

6. Demonstrate brazing of ferrous metals.

7. Have students practice the above exercises.

Suggested Instructional Materials and References

Instructional materials

1. Arc welder and equipment

2. Oxyacetylene welder and equipment

3. Copper, brass, aluminum, cast iron, and mild steel

4. Brazing rods, solder, and silver alloy rods

5. Proper fluxes for rods

References

1. Arc Welding Lessons, pp. 237-243.

2. The Oxyacetylene Handbook, pp. 246-253.

3. Smith's Short Course for Gas Cutting, Welding, Brazing, pp. 11-15.

4. The Farm Shop, pp. 153-155, 180-184.

XVI. To weld with inert gas

Teacher Preparation

Subject Matter Content

The inert-gas-shielded arc welding process is one of the newest methods of fusion welding. In it a shield of an inert gas protects the electrode and the weld puddle.

The gas shield is obtained by feeding an inert gas, such as argon or helium, around a single tungsten electrode through a confining cup. The arc is drawn between the work and the tungsten electrode. This electrode is run at a current density which causes it to be white-hot at the end, but not so hot as to melt and fall off. When the tungsten electrode is running

at the proper current density, a small ball forms at the end. This ball is steady and does not oscillate unless the current is too high; then it oscillates and falls off.

The tungsten electrode must be kept from oxidizing. Tungsten is ordinarily considered non-consumable, but about one-half thousandth of an inch of tungsten is used each time the arc is started. If the end of the tungsten is allowed to come in contact with air while it is hot, it may oxidize as much as 1/16 inch.

The welding torch and tungsten electrode are handled in somewhat the same manner as a gas welding torch. In many cases, filler metal may be added. Weld quality is high because the inert gas shield prevents oxidation and inclusion of gases or formation of water vapor in weld. The efficiency of the gas in shielding the molten metal makes possible welding virtually all of the commerically nonferrous materials.

The following table should be consulted when selecting current for inert-gas-shielded arc welding:

MATERIAL	ALTERNATING CURRENT With High Frequency Stabilization	DIRECT CURRENT STRAIGHT Polarity	DIRECT CURRENT REVERSE Polarity
Magnesium up to 1/8-in. thick	1	N.R.	1
Magnesium above 3/16-in. thick	1	N.R.	N.R.
Magnesium castings	1	N.R.	2
Aluminum	1	N.R.	N.R.
Aluminum castings	1	N.R.	N.R.
Stainless steel up to 0.050 in.	1	2	N.R.
Stainless steel 0.050 in. and thicker	2	1	N.R.
Brass alloys	1	1	N.R.
Everdur *	2	1	N.R.
Monel **	2	2	N.R.
Silver	2	1	N.R.
Hastellay alloys	1	2	N.R.

MATERIAL	ALTERNATING CURRENT With High Frequency Stabilization	DIRECT CURRENT STRAIGHT Polarity	DIRECT CURRENT REVERSE Polarity
Silver cladding	1	N.R.	N.R.
Hard-facing	1	2	N.R.
Cast iron	2	1	N.R.
Low carbon steel 0.015 to 0.050 in. (Killed Steel only)	1	2	N.R.
Low carbon steel 0.050 in. and thicker (Killed Steel only)	2	2	N.R.
High carbon steel 0.015 to 0.050 in.	1	N.R.	N.R.
High carbon steel 0.050 in. and thicker	2	1	N.R.
Deoxidized copper up to 0.090 in.	2	1	N.R.

Key: 1. Excellent operation---best recommendation
2. Good operation---2nd recommendation
N.R.: Not recommended
* Use d.c.s.p. for 3/8 in. and thicker
** Inert-Gas process not always satisfactory for Monel

Suggested Teaching-Learning Activities

1. Have students practice striking an arc with an inert-gas-shielder welder.

2. Have students practice running beads and fusing together the following metals:

   a. Magnesium

   b. Aluminum

   c. Stainless steel

   d. Hard-facing

   e. Silver

   f. Brass alloys

Suggested Instructional Materials and References

Instructional materials

1. A welder with an inert-gas-shielded torch
2. Metal pieces of the above-named kinds

Reference

Modern Arc Welding, pp. 473-482.

Suggestions for Evaluating Educati nal Outcomes of the Module

The educational outcomes of the module should be evaluated according to attitudes and manipulative skills developed.

1. Manipulative skills

   Each student should be required to perform suggested learning activities in each competency of the module. Welding is basically a skill developed by practice and experience. The teacher should observe the student closely in order to correct bad practices and to evaluate the student's accomplishments.

2. Attitudes

   Attitudes should be evaluated according to student participation in class discussion, response to assignments, and performance of jobs.

Sources of Suggested Instructional Materials and References

Printed texts

1. Arc Welding Lessons for School and Farm Shop. Cleveland, Ohio: The James F. Lincoln Arc Welding Foundation, 1964. Price: $1.

2. Hobart Vest Pocket Guide, (EW-332). Troy, Ohio: Hobart Technical School, 1964. Free. (Quantities availabe for school use.)

3. Linde. The Oxyacetylene Handbook. New York: Union Carbide Corporation, Linde Division, 270 Park Avenue. Price: $3.

4. Modern Arc Welding Procedures and Practices, (EW-200). Troy, Ohio: Hobart Technical School. Price: $3.50.

Suggested Instructional Materials and References

Instructional materials

1. A welder with an inert-gas-shielded torch
2. Metal pieces of the above-named kinds

Reference

Modern Arc Welding, pp. 473-482.

Suggestions for Evaluating Educati nal Outcomes of the Module

The educational outcomes of the module should be evaluated according to attitudes and manipulative skills developed.

1. Manipulative skills

   Each student should be required to perform suggested learning activities in each competency of the module. Welding is basically a skill developed by practice and experience. The teacher should observe the student closely in order to correct bad practices and to evaluate the student's accomplishments.

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4. Modern Arc Welding Procedures and Practices, (EW-200). Troy, Ohio: Hobart Technical School. Price: $3.50.

5. Phipps, Cook, Scranton, and McCalley. Farm Mechanics Text and Handbook. Danville, Illinois: Interstate Publishers, Inc., 1959.

6. Smith's Short Course for Gas Cutting, Welding, Brazing (form 242). Minneapolis: Educational Department of Smith Welding Equipment, Division of Tescom Corporation, 27th Avenue and 4th Street, S.E. Free

7. Wakeman, T. F. and McCoy, V. L. The Farm Shop. New York: The MacMillan Company, 1960.

Films, film strips, and slides

1. Arc Welding at Work, (16 mm.). Schenectady, New York: General Electric Company. Free.

2. Arc Welding Electrode Selection, (16 mm., 20 minutes). Troy, Ohio: Hobart Technical School, Free.

3. Causes and Cures of Common Welding Troubles, (35 mm. slides (12)). Troy, Ohio: Hobart Technical School, Price: $1.25.

4. Learning Arc Welding Skills, (35 mm., 3 strips, 136 frames). Troy, Ohio: Hobart Technical School, Price: $1.25.

5. Magic Wand of Industry, (16 mm., 25 minutes). Cleveland, Ohio: Lincoln Electric Company. Free

Teaching aids

"Factors to Consider in Selecting Electrodes". (chart 35" x 28"). Troy, Ohio: Hobart Technical School. Price: $1.25.

"Good and Bad Weld Plastic Replicas". (set of 10) Troy, Ohio: Hobart Technical School. Price: $6.00.

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AGRICULTURAL MACHINERY ASSEMBLY AND LUBRICATION

One of Sixteen Modules in the Course Preparing for Entry in

AGRICULTURAL MACHINERY - SERVICE OCCUPATIONS

Module No. 7

The Center for Research and Leadership Development
in Vocational and Technical Education

The Ohio State University
980 Kinnear Road
Columbus, Ohio, 43212

The development of these materials was supported by a grant
from the
Division of Adult and Vocational Research
United States Office of Education

August, 1965

V7 00494

MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
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FROM: (Person) James W. Hensel (Agency) The Center for Vocational and Technical Education

(Address) 980 Kinnear Road, Columbus, Ohio 43212

DATE: August 4, 1967

RE: (Author, Title, Publisher, Date) Module No. 7, "Agricultural Machinery Assembly and Lubrication," The Center for Vocational and Technical Education, August, 1965.

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Method of Design, Testing, and Trial Part of a funded project of the USOE, OE-5-85-009; materials based on research from state studies; see preface material in the course outline.

(3) Utilization of Material:
Appropriate School Setting Post high school
Type of Program General post high school class in agricultural machinery
Occupational Focus Agricultural machinery service occupations
Geographic Adaptability Nationwide
Uses of Material Instructor course planning
Users of Material Teachers

(4) Requirements for Using Material:
Teacher Competency Background in agricultural machinery
Student Selection Criteria Post high school, mechanical aptitude, high school background, goal in agricultural machinery service occupation.
Time Allotment Estimated time listed in module. (P)

Supplemental Media --
Necessary x
Desirable ____ (Check Which)

Describe Suggested references given in module. (P)

Source (agency)
(address)

AGRICULTURAL MACHINERY ASSEMBLY AND LUBRICATION

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AGRICULTURAL MACHINERY ASSEMBLY AND LUBRICATION

Major Teaching Objectives

To develop (1) an understanding of agricultural machinery assembly and lubrication procedures and (2) the ability to assemble and lubricate such machinery efficiently and correctly.

Suggested Time Allotments

At school		
Class instruction	9 hours	
Laboratory experience	129 hours	
Total at school		138 hours
Occupational experience		60 hours
Total for module		198 hours

Suggestions for Introducing the Module

Assembly of agricultural machinery has become a very important function of the service department in the agricultural machinery dealership. Machines are sent from the branch house or factory in as many small components as possible. This is done to cut down on freight costs as well as machinery damages while in transit to the agricultural machinery dealership. These components are stored in the dealership's warehouse until they are to be assembled and sold. The set-up man must be able to identify each machine part and understand its function in the machine's overall operation if he is to assemble the new machine properly. When the machine is assembled, he must be able to adjust and lubricate it properly to insure its proper operation under field conditions.

Following are some suggested techniques for creating interest when teaching the module.

1. Show the class a torn down tractor engine fouled by sludge and varnish build-up which may have been caused in part by improperly selected lubricants.

2. Bring to class several new machine parts. Have the class attempt to identify the machine using those parts and describe the function of each in the machine's operation.

3. Reverse the action of a manure spreader. Have students attempt to identify why the machine is running backwards. Emphasize how just a switch in the position of one part can affect the entire operation of a machine.

Competencies to be Developed

I. To understand the functions of lubricants for agricultural machinery and know how to select them properly

Teacher Preparation

Subject Matter Content

The factor that contributes most to the longevity of agricultural machinery is proper lubrication. It is important that agricultural machines be lubricated regularly and thoroughly. In order to lubricate agricultural machines properly, the person doing the lubrication must understand the reasons for using specific lubricants for different applications.

The primary reason for lubricating agricultural machines is to reduce the resistance (friction) between two moving parts which are in contact with each other.

Two types of friction develop in agricultural machinery, namely: (1) dry friction and (2) viscous friction.

The movement in different directions of two parts of a machine that are in contact with each other causes dry friction.

1. It is the purpose of the lubricant to separate these two parts with a thin coating or layer of oil or grease.

2. The oil or grease acts as a cushion between the two pieces of metal, reducing the amount of impact, friction, and wear.

Viscous friction refers to the friction that occurs between molecules of a lubricant.

1. Moving machine parts which float on a layer of oil or grease eliminate any part-to-part contact.

2. With proper lubrication, the energy required to operate the moving parts is greatly reduced.

3. The amount of molecular friction that develops depends upon the viscosity or grade of lubricant being used.

4. The lower the viscosity of the oil, the less the amount of friction which develops.

Lubricants used on agricultural machinery may be placed in three groups. They are:

1. Crankcase oil
2. Gear oil
3. Lubricating grease

Crankcase oil has five important functions to perform as a lubricant. They are:

1. To reduce friction and wear between surfaces
2. To remove heat caused by friction
3. To provide a seal against escaping gases
4. To keep the engine clean
5. To provide protection against rusting and attack by acids

Oils have been continuously improved to meet these demands. Most of this improvement has come about through the use of additives.

1. Oxidation and corrosion inhibitors have been added to oils to cut down on varnishes, sludges, and corrosive acids produced in the engine.
2. Detergent-dispersants have been added to give a cleaning action to oil.

When servicing a tractor for delivery to a farmer, the service man must decide what oils to use. He needs to know:

1. The oil grade or viscosity to use
2. The oil type to use (American Petroleum Institute--API service classification)

Viscosity is a term used to describe how fluid an oil is, or its resistance to flow. The heavier the grade of oil, the higher is its viscosity. Oils come in two viscosity grades.

1. Single-viscosity (SAE: 5W, 10W, 20, 20W, 30, 40, 50)
2. Multi-viscosity (SAE: 5W-20, 5W-40, 10W-30, 20W-40)

The use of the right oil is important in maintaining overall machinery efficiency.

1. If too light a grade of oil is used, it may be forced out from between the bearing surfaces allowing direct part-to-part contact, and therefore, causing very rapid wear.

2. When too heavy a grade of oil is used, the engine has to produce extra power needlessly in order to circulate the oil; if tight fitting bearings are present, they will be poorly lubricated.

Temperature greatly affects the ability of an oil to flow.

1. Oils without additives tend to thicken and increase in viscosity as the temperature decreases.

2. The same oil must be able to lubricate an engine at a starting temperature of 0°F but still lubricate an engine with an internal temperature of 320°F.

3. The following table from an operator's manual illustrates proper selection of oil according to temperature ranges:

Air Temperature	Single Viscosity Grade	Multi-Viscosity Grade
Above 90°F	SAE 30	SAE 20W-40
32°F to 90°F	SAE 20W	SAE 10W-30
-10°F to 32°F	SAE 10W	SAE 10W-30
Below -10°F	SAE 5W	SAE 5W-20

The use of a multi-viscosity grade of oil has the following advantages over the use of single-viscosity grades of oil.

1. Safer engine operation over a wider range of temperature conditions is maintained.

2. Easier engine starting in cold weather is possible.

3. There is less chance of burning or scoring main bearings and connecting rod bearings during those critical first few seconds of operation after starting.

4. Less oil consumption will occur.

5. One multi-grade oil may serve the needs of several engines requiring different single-grade oils.

In addition to selecting the proper oil viscosity, it is important that proper type of oil be used to fit the conditions under which the engine operates. The American Petroleum Institute (API) has developed a set of crankcase oil specifications for classifying gasoline and diesel motor oils. They are:

1. ML (motor light)
2. MM (motor moderate)
3. MS (motor severe)
4. DG (diesel general)
5. DM (diesel moderate)
6. DS (diesel severe)

The operator's manual recommends the type of oil service classification and grade to be used for different engine operating conditions. These should be carefully followed.

Gear oils are primarily used in the transmissions and rear-axle housings of agricultural machinery. In many respects they are similar to heavy crankcase oils, but their functions are somewhat different. They are given different viscosity-grade numbers (SAE: 80, 90, and 140) and different API classifications to prevent their being confused with crankcase oils.

As tractor horsepower has increased, gears have been improved to meet increased pressure and greater work loads. Gears have become smaller and tooth pressure has increased. In addition to the rolling action which occurs between gear teeth, gears go through a wiping action that tends to wipe away the oil layer separating the two gear surfaces. Additives have been added to gear oils to meet the more severe operating conditions now encountered and to cut down on the wear of gears caused by these increasingly severe operating conditions.

Temperature affects the viscosity of gear oils in the same manner that it affects crankcase oils. Therefore, it is necessary to consider viscosity grade and type classification when selecting gear oils.

1. Gear oil of proper viscosity has enough body to hold moving surfaces apart.
2. If gear oil is too heavy, engine power is wasted; the oil may channel and provide little or no lubrication thus making gears very hard to shift.

3. If the gear oil is too light, the oil film becomes so thin that high points on the sliding surfaces contact and wear rapidly.

Gear oils, like crankcase oils, contain certain kinds of additives depending upon their service classification. These additives include:

1. Anti-oxidants

2. Rust preventatives

3. Foam inhibitors

Lubricating grease is basically a lubricating oil with a soap-type thickening agent added to give it consistency. Different types of grease are used on agricultural machinery as determined by the operating requirements of a particular piece of equipment.

1. Lime soap is used in chassis grease; this results in a water-resistant grease that can be used anywhere where high operating temperatures are not present.

2. Soda soap is used to form a semi-smooth grease and is often referred to as wheel-bearing grease.

3. Lithium soap combines the water resistance and heat resistance of the other greases to provide a multi-purpose lubricant that is suitable for all-round use on farm machinery.

<u>Suggested Teaching-Learning Activities</u>

1. Obtain from a local service manager the shop records of the last month's repair jobs caused in part by faulty lubrication practices.

2. When introducing this competency, pass empty cans of different brands and API classifications around the class and raise the question, "Which oil would you use?"

3. Heat SAE 10 and SAE 40 viscosity grade oils to 100° and pour both down a smooth inclined plate to illustrate different flow characteristics. Repeat demonstration with both oils chilled by placing in ice water. Repeat with a multi-viscosity grade oil.

4. Demonstrate the viscosity of oils using the Saybolt viscometer for measuring motor oil viscosities. Cover half of a piece of window glass (single strength) with a SAE 50 oil film leaving the other half free of oil. Using a wooden mallet have a student tap the oil-free section a good tap making sure it breaks the first time. Have the student hit the oil covered section with the mallet at the same intensity. Emphasize that the oil acted as a cushioning agent, and as a result the glass didn't break. Show the class worn engine and agricultural machinery parts caused by varnishing, sludge, and corrosive acids.

5. On a glass plate, place a sample of a lime soap, soda soap, and lithium soap grease. Apply heat under each sample of grease noting the breakdown of the grease samples.

6. Drain the soil out of a tractor needing an oil change. Run the used oil through a filter to show the sludge deposited on the filter.

7. Have each student place a smear of unused and used oil and grease on microscope slides. Have them observe under the microscope the differences between the unused and used samples.

8. Show the class samples of the different types of oils and greases.

9. Have students develop a chart showing oil grade (viscosity) and oil type (API service classification) for different engines and working conditions.

10. Mix graphite, dirt, and then water into a clean quart of oil to emphasize what oil looks like when these foreign materials are added.

11. Have students inspect the surface of a piece of metal under a microscope noting the roughness of the surface. Emphasize the role of the lubricant in keeping the rough surfaces apart.

Suggested Instructional Materials and References

Instructional Materials

1. Samples of oil and grease of different types and grades

2. Saybolt viscometer

3. A 12" x 18" piece of single-strength glass and a wooden mallet

4. Worn engine and machine parts

5. A double strength piece of glass 12" x 12"

6. Grease samples of each soap type

7. A strainer and filter pad

8. Microscope slide plates and a microscope (might be borrowed from the biology teacher)

9. Charts on the characteristics of oils and lubricants

10. Operator's manuals for machinery used in the laboratory

11. Empty oil cans of different brands marked with the various API service classifications

12. A piece of metal

13. Materials for demonstrating impurities in oils

References

S*1. Engineering Bulletin Ft. 53, pages 59-74 and 79-82.

S 2. Gulf Farm Tractor Guide, pages 12-15.

S 3. Modern Farm Power, pages 143-151.

S 4. Tractor Fuels and Lubricants, pages 27-45.

*The symbol T (teacher) or S (student) denotes those references designed especially for the teacher or for the student.

Suggested Occupational Experience

Have students lubricate several new machines, using the operator's manual as the lubrication guide.

II. To (1) understand machinery assembly and adjustment and (2) develop the ability to assemble it

Teacher Preparation

Subject Matter Content

The operator's manual or assembly manual for each machine gives instructions for setting up and adjusting new agricultural machines. It provides the following information:

1. Proper operating instructions
2. Servicing requirements
3. Proper attachment, adjustment, and servicing of machine accessories
4. Machine assembly instructions
5. Machine specifications

It is important that the set-up man thoroughly understand the operation of the machine before he attempts to assemble and service it. The following procedure should be followed in setting up new agricultural machines.

1. Study carefully the operator's manual for the machine. Thoroughly understand its operation, adjustment, and servicing requirements.
2. Using the operator's manual as a guide, identify and collect the parts needed to assemble the machine.
3. Assemble the machine following the assembly instructions in the operator's manual.
4. Make all adjustments according to the specifications as listed in the operator's manual.
5. Properly lubricate the new machine.
6. Touch up any scuffs or chips in the paint caused in assembling it.

Suggested Teaching-Learning Activities

1. Have a local agricultural machinery dealer speak to the class on the importance of setting up machinery in his dealership. He should point out the correct procedures to use in assembling machinery.

2. Procedures outlined in the operator's or assembly manuals should be followed carefully in assemblying the machines listed below. Have students assemble, adjust, and service these agricultural machines in the order indicated.

   a. Spike-tooth harrow

   b. Spring tooth harrow

   c. Grain elevator

   d. Flare-type grain wagon and running gear

   e. Manure spreader

   f. Disk plow

   g. Moldboard plow

   h. Row-crop planter

   i. Grain drill

   j. Row-crop cultivator

   k. Baler

   l. Corn or cotton picker

   m. Combine

   n. Loader

Suggested Instructional Materials and References

Instructional Materials

New unassembled agricultural machines

References

S Operator's manuals or assembly manuals

Suggested Occupational Experience

Have students set up machinery at the local agricultural machinery dealership under the supervision of the service department set-up man.

Suggestions for Evaluating Educational Outcomes of the Module

The following may be considered in evaluating the educational outcome of this module.

1. Student interest in the materials included in this module
2. The ability of the student to set up, adjust, and service new machines
3. The ability of the student to use properly the operator's manual in setting up new machines
4. Employer's evaluations of the quality of work done by the students on the job

Sources of Suggested References

1. Henderson, G. E. and Turner, J Howard. Tractor Fuels and Lubricants, 1964. Southern Association of Agricultural Engineering and Vocational Agriculture, Barrow Hall, University of Georgia, Athens, Georgia. Price: $1.20.
2. Promersberger, W. J. and Bishop, F. E. Modern Farm Power, Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1962.
3. Engineering Bulletin FT 53, Basic Principals, Operations, and Maintenance, American Oil Company, Room 147, Box 6110-A, Chicago 80, Illinois, 1962. Price: $1.00.
4. Gulf Farm Tractor Guide, No. SP10293, Gulf Oil Corporations, Gulf Building, Houston, Texas. No charge.
5. Operator's or assembly manuals from machinery manufacturers.

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INSTRUCTOR NOTE: As soon as you have completed teaching each module, please record your reaction on this form and return to the above address.

1. Instructor's Name _____

2. Name of school _____ State _____

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_____Ornamental Horticulture--Service Occupations
_____Agricultural Machinery--Service Occupations

4. Name of module evaluated in this report _____

5. To what group (age and/or class description) was this material presented? ____
_____

6. How many students:
   a) Were enrolled in class (total) _____
   b) Participated in studying this module _____
   c) Participated in a related occupational work experience program while you taught this module _____

7. Actual time spent teaching module:

		Recommended time if you were to teach the module again:
_____hours	Classroom Instruction	_____hours
_____hours	Laboratory Experience	_____hours
_____hours	Occupational Experience (Average time for each student participating)	_____hours
_____hours	Total time	_____hours

(RESPOND TO THE FOLLOWING STATEMENTS WITH A CHECK (✓) ALONG THE LINE TO INDICATE YOUR BEST ESTIMATE.)

	VERY APPROPRIATE	NOT APPROPRIATE
8. The suggested time allotments given with this module were:	___.___.___.___	
9. The suggestions for introducing this module were:	___.___.___.___	
10. The suggested competencies to be developed were:	___.___.___.___	
11. For your particular class situation, the level of subject matter content was:	___.___.___.___	
12. The Suggested Teaching-Learning Activities were:	___.___.___.___	
13. The Suggested Instructional Materials and References were:	___.___.___.___	
14. The Suggested Occupational Experiences were:	___.___.___.___	

(OVER)

15. Was the subject matter content sufficiently detailed to enable you to develop the desired degree of competency in the student? Yes_____No_____
Comments:

16. Was the subject matter content directly related to the type of occupational experience the student received? Yes_____No_____
Comments:

17. List any subject matter items which should be added or deleted:

18. List any additional instructional materials and references which you used or think appropriate:

19. List any additional Teaching-Learning Activities which you feel were particularly successful:

20. List any additional Occupational Work Experiences you used or feel appropriate:

21. What do you see as the major strength of this module?

22. What do you see as the major weakness of this module?

23. Other comments concerning this module:

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MECHANICAL POWER TRANSFER SYSTEMS

One of Sixteen Modules in the Course Preparing for Entry in

AGRICULTURAL MACHINERY - SERVICE OCCUPATIONS

Module No. 8

The Center for Research and Leadership Development

in Vocational and Technical Education

The Ohio State University
980 Kinnear Road
Columbus, Ohio, 43212

The development of these materials was supported by a grant
from the
Division of Adult and Vocational Research
United States Office of Education

V7 00495

August, 1965

MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) James W. Hensel (Agency) The Center for Vocational and Technical Education

(Address) 980 Kinnear Road, Columbus, Ohio 43212

DATE: August 4, 1967

RE: (Author, Title, Publisher, Date) Module No. 8, "Mechanical Power Transfer Systems," The Center for Vocational and Technical Education, August, 1965.

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Level of Group National
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Users of Material Teachers

(4) Requirements for Using Material:
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Time Allotment Estimated time listed in module. (P)

Supplemental Media --
Necessary x
Desirable ____ (Check Which)

Describe Suggested references given in module. (P)

Source (agency)
(address)

MECHANICAL POWER TRANSFER SYSTEMS

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MECHANICAL POWER TRANSFER SYSTEMS

Major Teaching Objective

To understand and apply the fundamentals and principles of mechanical systems of power transmission in agricultural machinery

Suggested Time Allotments

At school		
Class instruction	24 hours	
Laboratory experience	36 hours	
Total at school		60 hours
Occupational experience		0 hours
Total for module		60 hours

Suggestions for Introducing the Module

The whole spectrum of career opportunities in agricultural machinery occupations involves, to a certain extent, a knowledge of the fundamentals and principles of power transmission. Whether tractors or engines are used as stationary or portable power plants to drive or pull various types of equipment, the power delivered by the engine must be transmitted through some type of transmission system to the equipment performing the job. The power train of a tractor which transmits the power from the tractor engine to the wheels involves two or more methods.

Although hydraulic systems of transmitting power are used extensively on tractors and other farm equipment, mechanical systems remain the basic method of transmitting power from its source to its use.

The complexity of the construction of agricultural equipment makes it essential that a person desiring employment in this area have a knowledge and understanding of the fundamentals and principles involved in mechanical power transmission.

The following technique should be used to create interest in the module:

> Bring before the class an item of equipment which operates through pulleys and belts from a stationary engine. Remove the pulleys and belts, start the engine, and ask students to explain why the item of equipment is not operating. Also bring a tractor and another item of equipment with a mounted engine before the class. Have the students examine each item of equipment and list the points or places through which power

is transmitted from the source to the use. Have a general discussion in which class members give their interpretation of how power is transmitted from its source to its use.

Competencies to be Developed

I. To (1) understand the function of the clutch and to (2) identify its parts

Teacher Preparation

Subject Matter Content

The purpose of the clutch is to connect or disconnect a machine from the source of power, or, as is the case with a tractor, to connect or disconnect the engine to or from its load.

There are two basic types of clutches used on agricultural machines.

1. Friction

2. Positive

The friction clutch is used on tractors and machines with their own source of power, such as the self-propelled combine.

On tractors, clutches are of two types.

1. Dry

2. Wet

The dry-type clutch is equipped with a driving plate and a driven plate. The driving plate is lined with friction surfaces that are pressed against the driven plates when the clutch is engaged. These friction surfaces which are extremely smooth, increase the frictional surface of the plate.

The multiple-disc clutch, commonly used in crawler tractors, has many driving and driven discs and runs in oil. This type of clutch is called a wet-type clutch.

The two kinds of clutches most commonly used on the majority of row crop tractors today are:

1. Spring-loaded foot-operated clutch

2. Over-center hand-operated clutch

On the spring-loaded foot-operated clutch, spring pressure clamps the driven disc between the pressure plate and the flywheel. The foot pedal is used to disengage the clutch. The spring-loaded foot-operated clutch is composed of the following main parts:

1. Driven disc
2. Pressure plate
3. Pressure spring
4. Shift rod
5. Throw-out bearing

The over-center hand-operated clutch is operated by a hand lever and cam mechanism. The driving plate is attached to the flywheel. Drive plates drive the power shaft that supplies power to the transmission. When the driving clutch is engaged, the driven plate is forced against the driving plate by the yoke assembly. The over-center hand-operated clutch is comprised of the following main parts:

1. Driven plates
2. Driving plates
3. Yoke assembly for engaging the clutch
4. Clutch shift
5. Thrust plate
6. Clutch brake

The safety snap clutch is a friction-type clutch used on agricultural machinery. Two notched plates are pressed together by springs of sufficient force to permit power to be transmitted for normal predetermined working loads. In the event that an overload occurs on the clutch, it slips with a snapping action and prevents damage to the working unit. This type of clutch is commonly used on corn pickers, forage harvesters, and haying machines.

The positive clutch consists of two parts. Each part has jaws so shaped and placed as to lock together as a unit when they are engaged. They are used on machines transmitting light loads at slow speeds, such as planters and grain drills.

In the main, three types of positive-type clutches are used on agricultural machinery.

1. Ratchet-and-pawl

2. Overriding or overruning

3. Belt tension
   (See Farm Machinery and Equipment, pp. 42-44, for discussion of each of the above.)

Suggested Teaching-Learning Activities

1. Bring before the class a clutch of each type identified in the content and demonstrate how each one works.

2. Tour an agricultural machinery dealership to observe the use of clutches on agricultural machines.

3. Have students disassemble each type of clutch discussed in the content, learn its parts, and reassemble them.

4. Demonstrate the proper use of tools used in disassembling clutches.

Suggested Instructional Materials and References

Instructional materials

1. Clutches of the types identified in the content

2. Tools used in disassembling clutches

References

1. Farm Machinery and Equipment, pp. 41-44.

2. Modern Farm Power, pp. 160-164.

3. Machines for Power Farming, pp. 96-100.

4. Manufacturer's service manuals.

II. To (1) understand the function of the transmission and to (2) identify its parts

Teacher Preparation

Subject Matter Content

The transmission is the speed-reducing mechanism on the tractor. It provides a mechanical means of

1. Transmitting power to the driven member of the machine

2. Increasing and decreasing speed or power of the machine

3. Controlling travel (forward or backward) of the machine

Speed reduction is accomplished through sliding (speed-changing) gears. The simple transmission is composed of the following parts:

1. Drive shaft

2. Gears

3. Transmission countershaft

4. Main shaft

The gears on the end of the drive shaft and the countershaft are in constant mesh. The gears located on the main shaft are moved into position with the gears on the countershaft to obtain the desired speed of travel. Figure 7-4 on page 101 of Machines for Power Farming illustrates the function of the transmission parts and the flow of power through the transmission. The gears on the main shaft are movable. By shifting these gears forward or backward on the main shaft, the flow of power and the speed at which the machine is operating can be changed.

Transmissions in tractors are designed for power. The only time speed is needed is when the tractor is operated in road gear. The gear ratio in a transmission is low in relation to speed, and high in relation to torque.

Tractors require different gear ratios to meet varying operating requirements. The two ways of referring to a

change from one gear ratio to another in a simple gear train are constant-mesh and sliding gear shifting.

Reverse speed is obtained by engaging the small pinion gear between the countershaft and the sliding gears.

Several types of transmissions are used in tractors.

1. Single shift

2. Dual shift

   These types of transmissions include only gear transmissions in which one gear must mesh and slide into another in order to shift from one gear to another.

3. Shift-on-the-go

   This type of transmission includes planetary gears. Gears are in constant mesh and are applied or released by a hydraulic clutch. Transmissions included in this type are

   a. Select-O-Speed

   b. Case-O-Matic

   c. Torque amplifier

   d. Power director

   e. Synchro-range

   f. Multi-power

   g. Hydra-power

   These transmissions can be shifted from one speed to another while the tractor is in operation.

<u>Suggested Teaching-Learning Activities</u>

1. Using wall charts, teacher-made transparencies, and the reference illustrations, discuss the operation and parts of the various types of transmissions.

2. Demonstrate the operation of a simple transmission. Use a cutaway of an actual transmission for demonstrating this operation.

3. Demonstrate proper usage of transmission disassembly and repair tools.

4. Have students disassemble a simple transmission, learn its parts and their functions, and reassemble the parts.

5. Tour several agricultural machinery dealerships to study the types of transmission used on the tractors in each dealership.

Suggested Instructional Materials and References

Instructional materials

1. Charts, overhead transparencies, and cutaway models of transmissions

2. A simple transmission for each student

References

1. Transmission Theory.

2. Modern Farm Power, pp. 164-170.

3. Machines for Power Farming, pp. 100-104.

III. To (1) understand the functions of the differential and final drive and to (2) identify their parts

Teacher Preparation

Subject Matter Content

The purpose of the differential is to divide the power transmitted to the two rear wheels. This power should be divided equally when the tractor moves straight forward and unequally when the tractor turns.

The differential is made up of the following parts:

1. Transmission spline shaft

2. Bevel pinion gear on transmission shaft

3. Differential bevel pinion gears (spider gears)

4. Slide gears

5. Ring gear

6. Countershaft

The ring gear is driven by the bevel pinion on the transmission spline shaft. The differential bevel pinions are located on the sides of the ring gear and are mounted on the axle stubs. The spider and bevel pinion assembly makes the only connection between the ring gear and the two bevel side gears, which are keyed to the inner ends of the final drive countershafts. Both these bevel side gears are in constant mesh with the four differential pinions.

The entire differential assembly revolves when the tractor moves straight ahead. When one rear wheel meets additional resistance, for example, in turning, the differential pinions not only are carried around by the housing but also begin to rotate on their stub axles. The differential pinions then ride on one of the bevel gears and drive the others, thus driving one wheel faster than the other.

The purpose of the final drive is to reduce greatly the speed of the engine before it is applied to the drive wheels.

The final drive is made up of the following parts:

1. Pinion gear

2. Bull gear

3. Side gears

4. Axles

5. Shafts

6. Housing

The belt pulley on some tractors is placed at the rear of the tractor and is driven by the PTO shaft. It is usually placed on the right side near the center of the tractor.

The power flows through a set of bevel gears sitting at a right angle with the engine crankshaft to the pulley. It is driven by a bevel gear located on the transmission driving

shaft. A special clutch, or throw-out, permits the belt pulley to be kept out of operation.

Several types of PTO's are found on tractors.

1. Constant-running. With this type, the PTO will continue to run after the forward motion of the tractor is stopped.

2. Independent. With this type, the PTO can be stopped without having to stop the tractor.

Power from the engine is transferred to the machine through telescoping shafts and universal joints.

Suggested Teaching-Learning Activities

1. Using charts and projected diagrams, discuss with the class how the differential, final drive, belt pulley, and PTO on a tractor operate.

2. Using cutaways of actual models, demonstrate these tractor parts to the class.

3. Demonstrate proper usage of tools to repair these tractor parts.

4. Have the students disassemble these tractor units, study their parts, and reassemble them.

5. Tour agricultural machinery dealerships to observe the variations in application of these tractor units.

Suggested Instructional Materials and References

Instructional materials

1. Charts, cutaways, and enlarged views of the differential, final drive, belt pulley, and PTO of a tractor

2. A differential, belt pulley, and PTO for each member of the class

References

1. Machines for Power Training, pp. 104-109.

2. Modern Farm Power, pp. 170-173.

3. Manufacturer's service manuals

IV. To (1) understand the functions of the steering mechanism and brakes on tractors and to (2) identify their parts

Teacher Preparation

Subject Matter Content

The purpose of the steering mechanism on a tractor or self-propelled agricultural machine is to change the direction of the machine while it is in motion.

Two types of steering mechanisms are commonly used on wheel tractors.

1. Worm-and-lever

2. Worm-and-sector

On each type of steering mechanism, the sector or lever rides in the grooves of the worm gear, which is located on the steering shaft opposite the steering wheel. When the steering wheel turns, the lever or sector riding on the worm gear moves up or down. This movement, in turn, moves the pitman arm that is connected to the shaft running to the front wheel steering assembly and turns the wheels in the desired direction. (See Modern Farm Power, p. 191, for illustrations of the above types of steering mechanisms.)

In recent years, hydraulic principles have been applied to steering mechanisms to make machine steering easier. On most tractors, vane-type hydraulic power steering units are used. A positive displacement pump supplies the hydraulic oil to the power steering unit, and a value arrangement directs the flow of oil to both sides of the steering cylinder.

Crawler tractors are steered by either a clutch-and-brake arrangement or a brake-and-differential-drive arrangement. (See Modern Farm Power, pp. 194-195, for illustrations of the above-mentioned crawler steering mechanisms.)

Brakes on a tractor serve several purposes: For turning and stopping the vehicle and for providing the tractor operator with a means of safely operating his tractor.

Three types of brakes are in common use on tractors.

1. Disk

2. External-band

3. Internal-expanding shoe

The disk type of brake is found either on the rear axle shaft or the differential shaft. Applying the brake causes the friction plate to be clamped between stationary plates. The friction plates are attached to the axle shaft or differential. When the stationary plate clamp is against the friction plate, the axle is stopped or slowed down. The disk-type brake is illustrated in Modern Power Farming on page 195.

The drum of the external-band type of brake is attached to the axle shaft or differential shaft and rotates with the axle. A band with a friction surface lining fits around the outside of the drum. When pressure is applied against the foot pedal of the brake, the linkage between the foot pedal and the bands tightens and clamps the external band against the drum, causing the tractor to slow down or stop. The external-band type of brake is illustrated on page 196 of Modern Power Farming.

The internal-expanding brake is located on either the axle or the differential shaft. It consists of a set of stationary brake shoes and a set of drums. When the brake is applied, the shoes are forced against the drums, causing the tractor to stop or slow down. See page 197 of Modern Power Farming for an illustration of the internal-expanding brake.

Suggested Teaching-Learning Activities

1. Using cutaways and mockups, demonstrate before the class how each type of steering mechanism and brake operates.

2. Have students disassemble each type of steering mechanism and brake, learn its parts, and reassemble them.

3. Identify and demonstrate special tools used in disassembling steering mechanisms and brakes.

Suggested Instructional Materials and References

Instructional materials

1. Cutaways and mockups of the steering mechanisms and brakes discussed in the content

2. Tools used in disassembling steering mechanisms and brakes

References

Modern Farm Power, pp. 190-196

V. To understand pulleys and belts as a means of power transmission

Teacher Preparation

Subject Matter Content

Because of their adaptability, belt pulleys and belts are used on many machines as a means of transmitting power. Power can be transmitted from less than a few feet to 100 feet or more. This system is used extensively on machines such as feed grinders, silage blowers, corn shellers, and irrigation pumps. Often tractors equipped with belt pulleys are used as stationary power units for belt-driven equipment.

There are two types of belts and pulleys.

1. V-belt

2. Flat belt

V-belts have gained in popularity during recent years. Advantages of a V-belt includes

1. It is simple and compact.

2. There is good pulley contact and very little slippage if the belt is given correct tension.

3. It cannot slip off pulleys.

4. Speeds can be changed without changing the entire pulley.

The flat belt pulley is usually "crowned"; that is, the diameter at the center of the pulley is a littler greater than at the outer edges. The crown helps keep the belt aligned when the pulley is moving.

Belting materials are usually leather, canvas, or rubber. Leather is an excellent material but is expensive and must be kept dry. Canvas belting is durable and withstands exposure to moisture and oil, but stretches or shrinks under certain conditions. Rubber belting is used extensively on farm equipment but does not withstand oils and greases.

Pulleys may be constructed of a number of materials. Most, however, are made of wood, steel, cast iron, fiber, or paper.

Correct size and speed of pulleys is very important. Persons planning for employment in an agricultural machinery occupation must have an understanding of the basic laws of physics and mathematics relative to pulleys and belts and be able to apply this understanding to practical situations.

The following equation should be used in determining pulley sizes and speed:

Equation 1 (To determine the size of pulley needed to give a machine the proper speed)

D = diameter of driver
S = speed of driver
d = diameter of driven pulley
s - speed of driven pulley

$$D \times S = d \times s$$

Example:

A 12-inch driver pulley on an agricultural machine that turns 800 r.p.m. is to operate a driven pulley at 2400 r.p.m. What size should the driven pulley be to operate at 2400 r.p.m.?

$$12 \times 800 = d \times 2400$$
$$d = \frac{12 \times 800}{2400} = 4 \text{ inches}$$

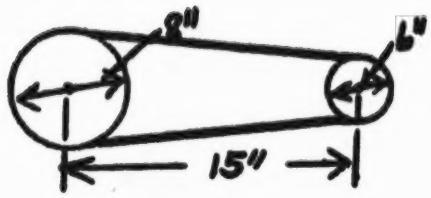
Often pulley belts wear or break on agricultural machines with pulleys of unequal sizes and must be replaced. The problem then is to determine the size of pulley with which to replace the worn or broken belt. The following methods should be used to determine the size of belt to use.

V-belt

The following formula should be used to determine the length of a V-belt.

$$L = 2C + 1.57\ (D+d) + \frac{(D-d)}{4C}$$

L = length of belt
C = distance between centers of sheaves
D = outside diameter of large sheaves
d = outside diameter of small sheaves



$$L = (2 \times 15) + 1.57\ (8'' + 6'') + \frac{(8'' - 6'')}{(4 \times 15)}$$

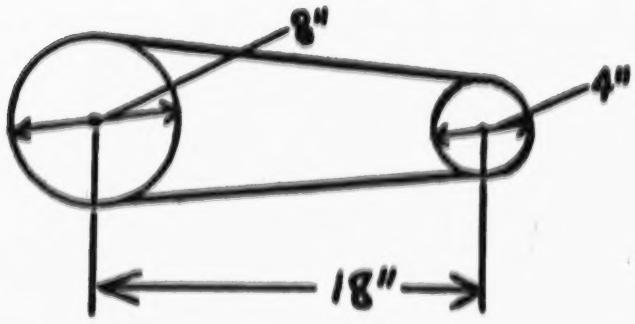
$L = 30 + 21.98 + .03$
$L = 52.01''$ or $52''$

Flat belts

The following method should be used to determine the size of flat belt needed.

1. Add together the diameters of the two pulleys.
2. Divide this sum by 2 and multiply the quotient by 3.
3. To this product, add twice the distance between the centers of the two pulley shafts.

Example:



1. $8'' + 4'' = 12''$
2. $2 \div 12'' \times 3'' = 18''$
3. $18'' + 18'' + 18'' = 54''$

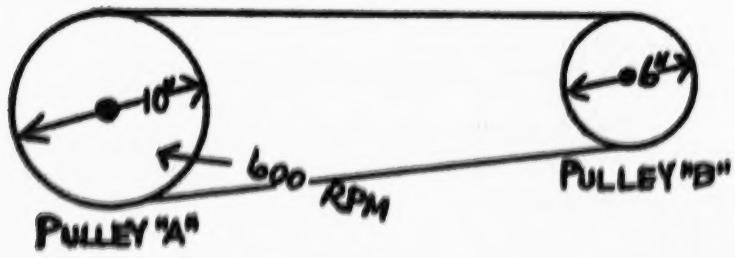
Suggested Teaching-Learning Activities

1. Have students examine several pieces of equipment which use flat and V-belts.

2. Have students cut used flat and V-belts to study their construction.

3. Have students work the following problems. Emphasize the purpose involved in each problem.

   a. To step up the speed of a pulley, using a large pulley to drive a small pulley.



   Pulley "a" is the driver pulley. How fast will pulley "b" turn?

   b. A 10" pulley running on the PTO shaft of a tractor is turning 540 r.p.m. The driven pulley on the machine is supposed to turn 1000 r.p.m. How large a driven pulley should be used to obtain a speed of 1000 r.p.m.?

   c. To slow down the speed of a pulley, using a small pulley to run a large pulley. A 4" driven pulley is turning 1000 r.p.m. The driven pulley on the machine is supposed to turn 600 r.p.m.'s. How large a driven pulley should be used to obtain a speed of 600 r.p.m.? Assume that the pulley shafts are 15" apart, and determine the length of V-belt and flat belt needed to drive the driven pulley.

Suggested Instructional Materials and References

Instructional materials

1. Samples of belt materials

2. Several V-belt and flat belt pulleys of various sizes which can be mounted on axles

3. Belts of various lengths

4. Diagrams of various kinds of pulleys and belts

5. One or more pieces of agricultural equipment for student use

References

1. Modern Farm Power, pp. 182-187.

2. Farm Machinery and Equipment, pp. 26-31.

3. Farm Gas Engines and Tractors, pp. 404-445, 475-479.

Suggested Occupational Experiences

Have students determine size and install pulleys on agricultural machines at the agricultural machinery dealership.

VI. To understand sprocket wheels and chains as a means of power transmission

Teacher Preparation

Subject Matter Content

Sprocket wheels and chains are positive means of power transmission. They are satisfactory even when the driving and the driven parts of the machine are several feet apart or when considerable speed reduction is desired.

Advantages of the sprocket and chain method of power transmission include:

1. Because it is positive, there is no slippage.

2. It can be coupled and uncoupled easily.

3. Chains absorb shock.

4. A small variation in the distance between sprocket centers is not harmful.

Types of chains include:

1. Detachable-link or hook-link chain

2. Pintle chain

3. Roller chain

4. Silent chain or chain belt

The detachable-link or hook-link and the roller are the two types of chains commonly used on agricultural equipment.

The roller-link chain is used for light work and medium speeds.

The pintle chain is used for heavy-duty and slow-speed work.

The roller chain, used for heavy-duty work, is also used extensively in the final drives of tractors, trucks, and self-propelled machinery.

The silent chain is a special type of chain, with the characteristics of a flexible metal corrugated belt. It is used for high-speed light work in engines, such as driving the cam shaft.

Suggested Teaching-Learning Activities

1. Have students examine various types of chains and sprockets.

2. Have students determine sizes of sprockets needed on a piece of equipment, according to varying requirements and uses of the machine.

3. Have students replace sprocket wheels and repair chains on agricultural machines.

Suggested Instructional Materials and References

Instructional materials

1. Several sizes of sprockets

2. Several lengths of chains for students to use with the various sizes of sprockets.

3. Samples of each type chain

4. One or more pieces of agricultural equipment for student use

5. Pictures and diagrams of chains and sprockets and their uses

References

1. Farm Machinery and Equipment, pp. 31-34.

2. Farm Gas Engines and Tractors, pp. 482-483.

VII. To understand gears and gearing as a means of power transmission

Teacher Preparation

Subject Matter Content

Gears, like sprockets and chains, are a positive means of power transmission. Positive power transmission means there is no slippage, as often occurs with pulleys and belts.

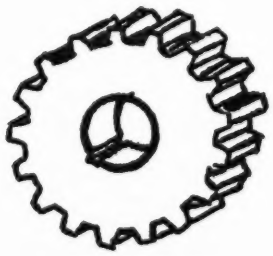
Gears and gearing are restricted primarily to the transmission of power from one part of a machine to another part of the same machine. Gears are also used extensively as a means of reducing or increasing speed of various parts of a machine.

Gears and gearing often are a more expensive means of power transmission than sprockets and chains, since the complete system may need to be replaced when repairs are needed.

Gears may be classed according to the following types:

1. Spur gear

   The shafts of spur gears are parallel, and their teeth are arranged so that their axes of rotation are parallel to the axes of rotation of the gears with which they mesh.



SPUR GEAR

2. Beveled gear

The teeth of beveled gears are arranged so that the shafts of the two gears meshed are at right angles, or nearly so. Beveled gears are used where power must be transmitted around corners. They are used extensively for differential pinion and axle gears in tractors.

BEVEL SPUR GEAR

3. Worm gear

Worm gears consist of two parts, the worm and the sector.

An advantage of the worm gear is that it permits a large speed variation between the driving and driven members of the machine. Disadvantages include:

a. Usually it will not operate in a reverse manner.

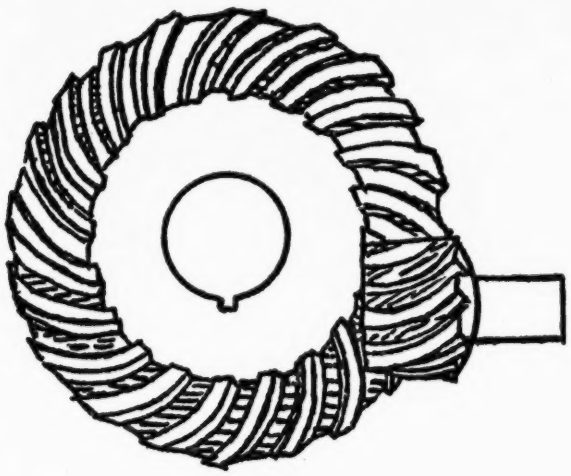
b. Its efficiency is lower than that of other types of gears.

c. Continuous lubrication is necessary during operation.

WORM GEAR

4. Hypoid gear

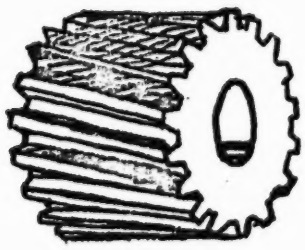
Hypoid gears are similar to spiral bevel gears except that the teeth have a distinct curvature. There is greater contact between the teeth and they operate under extreme pressure. Teeth contact is below the center line of the ring gear in tractors.



HYPOID GEAR

5. Helical gears

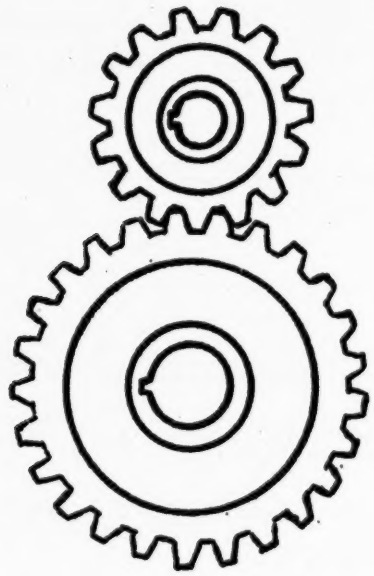
The teeth of helical gears are curved so as to remain in mesh or in constant contact longer than straight teeth. They may be of the spur gear type or the beveled gear type.



HELICAL GEAR

Agricultural machines require different gear ratios to meet varying operational requirements as demonstrated by the involvement of a transmission in the power train of a tractor. It is the function of the transmission to vary the speed, either up or down, at which the tractor is to operate. The

speed changes are made by bringing into contact gears of different sizes to transmit the power coming into the transmission. A large driving gear drives a smaller gear to increase the speed or amount of power. To reduce the amount of speed or power, a small gear drives a large gear. The relationship of gear sizes to each other is known as the gear ratio and is measured by measuring the circumferences of the two gears. An easy way to determine gear ratio is shown below.



There are 15 teeth on the small gear and 25 teeth on the large gear. The gear ratio is 5 to 3.

<u>Suggested Teaching-Learning Activities</u>

1. Have students study each type of gear listed in the content and be able to identify each gear upon sight.

2. Using agricultural machines, show students where each type of gear is used and demonstrate how it works in motion.

3. Using a tractor transmission, have the students determine the gear ratio when the tractor is engaged at each speed. After the students have determined the gear ratios, operate the tractor, noting the differences in speed caused by each gear ratio.

Suggested Instructional Materials and References

Instructional materials

1. Examples of each type of gear listed in the content

2. Pictures and diagrams of gears and gearing

3. Several pieces of equipment for students to disassemble or examine, including power train of a tractor

4. Tractor with transmission exposed to study gear ratios

References

1. Farm Machinery and Equipment, pp. 34, 35.

2. Farm Gas Engines, pp. 480, 481.

VIII. To understand the relationship of bearings to power transmission in agricultural machinery

Teacher Preparation

Subject Matter Content

Bearings are used in farm machinery to hold in position the various power transmitting parts and are designed to reduce the amount of resistance between these parts as much as possible.

Two types of bearings are used in agricultural machines.

1. Friction

2. Anti-friction

In friction bearings, the turning part is supported by and in direct contact with the inside surface of the bearing. The insert in the connecting rod coupling is an example of a friction-type bearing. Friction bearings are usually made of cast iron, bronze, or babbitt.

In anti-friction bearings, balls and rollers are placed between the moving part and the bearing. The rollers or balls turn with the moving part, reducing friction and wear on the moving part.

Several types of anti-friction bearings are used on agricultural machinery.

1. Ball

2. Roller

Ball bearings are more versatile than other types of rolling bearings. They operate with less friction, and may be used at higher speeds. In the diagrams on page 4 of Ball and Roller Bearings, the construction of a ball bearing is illustrated.

Several types of ball bearings are used on agricultural machinery.

1. Internal self aligning

2. Single row drop groove

3. Loading groove

4. Single row angular contact

5. Double row deep groove

6. Double row angular contact

7. Ball thrust

8. Sealed, prelubricated
   (See Ball and Roller Bearings, pp. 5-7, for a discussion of each of the above.)

Roller bearings use small cylindrical rollers that reduce friction. Roller bearings are particularly useful where the bearing is subjected to high pressure because of its larger bearing surface.

As is the case with ball bearings, several types of roller bearings are used on agricultural machinery.

1. Spherical

2. Straight

3. Spherical thrust

4. Tapered

5. Needle

6. Thrust
(See Ball and Roller Bearings, pp. 7 and 8, for examples and a discussion on each of the above listed bearings.)

Proper removal and installation of ball and roller bearings is of utmost importance if the bearing is to function properly and if damage to the moving part to which it is attached is to be avoided. Procedures for removing and installing bearings are illustrated in Ball and Roller Bearings, pp. 11-14, and 18-21.

Suggested Teaching-Learning Activities

1. Using overhead transparencies made from the diagrams Ball and Roller Bearings, discuss the various types of roller and ball bearings.

2. Show students where each type of bearing covered in the subject matter content is used on agricultural machinery.

3. Have students disassemble each type of bearing covered in the content and study its construction.

4. Demonstrate the use of bearing removal and installation tools and have each student use these tools in removing and installing bearings.

Suggested Instructional Materials and References

Instructional materials

1. Overhead transparencies of bearing types covered in the content

2. Bearings of each type identified in the content for students to disassemble

3. Bearing removal and installation equipment

References

1. Ball and Roller Bearings, pp. 1-27.

2. Shop Manual for Timkin Roller Bearings, pp. 1-81.

3. Farm Machinery and Equipment, pp. 46-49.

4. Quite Naturally (16mm film)

Suggestions for Evaluating Educational Outcomes of the Module

The following criteria should be used to evaluate the educational outcomes of this module:

1. Student interest in the material covered in this module
2. Student participation in class activities
3. The ability of the student to carry out the teaching-learning activities
4. The ability of the student to use the special tools identified in the teaching-learning activities

Sources of Suggested Instructional Materials and References

Instructional materials

1. Ball Bearing Maintenance. Bristol, Connecticut: New Departure, Division of General Motors.
2. Quite Naturally, (16mm film). Canton 6, Ohio: The Timken Roller Bearing Company.

References

1. Ball and Roller Bearings. Chicago: International Harvester Company, 180 North Michigan Avenue, 1964. Price: $1.00.
2. Basic Ball Bearing Types. Bristol, Connecticut: New Departure, Division of General Motors Corporation.
3. Bearing Failure Identification. Bristol, Connecticut: New Departure, Division of General Motors Corporation.
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IN VOCATIONAL AND TECHNICAL EDUCATION
THE OHIO STATE UNIVERSITY
980 KINNEAR ROAD
COLUMBUS, OHIO, 43212

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2. Name of school_____State_____

3. Course outline used: _____Agriculture Supply--Sales and Service Occupations
_____Ornamental Horticulture--Service Occupations
_____Agricultural Machinery--Service Occupations

4. Name of module evaluated in this report_____

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_____

6. How many students:
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7. Actual time spent teaching module:

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_____hours	Classroom Instruction	_____hours
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(RESPOND TO THE FOLLOWING STATEMENTS WITH A CHECK (✓) ALONG THE LINE TO INDICATE YOUR BEST ESTIMATE.)

	VERY APPROPRIATE	NOT APPROPRIATE
8. The suggested time allotments given with this module were:	___.___.___.___.___	
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13. The Suggested Instructional Materials and References were:	___.___.___.___.___	
14. The Suggested Occupational Experiences were:	___.___.___.___.___	

(OVER)

15. Was the subject matter content sufficiently detailed to enable you to develop the desired degree of competency in the student? Yes_____No_____
Comments:

16. Was the subject matter content directly related to the type of occupational experience the student received? Yes_____No_____
Comments:

17. List any subject matter items which should be added or deleted:

18. List any additional instructional materials and references which you used or think appropriate:

19. List any additional Teaching-Learning Activities which you feel were particularly successful:

20. List any additional Occupational Work Experiences you used or feel appropriate:

21. What do you see as the major strength of this module?

22. What do you see as the major weakness of this module?

23. Other comments concerning this module:

_____ _____
(Date) (Instructor's Signature)

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HYDRAULIC POWER TRANSFER SYSTEMS

One of Sixteen Modules in the Course Preparing for Entry in

AGRICULTURAL MACHINERY - SERVICE OCCUPATIONS

Module No. 9

The Center for Research and Leadership Development
in Vocational and Technical Education

The Ohio State University
980 Kinnear Road
Columbus, Ohio, 43212

The development of these materials was supported by a grant
from the
Division of Adult and Vocational Research
United States Office of Education

August, 1965

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MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) James W. Hensel (Agency) The Center for Vocational and Technical Education

(Address) 980 Kinnear Road, Columbus, Ohio 43212

DATE: August 4, 1967

RE: (Author, Title, Publisher, Date) Module No. 9, "Hydraulic Power Transfer Systems," The Center for Vocational and Technical Education, August, 1965.

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Provide information below which is not included in the publication. Mark N/A in each blank for which information is not available or not applicable. Mark P when information is included in the publication. See reverse side for further instructions.

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Development Group National Task Force
Level of Group National
Method of Design, Testing, and Trial Part of a funded project of the USOE, OE-5-85-009; materials based on research from state studies; see preface material in the course outline.

(3) Utilization of Material:
Appropriate School Setting Post high school
Type of Program General post high school class in agricultural machinery
Occupational Focus Agricultural machinery service occupations
Geographic Adaptability Nationwide
Uses of Material Instructor course planning
Users of Material Teachers

(4) Requirements for Using Material:
Teacher Competency Background in agricultural machinery
Student Selection Criteria Post high school, mechanical aptitude, high school background, goal in agricultural machinery service occupation.
Time Allotment Estimated time listed in module. (P)

Supplemental Media --
Necessary x
Desirable ____ (Check Which)

Describe Suggested references given in module. (P)

Source (agency)
(address)

HYDRAULIC POWER TRANSFER SYSTEMS

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HYDRAULIC POWER TRANSFER SYSTEMS

Major Teaching Objective

To understand basic hydraulics and its application to agricultural machinery

Suggested Time Allotments

At school		
Class instruction	90 hours	
Laboratory experience	120 hours	
Total at school		210 hours
Occupational experience		60 hours
Total for module		270 hours

Suggestions for Introducing the Module

The application of hydraulic principles to agricultural machinery operation has become increasingly more important in recent years. The size, weight, and complexity of modern agricultural machinery requires a much more powerful and flexible means of control. These machines are required to perform more jobs requiring more power to conduct them. Hydraulic principles have provided agricultural machinery designers with a practical means of meeting new demands placed on agricultural machinery.

Modern hydraulic systems on many types of agricultural machines seem complicated, and some are. Actually, the fundamental design is quite simple.

A person planning to work as an agricultural machinery mechanic must thoroughly understand basic hydraulic principles and systems and their application to agricultural machinery. He must also be able to recognize types of hydraulic pumps and valves and their parts and functions (cylinders, seals and packings, and lines and fittings) if he is to repair and service hydraulic systems on agricultural machinery properly.

The study of hydraulic transmissions has been omitted from this module. Due to the degree of specialization in this field, industry representatives felt that training is this area could best be provided through their service schools.

The following are suggested techniques for use in creating interest in the module:

1. Place various hydraulic system parts around the classroom and have the students attempt to identify them. Emphasize the need for being able to identify parts of the hydraulic system in order to work effectively on hydraulic systems.

2. Bring several agricultural machines before the class that have faulty hydraulic systems. Have students attempt to locate the source of the problem in each system.

3. Demonstrate before the class how a small piston can increase the output force of a hydraulic system. Have students attempt to explain how this phenomenon takes place.

Competencies to be Developed

I. To understand hydraulic terminology

Teacher Preparation

Subject Matter Content

The following terms should be thoroughly understood as they relate to hydraulic systems:

1. Actual size
2. Aeration
3. Ambient temperature
4. Atmospheric pressure
5. Back pressure
6. Baffle
7. Bernoullis principles
8. Bleed-off
9. Breather
10. By-pass of filter
11. By-pass
12. Cavitation
13. Chamber
14. Check valve
15. Circuit
16. Components
17. Control valves
18. Cylinders
19. Displaced oil
20. Feather
21. Filter
22. Flexible hose
23. Float
24. Fluids
25. Force
26. Four-way valve
27. Four-way four position spool
28. Four-way three position spool
29. Friction
30. Full-flow filter
31. G.P.M.
32. High pressure
33. Horsepower
34. Hydraulics
35. Inertia
36. Knock out valve
37. Line
38. Liquid
39. Low circulating pressure
40. Minimal size
41. Motion
42. Neutral
43. Non-position displacement pump
44. Operator
45. Pascal's law
46. Pipe
47. Positive displacement
48. Power point
49. Power
50. Pressure
51. Pressurized
52. Proportional type filter
53. PSI
54. Pump
55. Quantity of flow
56. Rate of flow
57. Relief valve
58. Reservoir
59. Resistance

60. R.P.M.
61. Sealed system
62. Spool
63. Static pressure
64. Strainer
65. Surge
66. Tubing
67. Two-way valves
68. Vacuum
69. Valve
70. Velocity
71. Vent
72. Viscosity index
73. Work
74. Energy
75. Pressure drop
76. Compressibility
77. Oscillation

Suggested Teaching-Learning Activities

Success in teaching this competency will depend on the teacher's ability to create interest in understanding these terms. Demonstration of the meaning of the terms, when possible, will provide the stimulus for this interest.

The majority of these terms can be demonstrated by using the hydraulic demonstration unit referred to in the suggested instructional materials.

Suggested Instructional Materials and References

Instructional materials

1. Hydraulic demonstration unit

2. Pumps, lines valves, etc., to demonstrate terms

References

S*1. Hydraulic Theory, Section I

*The symbol T (teacher) or S (student) denotes those references designed especially for the teacher or for the student.

II. To understand principles of hydraulic operation

Teacher Preparation

Subject Matter Content

The word hydraulics is a term applied to a science that deals with the physical behavior of liquids. Included in these liquids

are oils used in present day hydraulic systems. The study of hydraulics include

1. The laws of floating bodies

2. The flow of liquids under various conditions

3. Ways of directing the flow of liquids to useful ends

In order to understand the physical behavior of liquids, the physical properties of liquids must be thoroughly understood. These include

1. Shapelessness

2. Incompressibility

3. Density

4. Specific gravity

Liquids have no outer form of their own. They quickly conform in shape to their containers. They can be led almost anywhere in a pipe or a base by means of gravity or by applying force to them.

Even though liquids have no shape of their own, they are even less compressible than most solids. When a force is applied to a confined liquid, it exhibits substantially the same effect of rigidity as a solid. This rigidity can be combined with fluidity to transmit a force.

Example--A force of 15 pounds on a cubic inch of a particular fluid will decrease its volume by only 1/20,000. It would take a force of over 32 tons to reduce it 10 per cent.

Pressure set up in a liquid acts equally in all directions. The shape of the container in no way alters pressure relations.

Example--See figure 10. p. 10.

Pressure due to the weight of a liquid depends upon the vertical height of liquid from a given level to the surface of the liquid. The vertical distance between two horizontal levels in a liquid is known as the head of the liquid. (Refer to Basic Hydraulics, p. 9.)

Density refers to weight of fluid per unit of volume.

Example--Water weighs 62.4 pounds per cubic foot. A certain oil might weigh 55 pounds per cubic foot.

Specific gravity of a substance is the ratio of the weight of a unit volume of that substance, its density, to the weight of the same volume of some standard substance, measured under standard pressure and temperature conditions.

1. Water is the standard used for liquids and solids.

2. The weight of water is 62.4 pounds per cubic foot.

3. The weight of a given oil might be 55 pounds per cubic foot.

4. The specific gravity of the oil is computed in the following manner: 55/62.4 = .881 specific gravity.

By confining the fluid and adding pressure, the above principles can be applied to agricultural machinery.

Pressure is defined as force divided by the area over which it is distributed.

Example--See Basic Hydraulics, figures 10 - 12, pp. 10-12.

When two pistons are used in a hydraulic system, two basic rules always apply.

1. The force acting on each piston is directly proportional to its area, and the magnitude of each force is the product of the pressure and its area.

2. The distance the receiving piston is moved is inversely proportional to the area of the exerting piston.

Example--See Basic Hydraulics, figure 12, p. 12.

To understand the work output of a hydraulic system, an agricultural mechanic must understand input and output relations of a hydraulic system.

1. An increase in output force over input force is accompanied in exactly the same ratio by a decrease in the distance moved.

2. An increase in force can be obtained only by a proportional decrease in the distance the fluid is moved.

3. A distance increase can be obtained only at the expense of a force decrease in the same ratio.

4. In any hydraulic system, the input force multiplied by the distance through which it moves is always exactly equal to the output force multiplied by the distance through which it moves.

5. The total output in all forms always exactly equals the total energy input.

6. All of the above factors are subject to frictional loses.

When studying the working relations of a hydraulic system, one must understand the terms work and energy as they relate to hydraulic systems.

1. The amount of work done is the product of the force multiplied by the distance through which it moves.

2. Energy includes work and all the forms into which work can be converted or forms which can be converted into work.

In all working parts of hydraulic systems friction is present as the parts operate.

1. Work done against friction in a hydraulic system produces heat.

2. Heat produced in the hydraulic system is a form of energy dissipation causing a change in the input-output relationship.

In order to understand hydraulic systems in agricultural machinery in action, one must become acquainted with the characteristics of liquids in motion. Among these characteristics are

1. Volume and velocity of flow

2. Steady and unsteady flow

3. Streamline and turbulent flow

4. Force and energy changes

5. Relations of different kinds of energy to each other

Volume of flow refers to the amount of fluid that passes a given point in a hydraulic system in a given length of time. The rate of speed at which the fluid is moving forward at a particular point in the hydraulic system is called velocity of flow. It is expressed in such terms as 100 cubic feet per minute, or 100 gallons per minute or hour (G.P.M.).

A single continuous stream of fluid is known as a steady flow. When this continuous stream is interrupted by increasing or decreasing the volume of fluid passing a given point in the system, unsteady flow develops. The unsteadiness of flow is temporary, however, since it occurs during the time the rate of flow is increasing or decreasing to the new rate of flow. After it reaches this new level, a steady flow is re-established.

Streamline flow of hydraulic fluids refers to the action of fluid particles as they move straight forward without crossing the paths of other particles and without bumping into other particles. Streamline flow is accomplished under the following conditions:

1. When the fluid is flowing at low velocities

2. When the fluid is flowing through tubes or lines with small diameters

Turbulent flow of hydraulic fluid occurs when colliding fluid particles cause swirls, eddies, and cross-motions to develop in a hydraulic line. Turbulence in a hydraulic system is caused by the following:

1. Increases in the velocity of the fluids

2. Narrowing of the fluid passageway

3. Roughness of the inside of the hydraulic line

4. Dirt in the fluid

5. Degree of curvature of bends in the line

6. Friction in the hydraulic line

Five physical factors act upon the fluid in a hydraulic system.

1. Gravity

2. Atmospheric pressure

3. Specified applied forces

4. Friction

5. Inertia

   Inertia is that property possessed by all forms of matter which makes the matter resist being moved if it is at rest and, likewise, resist any change of motion if it is moving.

   a. To overcome this resistance to movement, some force must act on the object.

   b. A direct relationship develops between the magnitude of the force exerted and the inertia against which it acts. This force depends on two factors.

      1) The mass of the subject to be moved
      2) The rate at which the velocity of the object is changed

All of the physical actions of liquids in all agricultural machinery systems are determined by the relationships of these five factors to each other.

<u>Suggested Teaching-Learning Activities</u>

1. Through the use of the hydraulic demonstration unit, demonstrate shapelessness and incompressibility of hydraulic fluids.

2. Have students measure the amount of pressure exerted on a piston using the following hydraulic cylinders:

   a. A cylinder with an exerting piston of the same size

   b. A cylinder with a smaller initiating piston

   c. A cylinder with multiple pistons of different sizes

3. Have students work the following problems:

a. How much pressure is exerted on piston "b" in illustration No. 1?

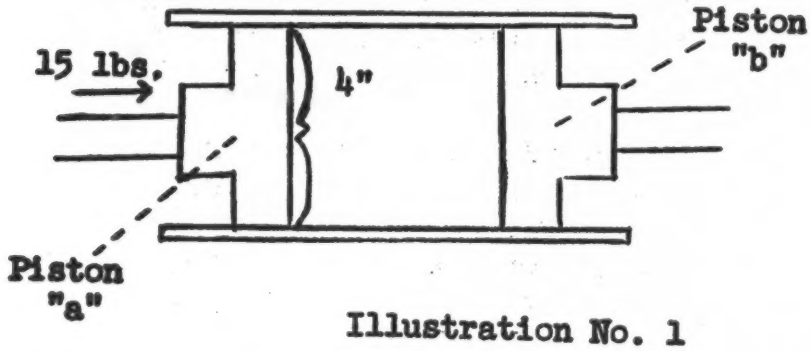

Illustration No. 1

b. Piston "a" in Illustration No. 2, is the initiating piston and has an area of 3 square inches. Sixty pounds of pressure is applied to piston "a."

1) How much pressure is exerted on piston "b," whose area is 9 square inches?
2) How much pressure is exerted on piston "c," whose area is 7 square inches?
3) How much pressure is exerted on piston "d," whose area is 4 square inches?

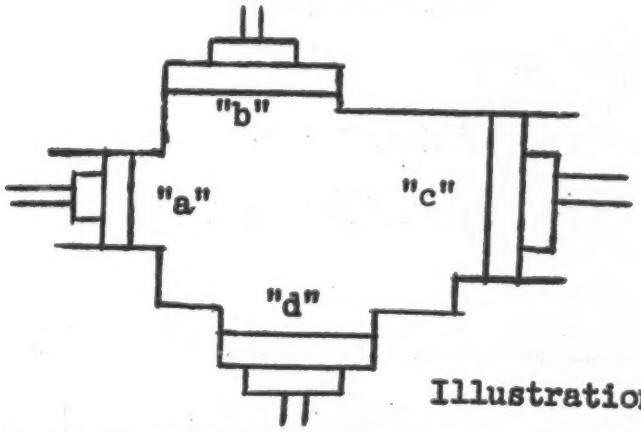

Illustration No. 2

c. If the initiating piston has an area of 3 square inches in Illustration No. 3, how much pressure is exerted on piston "b," whose area is 12 square inches.

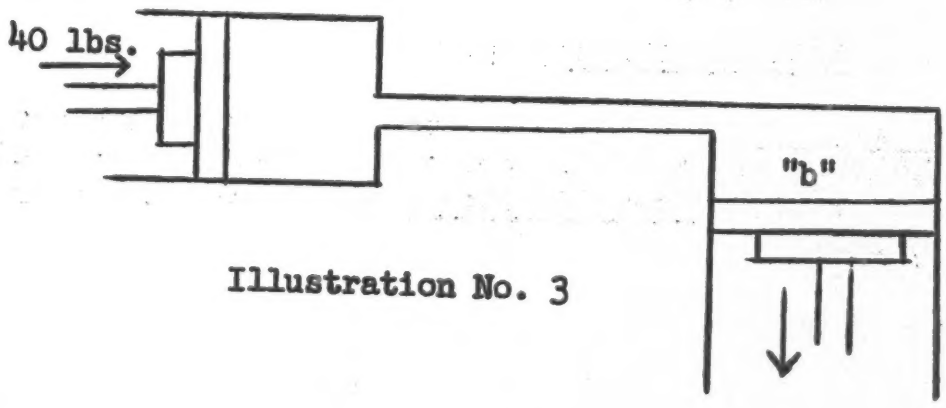

Illustration No. 3

d. What is the pressure exerted on the bottom of a container by a column of liquid 200 inches high, if it's cross-section area is 60 square inches and it weighs .06 pounds per cubic inch?

e. What is the weight of a column of oil 40 inches high if it's cross-section area is 20 square inches and weighs .06 pounds per cubic unit?

f. A hydraulic jack has a single output piston with an area of 50 square inches. The area of the input is 10 square inches. If a force of 10 pounds is exerted on the input piston, how much force will be exerted on the output piston?

g. If the input in problem "f" is moved downward 5 inches, how far will the output piston be moved?

Suggested Instructional Materials and References

Instructional materials

1. A simple hydraulic pump for disassembly

2. Three different types of pumps for use in determining the amount of pressure exerted on the receiving piston

References

S 1. Hydraulics, pp. 3-6

S 2. Basic Hydraulics, pp. 1-45

III. To understand the basic hydraulic system

Teacher Preparation

Subject Matter Content

Hydraulics, pp. 6-10

Hydraulic Theory, pp. 28-34

Hydraulics should be used as a basic reference and the materials followed in the order they are presented in the reference. The materials in Hydraulic Theory should be used to supplement Hydraulics.

Suggested Teaching-Learning Activities

1. Using charts, graphs, and mockups, show the components of the basic hydraulic system and its operation.

2. Have students disassemble a simple hydraulic system to identify the parts and their functions.

3. Using a plastic model of a simple hydraulic system, demonstrate to the class how the system operates. As the system is demonstrated, restrict the output of the pump to cause the relief valve to operate.

Suggested Instructional Materials and References

Instructional materials

1. A simple hydraulic pump for each student

2. A plastic model of a simple hydraulic system

References

1. Hydraulics, pp. 6-10

2. Hydraulic Theory, pp. 28-34

IV. To (1) identify various types of hydraulic pumps and (2) understand how they operate

Teacher Preparation

Subject Matter Content

Hydraulics, pp. 10-17

Hydraulic Theory, pp. 37-46

Hydraulic Fundamentals, pp. 10-13

Basic Hydraulics, pp. 186-270

Hydraulics should be followed as the basic reference and the materials covered in the order they are presented. The other three references listed above should be used to supplement Hydraulics.

Suggested Teaching-Learning Activities

1. Using charts, models, and mockups, discuss and identify the parts and functions of each of the kinds of hydraulic pumps.

2. Have students disassemble each kind of pump, identify its parts and reassemble it.

3. Using machinery brought to the school shop or available at local agricultural machinery dealerships, show the class examples of machines on which each type of hydraulic pump is used.

4. Demonstrate the use of high pressure guage to check maximum pressure from the setup.

5. Using a flowmeter, check the output of the pump.

6. Adjust pressure relief valve to show the various pressures obtainable from a setup.

7. Demonstrate how a plugged filter or screen on the intake of the pump will diminish the volume output of the pump.

Suggested Instructional Materials and References

Instructional materials

1. Charts, models and mockups of the different kinds of hydraulic pumps discussed in the content

2. Hydraulic pumps of each type discussed in the content

References

1. Hydraulics, pp. 10-17

2. Hydraulic Theory, pp. 37-46

S 3. Hydraulic Fundamentals, pp. 10-13

4. Basic Hydraulics, pp. 186-270

Suggested Occupational Experience

Have students repair several hydraulic pumps in the service department of a local farm machinery dealership.

V. To (1) identify various types of valves used in hydraulic systems and (2) understand their functions

Teacher Preparation

Subject Matter Content

Hydraulic Machinery, pp. 25-32

Hydraulics, pp. 17-24

Hydraulic Fundamentals, pp. 14-16

Basic Hydraulics, pp. 92-152

Hydraulic Machinery and Hydraulics should be followed as the basic references for teaching this competency and the materials covered in the order they are presented. The other two references should be used to supplement Hydraulic Machinery and Hydraulics.

Suggested Teaching-Learning Activities

1. Have students disassemble and identify the parts of each of the valves identified in the content.

2. Have students hook up each type of valve to a hydraulic line and observe how it functions.

3. After the class has completed the above activities, place various valves and valve parts around the classroom and have the students identify them.

4. Show the class examples of worn valves, pointing out the causes for their wear.

Suggested Instructional Materials

Instructional materials

Valves of each kind identified in the content

References

1. Hydraulic Machinery, pp. 25-32
2. Hydraulics, pp. 17-24
3. Hydraulic Fundamentals, pp. 14-16
4. Basic Hydraulics, pp. 92-152

Suggested Occupational Experience

Have students locate valves that are working improperly on hydraulic systems.

Have students replace worn-out valves on hydraulic systems.

VI. To (1) understand hydraulic cylinders and (2) develop the ability to maintain them

Teacher Preparation

Subject Matter Content

Hydraulic Machinery, pp. 20-24

Hydraulics, pp. 24-28

Hydraulic Theory, pp. 55-56

Hydraulics should be followed as the basic reference and the materials covered in the order they are presented. The other two references should be used to supplement Hydraulics.

Suggested Teaching-Learning Activities

1. Using charts and models, demonstrate to the class how a cylinders works and how cylinders differ.
2. Demonstrate with actual models the differences between the types of cylinders identified in the content.
3. Bring several hydraulic cylinders to class that are malfunctioning in different ways. Have students locate

the trouble causing the malfunctioning and correct it. (Possible causes of cylinder malfunctioning are given on pp. 22-23 of Hydraulic Machinery.)

4. Use a power steering pump on a tractor to demonstrate pump, cylinders, etc.

Suggested Instructional Materials and References

Instructional materials

1. Charts and models of the different types of hydraulic cylinders

2. Hydraulic cylinders that are not operating properly

References

1. Hydraulic Machinery, pp. 34-43

2. Hydraulics, pp. 24-28

3. Hydraulic Theory, pp.55-56

Suggested Occupational Experiences

1. Have students test hydraulic cylinders for leaks, and other malfunctions.

2. Have students correct malfunctions in hydraulic systems brought to a local agricultural machinery dealership for repair.

VII. To (1) recognize various types of packings, seals, lines, and fittings, and (2) understand how they are used on agricultural machinery and hydraulic systems

Teacher Preparation

Subject Matter Content

Hydraulics, pp. 28-31

Hydraulic Machinery, pp. 34-43

Basic Hydraulics, pp. 67-90

Hydraulics should be followed as the basic reference and the materials covered in the order they are presented in the reference. The other two references should be used to supplement Hydraulics.

Suggested Teaching-Learning Activities

1. Have students identify various types of tubing, packings, and seals used in several agricultural machinery hydraulic systems.

2. Have students replace worn-out tubing, packings, and fittings on hydraulic systems on agricultural machines.

Suggested Instructional Materials and References

Instructional materials

1. Various samples of different types of tubing, packings, and seals used on agricultural machinery hydraulic systems

2. Agricultural machinery hydraulic systems with worn tubings, packings, and seals

3. New hydraulic tubings, packings, and seals

References

1. Hydraulics, pp. 28-31

2. Hydraulic Machinery, pp. 34-43

3. Basic Hydraulics, pp. 67-90

VIII. To understand types of hydraulic systems used on agricultural machinery

Teacher Preparation

Subject Matter Content

Hydraulics, pp. 35-38

Hydraulic Theory, pp. 57-65

Hydraulics should be followed as the basic reference and the materials covered in the order they are presented. The materials in Hydraulic Theory should be used to supplement those in Hydraulics.

Suggested Teaching-Learning Activities

1. Have available for the class a tractor with a hydraulically-controlled implement attached. Disassemble the hydraulic system, identifying each part and explaining its function to the class.

2. Have students disassemble several types of hydraulic systems studied in the content. Have them identify each part of the system and reassemble it.

3. Have students visit a local agricultural machinery dealership and identify the types of hydraulic systems used on the agricultural machinery at the dealership.

Suggested Instructional Materials and References

Instructional materials

1. A tractor with a hydraulically-operated implement attached

2. Charts and diagrams of hydraulic systems

3. Several hydraulic systems covered in the content

References

1. Hydraulics, pp. 35-38

2. Hydraulic Theory, pp. 57-65

3. Machines for Power Farming, pp. 109-115

IX. To understand hydraulic system troubles

Teacher Preparation

Subject Matter Content

Hydraulics, pp. 33-35

Suggested Teaching-Learning Activities

1. Bring to the class a ruptured line, an exploded cylinder, and a collapsed suction hose. Explain to the class the causes of these defects. Point out the different amounts of pressures created by various makes of tractors and their relationships to these problems.

2. Bring to the class several agricultural machines whose hydraulic systems are not operating properly. Have the students determine what is wrong in each system and correct it.

3. Demonstrate to the class what happens to a hydraulic line when the wrong size of pump is used in a hydraulic system.

4. Demonstrate what can happen when cotton braid base is used instead of wire braid base under high pressure.

Suggested Instructional Materials and References

Instructional materials

1. A ruptured hydraulic line, an exploded cylinder, and a collapsed suction hose

2. Several agricultural machines with hydraulic systems that are not working properly

3. A hydraulic system and several hydraulic pumps of different sizes

References

Hydraulics, pp. 33-35

X. To understand the types and qualities of hydraulic oils

Teacher Preparation

Subject Matter Content

Hydraulics, pp. 41-43

Hydraulic Theory, pp. 24-28

Hydraulic Fundamentals, pp.23-34

Hydraulic Machinery, pp. 49-69

Hydraulics should be followed as the basic reference and the materials covered in the order they are presented. The other three references should be used to supplement Hydraulics.

Suggested Teaching-Learning Activities

Demonstrate the following before the class:

1. Pour point
2. Effects of foaming
3. Sludge deposits
4. Aniline point
5. Viscosity
6. Oxidation of hydraulic oil

Suggested Instructional Materials and References

Instructional materials

1. Saybolt meter
2. Test tubes for demonstrating pour point
3. A hydraulic system with oil that foams badly and has a build-up of sludge
4. Test tubes, hydraulic oils, aniline dyes, and gas burner

References

1. Hydraulics, pp. 41-43
2. Hydraulic Theory, pp. 24-28
3. Hydraulic Fundamentals, pp. 23-34
4. Hydraulic Machinery, pp. 49-69

XI. To (1) understand hydraulic system trouble shooting procedures and (2) be able to locate failures in hydraulic systems

Teacher Preparation

Subject Matter Content

Operation and Care of Hydraulic Machinery, pp. 84-91

Hydraulic Fundamentals, pp. 38-40

Hydraulic Fundamentals should be followed as the basic reference in teaching this competency. The materials should be covered in the order they are presented.

Suggested Teaching-Learning Activities

Using the trouble shooting chart in Hydraulic Fundamentals, pp. 39-42, have students trouble shoot several faulty hydraulic systems on agricultural machines.

Suggested Instructional Materials and References

Instructional materials

Several faulty hydraulic systems

References

1. Hydraulic Fundamentals, pp. 38-40

S 2. Operation and Care of Hydraulic Machinery, pp. 84-91

Suggested Occupational Experience

Have students trouble shoot several hydraulic systems at local agricultural machinery dealerships.

Suggestions for Evaluating Educational Outcomes of the Module

The educational outcome of the module should be evaluated according to the following criteria:

1. Changes in student understanding of hydraulic principles as they relate to agricultural machinery

2. Ability of the student to diagnose hydraulic system problems and correct them (Each student should be required to trouble shoot a hydraulic system and correct any problems encountered.)

3. Student interest in the materials covered in this module

4. Changes in attitude on the part of the student toward his work

5. Changes in student understanding of agricultural machinery hydraulics, as determined by the difference in scores in pre- and post-tests in hydraulics.

Sources of Suggested Instructional Materials and References

Instructional Materials

E. M. Hydraulic Trainer, Electromatic. Box 182, Mc Minnville, Tennessee.

References

1. Basic Hydraulics, NAVPERS 16193. Washington 25, D.C.: U. S. Government Printing Office.

2. Hydraulic Fundamentals, Philadelphia: Sun Oil Co., 1608 Walnut Street.

3. Hydraulic Machinery, New York 17: Texaco, Inc., 135 East 42nd Street.

4. Hydraulics, Bulletin No. GSS 1277-Z. Chicago: International Harvester Co., 180 N. Michigan Avenue. Price: $1.50 per copy.

5. Hydraulic Theory, Racine, Wisconsin: J. I. Case Company.

6. Operation and Care of Hydraulic Machinery, Texaco Inc., 135 East 42nd Street, New York 17, New York, 1962.

7. Stone and Gulvin. Machines for Power Farming, New York: John Wiley and Sons, Inc. Price: $5.95.

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THE CENTER FOR VOCATIONAL AND
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THE OHIO STATE UNIVERSITY
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ADJUSTMENT, MAINTENANCE, AND REPAIR OF

TILLAGE, PLANTING, SPRAYING, & FERTILIZING MACHINERY

One of Sixteen Modules in the Course Preparing for Entry in
AGRICULTURAL MACHINERY - SERVICE OCCUPATIONS

Module No. 10

The Center for Research and Leadership Development
in Vocational and Technical Education

The Ohio State University
980 Kinnear Road
Columbus, Ohio, 43212

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from the
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United States Office of Education

August, 1965

VT 004497

M E M O R A N D U M

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) James W. Hensel (Agency) The Center for Vocational and Technical Education

(Address) 980 Kinnear Road, Columbus, Ohio 43212

DATE: August 4, 1967

RE: (Author, Title, Publisher, Date) Module No. 10, "Adjustment, Maintenance, and Repair of Tillage, Planting, Spraying, and Fertilizing Machinery," The Center for Vocational and Technical Education, August, 1965.

Supplementary Information on Instructional Material

Provide information below which is not included in the publication. Mark N/A in each blank for which information is not available or not applicable. Mark P when information is included in the publication. See reverse side for further instructions.

(1) Source of Available Copies:
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(3) Utilization of Material:
Appropriate School Setting Post high school
Type of Program General post high school class in agricultural machinery
Occupational Focus Agricultural machinery service occupations
Geographic Adaptability Nationwide
Uses of Material Instructor course planning
Users of Material Teachers

(4) Requirements for Using Material:
Teacher Competency Background in agricultural machinery
Student Selection Criteria Post high school, mechanical aptitude, high school background, goal in agricultural machinery service occupation.
Time Allotment Estimated time listed in module. (P)

Supplemental Media --
Necessary x
Desirable ____ (Check Which)

Describe Suggested references given in module. (P)

Source (agency)
(address)

ADJUSTMENT, MAINTENANCE, AND REPAIR OF TILLAGE, PLANTING, SPRAYING, AND FERTILIZING MACHINERY

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THE CENTER FOR RESEARCH AND LEADERSHIP DEVELOPMENT
IN VOCATIONAL AND TECHNICAL EDUCATION
THE OHIO STATE UNIVERSITY
980 KINNEAR ROAD
COLUMBUS, OHIO, 43212

INSTRUCTOR NOTE: As soon as you have completed teaching each module, please record your reaction on this form and return to the above address.

1. Instructor's Name_____

2. Name of school_____State_____

3. Course outline used: _____Agriculture Supply--Sales and Service Occupations
_____Ornamental Horticulture--Service Occupations
_____Agricultural Machinery--Service Occupations

4. Name of module evaluated in this report_____

5. To what group (age and/or class description) was this material presented?____
_____

6. How many students:
   a) Were enrolled in class (total) _____
   b) Participated in studying this module _____
   c) Participated in a related occupational work experience program while you taught this module _____

7. Actual time spent teaching module:

		Recommended time if you were to teach the module again:
_____hours	Classroom Instruction	_____hours
_____hours	Laboratory Experience	_____hours
_____hours	Occupational Experience (Average time for each student participating)	_____hours
_____hours	Total time	_____hours

(RESPOND TO THE FOLLOWING STATEMENTS WITH A CHECK (√) ALONG THE LINE TO INDICATE YOUR BEST ESTIMATE.)

	VERY APPROPRIATE	NOT APPROPRIATE
8. The suggested time allotments given with this module were:	___.___.___.___.___	
9. The suggestions for introducing this module were:	___.___.___.___.___	
10. The suggested competencies to be developed were:	___.___.___.___.___	
11. For your particular class situation, the level of subject matter content was:	___.___.___.___.___	
12. The Suggested Teaching-Learning Activities were:	___.___.___.___.___	
13. The Suggested Instructional Materials and References were:	___.___.___.___.___	
14. The Suggested Occupational Experiences were:	___.___.___.___.___	

(OVER)

15. Was the subject matter content sufficiently detailed to enable you to develop the desired degree of competency in the student? Yes_____No_____
Comments:

16. Was the subject matter content directly related to the type of occupational experience the student received? Yes_____No_____
Comments:

17. List any subject matter items which should be added or deleted:

18. List any additional instructional materials and references which you used or think appropriate:

19. List any additional Teaching-Learning Activities which you feel were particularly successful:

20. List any additional Occupational Work Experiences you used or feel appropriate:

21. What do you see as the major strength of this module?

22. What do you see as the major weakness of this module?

23. Other comments concerning this module:

_____ _____
(Date) (Instructor's Signature)

_____
(School Address)

ADJUSTMENT, MAINTENANCE, AND REPAIR OF TILLAGE, PLANTING, SPRAYING, AND FERTILIZING MACHINERY

Major Teaching Objective

To (1) understand tillage, planting, fertilizing, and spraying machinery and their parts, and (2) the ability to adjust, repair, and maintain these machines.

Suggested Time Allotment

At School

Class instruction	94 hours	
Laboratory experience	188 hours	
Total at school		282 hours
Occupational experience		142 hours
Total for module		424 hours

Suggestions for Introducing the Module

One job activity of mechanic's helpers and mechanics is adjusting, repairing, and servicing agricultural soil tillage, crop planting, fertilizing and crop spraying machines, both in the service department of the local agricultural machinery dealership and in the farmer's field. These employees, as well as the parts man, must know the types of these machines, their functions (including how they work in relation to a particular type of soil and crop), and their repair and maintenance.

Because of the diversity among machines used in various parts of the country, that serve the same purpose and the design differences developed by the major line agricultural machinery manufacturers, the operator's and service manuals should be used as the basic references for this module. All adjustments and repairs should be made according to specifications and procedures outlined in these manuals. The information in each competency provides the necessary background to make these adjustments and repairs.

The following techniques should be used to create interest in the module:

1. Locate machines in the community that are out of adjustment and in need of repair. Take students on a tour of the farms where they are, and demonstrate operation of these machines. Have students attempt to identify what part or parts are out of adjustment and how they should be properly adjusted.

2. Place parts from several machines around the classroom and have students attempt to identify them.

3. Place a relatively simple tillage machine before the class that is completely out of adjustment and in need of a number of repairs. Have each student attempt to diagnose what repairs and adjustments need to be made on the machine.

Competencies to be Developed

I. To understand how to use operator's and service manuals when adjusting, maintaining, and repairing agricultural machinery

Teacher Preparation

Subject Matter Content

For each machine that an agricultural machinery manufacturer builds, he develops and supplies the purchaser with an operator's manual that gives information concerning the following:

1. Machine specifications
2. Lubrication
3. Operation
4. Adjustment
5. Trouble shooting
6. Attachments
7. Setting-up instructions
8. A description of the machine, the function it is to perform, and design to perform this function

The specifications given for a particular machine vary among the major line agricultural machinery manufacturers, but generally include the following information:

1. Type of machine
   (Example--pull-type, self-propelled, mounted)
2. Weight, length, and width of machine
3. Lifting controls

4. Dimensions of moving parts

5. Safety clutches

6. Number and types of bearings

Proper lubrication is essential to long life and trouble-free operation of the machine. The following information is provided concerning lubrication of each machine.

1. Intervals at which lubricants should be applied

2. Recommended oils and greases to be used

3. Pictures and diagrams showing grease fittings

4. Pictures and diagrams showing the location of pre-lubricated sealed-type ball bearings and oil-less plain bearings

When servicing a machine, lubrication procedures should be studied thoroughly and followed carefully.

To make any adjustment on an agricultural machine, a mechanic or mechanic's helper must understand thoroughly the operation of each part of the machine. This information is given in the operator's manual in the section entitled "operation," which provides such information as

1. A description of how the machine is designed to work

2. The source of power and how the machine is attached to it

3. An identification of the processes the machine is designed to carry out and how the machine performs these functions

4. Maximum and minimum speeds at which the machine is designed to perform

5. An identification of each part in the machine and a description of how each part operates

6. Information to be used when servicing each machine part

Closely associated with the operation of an agricultural machine and of equal importance is proper adjustment, which is also covered in detail in the operator's manual. It should be thoroughly understood by the person making adjustments on machines in the agricultural machinery dealership. The adjustments to be made on a machine are presented and described in the same manner as are the items under the section entitled "operation."

In the trouble shooting section of the operator's manual, problems that may develop as a result of improper adjustment are identified and remedies suggested.

The agricultural machinery manufacturer develops at the same time, the operator's manual for the purchaser to use, and a service manual for the local agricultural machinery dealership to use. This manual describes in detail the disassembly, inspection, repair, and reassembly procedures to follow in making repairs on the machine. When repairing a machine, the procedures outlined in this manual must be carefully followed in order to insure proper and efficient repairing of the machine.

Suggested Teaching-Learning Activities

1. Demonstrate the use of the operator's and service manuals in making adjustments and repairs on an agricultural machine.

2. Have students lubricate, adjust, and make minor repairs on several comparatively simple (disk plow, row-crop planter) agricultural machines using the operator's and service manuals as guides. Emphasize proper use of these manuals at all times.

3. Have a lubrication specialist from a major line oil company speak on and demonstrate use of oils and greases on agricultural machinery.

Suggested Instructional Materials and References

Instructional materials

1. Operator's manuals

2. Service manuals

3. Machines needing adjusting and repairing

References

S*1. Operator's manuals

2. Service manuals

"The symbol T (teacher) or S (student) denotes those references designed especially for the teacher or for the student.

II. To understand the relationship of soil tillage methods to the soil

Teacher Preparation

Subject Matter Content

The primary function of all tillage machinery is to pulverize, aerate, and loosen the soil in preparation for planting a crop. In addition, soil tillage machines level and smooth fields, compact the top soil, and kill weeds that have started to grow before the crop is planted.

The degree to which these activities are performed on the soil and tillage machines that are selected to perform these activities is dependent on several factors.

1. Soil type
2. Erosiveness of the soil
3. Moisture availability during the growing season
4. Crops to be planted

The type of soil influences greatly the type of tillage treatment necessary to develop a well-pulverized seedbed that will produce a high-yielding crop. Soils are grouped on the following basis:

1. Sandy
2. Sandy loam
3. Loam
4. Silt loam

5. Clay loam

6. Clay

7. Heavy clay

The amount and depth of tillage necessary to prepare a good, firm seedbed varies according to the soil type. Because of the coarse texture of sandy soils, less tillage is required to loosen and aerate the soil, and machines that penetrate the soil at comparatively shallow depths are used. On heavy, compactable soils, such as clay or clay loam, more extensive tillage is required to develop a good, firm, permeable seedbed; and machines that penetrate the soil at a depth of 6" or more are used.

Another factor closely associated with the type of soil which also places limitations on the method and extent of tillage, is the susceptibility of the soil to erosion.

Two elements are responsible for causing soil erosion.

1. Wind

2. Rain

Soils that are susceptible to erosion due to high winds and rain require different tillage practices than soils in areas not so susceptible to these hazards. In areas where erosion by wind is a problem, farmers stir the subsurface avidly turning under the top soil as much as possible. In areas where erosion by rainfall is a problem, farmers turn the soil as deeply as possible to increase the permeability of the soil.

The major elements determining the physical condition and productivity of the soil are texture and structure of the soil, which tillage practices break down, thus making the soil more susceptible to erosion. This fact is illustrated in the following table.

Surface Condition	Runoff Percent	Erosion per Acre Ton
Surface fine and moist	75	12
Surface fine and dry	66	7
Surface cloddy	26	2.4

In many areas of low annual rainfall, conservation of soil moisture is of utmost importance in avoiding crop failure. Here tillage of the soil must be held at a minimum to avoid undue moisture losses. In areas where adequate rainfall prevails, the soil must be thoroughly pulverized to absorb rainfall and retain moisture for crops. In these areas unplowed soil loses most of the rainfall by runoff. Usually in these areas the humidity is so high that it is necessary to plow deep enough to bury insects and plant diseases that build up in crop residue on top of the soil.

The crop to be planted also influences the soil tillage methods to be used. Some crops need a firm, deep seedbed to develop the root system needed for maximum growth; whereas others do well in a shallow seedbed. Pulverizing the soil aerates it and enhances the activity of microorganisms and bacteria, causing rapid oxidation and decay of crop residues. Stirring the soil also aids in the nitrification and liberation of plant nutrients within the soil. The effects of various tillage practices on crop growth is pointed out in the following tables.

Table 1 - Effect of tillage treatments on corn yield, stand, height

Tillage treatment	Yield 14-year	Plants (7-year average	Height (10-year average)
	Bu.	Hundreds	In.
1. Standard plow	53.4	117	60.6
2. Prairie breaker	54.5	114	57.4
3. Rotary tillage	46.9	107	56.0
4. Surface and sub-surface tillage	44.7	95	50.5
5. Surface tillage only	40.2	92	50.4
6. Standard plow plus mulch	54.9	129	63.2

Table 2 - The effect of tillage treatments on wheat and hay yields.

Tillage treatment	Yields per Acre Wheat 9-year average		Hay* 3-year Average
	Stalks removed bu.	Stalks left bu.	lb.
1. Standard plow	27.2	21.6	3,870
2. Prairie breaker	28.6	22.9	3,870
3. Rotary tillage	26.7	24.6	3,890
4. Surface and sub-surface tillage	23.9	23.0	4,210
5. Surface tillage only	23.8	21.7	3,840
6. Standard plow plus mulch	16.8	11.8	3,830
Average	24.5	20.9	.....

*First cutting only.

Source - Ohio Agricultural Experiment Station Research Circular #30.

Suggested Teaching-Learning Activities

1. Have the local soil conservation specialist speak to the class on the relationship of soil tillage methods to the soil.

2. Take a field trip to fields in the community affected by soil erosion problems. Stress the relationship of these problems to the tillage methods applied to the soil.

3. Bring soil samples to class and have students learn to identify them.

4. Take a plow or any other soil tillage machine to fields with different soil types and affected by different climatic conditions. Have students observe how the machines work in each field.

5. Have students select a field in the community and trace the tillage practice on that field. Have students note the condition of the field in terms of erosion and soil structure breakdown and relate these conditions to the tillage histroy of the field.

Suggested Instructional Materials and References

Instructional material

Soil samples of each type identified in the subject matter content

Reference

Profitable Soil Management, pp. 195-309.

III. To select and use proper lubricants for agricultural machines

Teacher Preparation

Subject Matter Content

If the person being taught this module has not been taught the competency on understanding agricultural machinery lubrication included in the module on "Agricultural Machinery Assembly and Lubrication," he should be taught that competency at this time.

IV. To (1) identify types and parts of primary soil tillage machines and understand their functions and to (2) adjust and repair these machines

Teacher Preparation

Subject Matter Content

Machines that are used to break and loosen the soil for a depth of 6 to 36 inches to prepare a suitable seedbed are primary tillage machinery. These machines are designed to carry out the following functions:

1. Create a deep seedbed physically, chemically, and biologically fitted to the growth of crops.

2. Add humus and fertility to the soil by covering and burying crop residues so they can be incorporated into the soil.

3. Prevent and destroy weeds or other unwanted vegetation

4. Leave the soil so that air will circulate through it freely

5. Leave the soil in such condition as to retain moisture

6. Destroy insects, as well as their eggs, larvae, and breeding places

7. Leave the surface so as to prevent erosion by winds and water

Included in the primary tillage machine group are moldboard, disk, and chisel plows.

In order to understand the operation of primary tillage machines, it is necessary that the mechanic be able to identify the machine parts and understand their functions.

Moldboard plow

Part	Function
Beam	The frame that holds the plow bottoms in the correct position
Frog	That part of the plow to which all other bottom parts are bolted
Share	That part of the plow bottom that cuts the underside of the furrow slice away from the land
Moldboard	Turns the furrow slice on edge
Landside	The long flat metal piece which absorbs the side forces created when the furrow is turned and levels the plow bottom into a free floating position

Bottom	Lifts, turns, and pulverizes the soil
Coulters	The round disk blade used for cutting the earth and trash ahead of the plow

Several types of moldboards are built by manufacturers of agricultural machinery. Each type has been designed to perform a specific function. These are:

1. Stubble
2. General purpose
3. Breaker
4. High-speed

Three materials are used in the manufacture of moldboards.

1. Soft-center steel
2. Crucible steel
3. Chilled cast iron

Soft center steel moldboards are used under most conditions because of their ability to scour. Steel plows are used most in the Middle West because of their wear-resistant qualities. Chilled plows are better for sandy, gritty, and gravel soils. The share of moldboard plows, which provides the cutting edge, is made of plain crucible steel, soft-center steel, chilled cast iron, and cast iron.

Several types of moldboard plows are produced by agricultural machinery manufacturers for use by farmers. These are:

1. Trailing
    a. Regular -- one to eight bottoms
    b. Two-way -- one to four bottoms
    c. Middlebreakers -- one to four bottoms

2. Mounted

   a. Regular -- one to five bottoms

   b. Two-way -- one to two bottoms

   c. Middlebreaker -- one to four bottoms

3. Semi-mounted

   a. Steerable -- over five bottoms

   b. Non-steerable -- one to five bottoms

The depth that a plow penetrates the soil and the width of the furrow are determined by the suction created by the share. Common degrees of suction used on most plows are

1. Regular-suck (3/16")

2. Deep-suck (5/16")

3. Double-deep-suck (3/8")

Shares with a regular-suck are best suited for light, easy-to-penetrate soils. Shares with a deep-suck are built for soil that is dry and hard, and the double-deep-suck is used in stiff clay soils, gravel land, and other soils where penetration is difficult.

The depth that a plow penetrates the soil is determined by the landside. The plow bottoms level off when the heel of the landside contacts the furrow sole.

The factors of major concern to the mechanic in adjusting a plow to operate properly are these:

1. Proper draft

2. Proper hitching

Draft is the amount of resistance that a plow creates to the source of power. Draft should be kept as light as possible in order to conserve tractor power. Draft on a plow is caused by several factors.

1. Soil condition

2. Topography

3. Adjustment of the plow

4. The hitch to the tractor

5. Depth and rate of plowing

6. Sharpness of the shares, coulters, and jointers

The following table illustrates the amount of draft exerted on a plow bottom in the various soil types

Soil	Resistance (pounds per square inch)
Sandy	3
Sandy loam, moist	3-4
Sandy loam, dry	4-6
Silt loam, moist	5-6
Silt loam, dry	6-7
Clay loam, moist	6-7
Clay loam, dry	7-8
Heavy clay, dry	9-10
Heavy clay, sod	10-1

The two types of draft that work on a plow should be thoroughly understood and adjusted if the plow is to function properly.

1. Vertical

2. Horizontal

On trailing plows the vertical line of draft is a straight line from the draft center of the plow to the tractor drawbar looking at the plow from the side. The draft center of the plow is a point near the top of the share and about 2 inches from the landside. It is located below the beam if one bottom is used, halfway between the beams if two bottoms are used. (Refer to Machines for Power Farming, p. 166, for example.)

Tendencies of the plow to ride out of the ground or the rear of the plow to bob out of the ground are symptoms of improper vertical draft adjustment. These problems can be corrected by raising or lowering the plow drawbar to align with the vertical line of draft.

The horizontal draft line is a straight line from the draft center of the plow to the tractor drawbar looking down on the plow. The draft center for the plow is halfway between the draft center of the two outermost shares and halfway between the rear wheels of the tractor. Ideally the plow draft center and the tractor pull center should be in line if the plow is to function at its best.

The easiest way to make a horizontal adjustment is to make the tread of the tractor wheels fit the trailing plow. In the event that the two centers cannot be lined up, an adjustment halfway between these two points should be made. Unevenness of furrow slices and hard-steering of the tractor are indications of improper horizontal draft adjustment. (Example--Machines for Power Farming, p. 167.)

Often it is necessary to adjust the clearance under the landside and between the landside and furrow wall. These adjustments are given in Farm Machinery and Equipment, p. 101.

The draft on mounted plows is adjusted hydraulically from the tractor. Any adjustments that are needed should be made according to the manufacturers specifications as set down in the service manuals.

Mounted plows are also classified according to the type of hitch used to attach them to the tractor. These include:

1. Single-point hitch, free floating; rear-mounted

2. Three-point, free floating, variable-pitch, rear mounted

3. Hydraulically supported three-point suspended

4. Hydraulically suspended free-floating three-point variable pitch

On the single-point hitch free floating, rear-mounted plow, the plow beam extends to a point ahead of the tractor rear axle. The height of the hitch point is adjusted manually or hydraulically. The weight of the plow causes the plow bottom to enter the ground as it is lowered into the ground. As the plow moves

forward, the suction created by the share and the weight of the soil being moved causes the plow to penetrate the soil until the heel of the landside comes into contact with the furrow. The depth of penetration is determined and regulated by the height of the hitch point.

The three-point, free floating, variable pitch, rear-mounted plow uses three links for connection to the tractor. The upper link adjusts the plow for deep or shallow plowing. The other two links are non-adjustable. The plow enters and penetrates the soil in the same manner as the single-point-hitch-type plow.

The hydraulically supported three-point suspended plow is supported during plowing and moved by hydraulically controlled linkage. This linkage holds the plow up, but does not force it into the soil. When soil resistance increases, the upper attaching link pushes against a spring controlling a hydraulic mechanism that raises the plow. The increase in weight on the rear tractor tires caused by the plow rising increases the traction on the tractor wheels.

The landside does not function as far as downward forces go, but it does absorb the side thrusts of the plow.

The hydraulically suspended, free floating three-point variable-pitch plow combines the features of the other three plows. The plow bottoms enter the soil and come to the correct depth after the landside makes contact with the furrow sole. From this point, the plow is free floating. The depth of penetration of the bottoms is controlled by adjusting a crack which points the bottoms up or down.

The following attachments are available for the moldboard plow.

1. Trash cover boards

2. Jointers

3. Weed rods

Disk plows

The disk plow has one or more rolling cutters. It creates no suction, as a moldboard plow does, and depends on weight and disk angle for penetration. Its maintenance cost is low, and its parts last a long time.

The disk plows work well under the following adverse conditions:

1. Wet, sticky, non-scouring gumbo, hardpan or black waxy soil

2. Soils containing large stones or rocks

3. Dry, hard soil

4. Rooty, stumpy soil

5. Abrasive soils

The three main types of disk plows are

1. Direct-mounted

2. Semi-mounted

3. Trailing

Direct-mounted plows are attached to the tractor by one-, two-, or three-point hitch linkages and can be raised or lowered hydraulically. They usually are rear-mounted and have a rear wheel to absorb the side thrust.

Semi-mounted disk plows are attached to the tractor drawbar or by a special drawbar. They are raised by moving a lever at the front of the plow. A long rod which extends to the tractor drawbar is used to steer the rear wheel.

Trailing disk plows have three wheels for support and can be pulled by any make of tractor. The front wheel performs the following functions:

1. Helps lift the plow

2. Turns sideways for steering the plow

3. Absorbs some of the side thrusts

The rear wheel is non-steering, but it absorbs thrusts and lifts the rear part of the plow.

The draft created by a disk plow is usually about the same as that of the moldboard plow; but since the disk plow is often heavier than the moldboard plow, its draft is usually greater.

The disk plow is comprised of the following parts:

1. Disk blades
2. Standards and clamps
3. Bearings
4. Beams and frames
5. Lifting and steering mechanisms
6. Wheels

Three types of adjustments are common to all types of disk plows.

1. Cutting angle adjustment
2. Width-of-cut adjustment
3. Vertical adjustment of the disk blade

Disk blades will not cut if they roll straight ahead, but must work at an angle. This angle is measured between a perpendicular line from the line of travel, to the axle line of each disk blade. The cutting angle of the disk plow can be changed by either of two methods.

1. Pivoting the beam
2. Pivoting the blade and standard
   (See Machines for Power Farming, p. 199-200.)

Two adjustments can be made to adjust the width-of-cut made by the plow.

1. Front disk blade cut adjustment
2. Cutting width adjustment
   (See Machines for Power Farming, p. 201-202.)

The vertical adjustment or position of the disk blade, also called the tilt or slant, directly affects the degree of penetration of the plow, in relation to the amount the disk is inclined from the vertical position. Two methods can be used in tilting the disk.

1. Standard-to-beam method

2. Standard-to-bearing method
   (See Machines for Power Farming, pp. 201-202.)

3. Chisel plow
   (Refer to references for this material.)

Suggested Teaching-Learning Activities

1. Demonstrate how primary tillage machines used by farmers in the area work in the soil. After showing the proper operation of each machine, throw it out of adjustment and have students observe the results. Have students study each machine part to learn its functions.

2. Bring examples of all hitches discussed in the content before the class. Have students study their construction and operation.

3. Bring to class primary tillage machines in need of adjustment and repair of each type discussed in the content. Follow the procedure below when making the needed adjustments and repairs.

   a. Operate the machine in the field and note any malfunctions in operation.

   b. Inspect the machine, noting worn and broken parts or parts out of line or adjustment.

   c. Following the operator's and service manuals, make the necessary repairs and adjustments.

   d. Lubricate the machine for field operation.

   e. Test the machine in the field and make adjustments necessary for proper operation.

Suggested Instructional Materials and References

Instructional materials

Demonstration machines of each type identified in the content

References

1. Farm Machinery and Equipment, pp. 93-144.

2. Machines for Power Farming, pp. 151-224.

3. Operator's manuals

d. Service manuals

Suggested Occupational Experience

Following the procedures outlined in the teaching-learning activities, have students adjust, repair, and lubricate primary tillage machines at the local agricultural machinery dealership.

V. To (1) identify the parts and types of secondary soil tillage machines and understand their functions and to (2) adjust, repair, and lubricate these machines

Teacher Preparation

Subject Matter Content

Machines that stir the soil at comparatively shallow depths are classified as secondary tillage machines. Included in this group are the various types of harrows, rollers, and pulverizers, and tools for mulching and fallowing. These machines are designed to perform the following:

1. Improve the seedbed by greater pulverization of the soil

2. Conserve moisture through summer-fallow operations by killing weeds and reducing evaporation

3. Cut up crop residue and cover crops and mix vegetable matter with the top soil

4. Break up clods, firm the topsoil, and put it in better tilth for seeding and germination of seeds

5. Destroy weeds on fallow lands

6. Fill in air spaces and level the ground

Several types of harrows are made by agricultural machinery manufacturers for farm use.

1. Disk harrows

2. Spring-tooth harrows

3. Spike-tooth harrows

The disk harrow mixes the soil, breaks up clods, levels the lands, aerates the soil, and kills weeds. It works somewhat like a moldboard plow, for it raises the earth and pushes it to one side.

In operation, the disk harrow is balanced. The side forces are balanced: one-half of the disk blades are placed with their concave cutting faces in one direction and the other half in the opposite direction.

The depth of penetration of the disk blades is controlled in the following ways:

1. Using a heavy or light harrow

2. Adding weights to the harrow

3. Using few or many disks per harrow

4. Exerting hydraulic forces, up or down

5. Using transport and depth regulating wheels

6. Using dull or slump disk blades

7. Using smaller or larger disks

8. Using cutout or notched disks

9. Adjusting the angle of the disk gangs

Disk type harrows are grouped into two main types.

1. Regular

2. Offset

The regular type disk harrow is grouped according to the type of action created by the disk.

1. Single-action

2. Double-action

A single-action disk usually consists of two assemblies of disks, called gangs, which are joined together by a common shaft or bolt through their centers and all rotate together. The two gangs are set at angles to each other and the line of pull, and the soil and other field materials are always moved outward from the harrow center.

In recent years a new development in disk harrow design has separated disk harrows into other classifications.

1. Rigid

2. Flexible

A group of two or more disks that rotate in the same direction is referred to as a gang. The disks are held together by a shaft, either round or square, called the arbor bolt, and held apart by spacers. The disks, shaft, and spacers turn together.

The two-section type with one section trailing behind the other is the double-action or tandem-type disk harrow. It is called a double-action plow because

1. It has two sections

2. The rear section turns back the furrows created by the front section. The gangs of the first section turn the soil to the left, and the rear section turns the soil to the right.

Disk harrows vary in size. Several systems are used by manufacturers of the machines to classify them by size.

1. Width of cut

2. Diameter of the disk blades

3. Number of disks

The disks used to turn the soil on a disk harrow are similar to those of the disk plow. Several types of harrow disks are available for use on the disk harrow. Common types are

1. Plain

2. Crimped disk

3. Auburn

4. Scalloped

A disk plow usually has two or three bearings per gang. These may be of either the friction or anti-friction type. The latter are used more because they decrease replacement costs by lessening wear on machine parts.

The spring-tooth harrow is one of the most useful machines available to farmers. It is a drag-type harrow capable of doing the following:

1. Level and smooth the soil

2. Work well in rough, stony soils

3. Remove plant growth from the soil without cutting it up

4. Break the soil crust and penetrate as deep as seven inches

5. Pull weed roots to the surface where the sun dries and destroys them

6. Mix trash and stubble

7. Tend to aerate and warm the soil by stirring it

There are two main types of spring-tooth harrows.

1. Lift

2. Trailing

The lift type is built to be raised by the hitch that is a part of the tractor.

The harrow teeth are made from spring steel which has been forged and rolled to shape and then oil tempered. Their variables in thickness are determined by the toughness of the work that is to be done, but the average thickness is 5/16 inch.

Two main types of teeth are used on spring-tooth harrows.

1. Those with the end of the tooth sharpened

2. Those having reversible parts

The spring tooth harrow is made up of the following parts:

Part	Function
Harrow teeth	To prepare land for seed
Tooth bar	To support the harrow teeth
Tooth bar standards	To provide clearance for the tooth bar over soil and trash
Tooth clamps	To attach the teeth to the tooth bar
Frames	To support the harrow teeth, standards, and other parts
Shoes	To come in contact with the ground
Tooth penetration levers	To set the depth at which the machine is to operate

Another drag-type harrow is the spike-tooth harrow. It is often called the peg-tooth harrow. It is designed to do the following:

1. Smooth and compact the topsoil
2. Fill large air spaces left from plowing
3. Break up lumps and clods
4. Finish the ground just before planting
5. Cover small seeds broadcast over the surface
6. Break crust and destroy small weeds
7. Cultivate small plants

The two main types of spike-tooth harrows are

1. Rigid
2. Flexible

The rigid harrow has one-piece end rails holding the teeth bars, which make all the teeth cut the same depth. The flexible harrow has jointed end rails, which allow the individual tooth bars to rise vertically to go over obstructions.

The spike-tooth harrow is made up of the following parts:

1. Spike teeth
2. Tooth bars
3. Tooth clamps
4. Frame

Several spike-tooth harrow rigid-frame and tooth bar arrangements are in use. They include

1. Closed square-end harrow
2. Open-end harrow
3. Curved-end-type harrows
   (See Machines for Power Farming for discussion of each type)

The rotary shredder is a popular American tillage machine because of its wide range of functions. It cuts, shatters, tears, chops, mows, pulverizes, spreads, and mulches.

Rotary shredders use high speed revolving flails, blades, or hammers to carry out these functions. On some shredders the flails, blades, or hammers travel about 9000 feet per minute.

Two types of machines are made by agricultural machinery manufacturers.

1. Trailing

2. Mounted

About half of the machines have a long horizontal shaft with attached flails or hammers. This arrangement gives a hammer mill effect and permits the shredding of stalks and trash into small pieces. The other machines have a short vertical or horizontal shaft called a spindle. One end of the spindle is driven directly from the tractor PTO, and the other end has a plate or hub which carries the cutting knives. The spindle knife cutter has a propeller-like appearance, as seen from the soil side. (See Machines for Power Farming, p. 264.)

Several types of cutting assemblies are used on rotary shredders.

1. Rotor or cylinder cutters

2. Vertical or horizontal spindle cutters

3. Knives for rotary cutters

Rotor or cylinder cutters have a long axle that operates parallel to the ground. The flails which are attached combines with it to constitute the rotor. The rotor may operate with or against the direction of travel, but the operation against the direction of travel is most desirable because the machine does a better job of cutting weeds and pulverizing trash.

Flails consist of a hammer and a length of chain. The hammers weigh the same, but the chains are of different lengths, causing the machine to do a better job of flailing. The hammers usually take on the shape of a "T" or a "Y". On some machines, flails are used in combination with a shear bar. The flails cut the vegetation against a shear bar and pulverize the materials after they are cut.

On vertical and horizontal spindle cutting machines the horizontal spindle travels above and parallel to the rows. As many as five spindles may be used, thus providing a closer cut. Shredders operating with a type of rotor assembly are most useful on rough, hilly ground.

The rotary shredder is driven from the PTO shaft of the tractor. The direction of the drive is changed by a set of bevel gears carried in the housing of the shredder. The vertical-spindle cutters are driven directly from the bevel gears. The vertical spindle passes through a bearing attached to the top of the plate of the shredder and the cutter hub is attached to the lower end of the spindle. A shear pin is used as a safety feature in case the cutters hit something solid.

Soil pulverizers are machines used to put finishing touches to the seedbed. They pulverize lumps and clods, pack the soil particles after plowing or harrowing, aid in holding moisture, and eliminate air pockets.

Soil pulverizers consist of an axle between two bearings spaced evenly with wheels or sprockets. The wheels are made of cast iron and are constructed with a rim on the hub to keep dirt out of the wheel cylinder.

Soil pulverizers, similar to disk harrows, are of two types.

1. Single section

2. Double section

Because its axles are supported by a hinged bearing housing, the double section pulverizer, or tandem type, provides a finer seedbed and more flexibility.

Several types of wheels are used as soil pulverizers. Some of these types may be used at the same time, depending on the function desired.

1. Plain ridge

2. Serrated ridge

3. Wavy ridge

4. Sprocket

When plain ridge wheels are the only wheels used on the machine, it packs the soil. With the addition of sprocket wheels, the machine pulverizes and packs at the same time.

The soil pulverizer is comprised of the following parts:

1. Wheels
2. Sprockets
3. Frame
4. Bearings

Suggested Teaching-Learning Activities

1. Have students disassemble each type of tillage machine discussed in the content and learn its parts. Point out to the students the materials used in constructing each part and the function of each part in the total operation of the machine.

2. Demonstrate proper and improper operation of each of the tillage machines identified in the content under field conditions.

3. Bring to the class secondary tillage machines of each type studied to be adjusted and repaired. Follow the procedure below when correcting the faults.

   a. Operate the machine in the field to discover any malfunctions in operation.

   b. Inspect the machine, noting worn and broken parts and parts that are out of line or adjustment.

   c. Following the operator's and service manuals, make the necessary repairs and adjustments.

   d. Lubricate the machine for field operation.

   e. Test the machine in the field and make all adjustments necessary for proper operation.

Suggested Instructional Materials and References

Instructional materials

1. Machines for disassembly

b. Machines for use in demonstrating proper and improper field operation

References

1. Farm Machinery and Equipment, pp. 145-166

2. Machines for Power Farming, pp. 227-277

3. Operator's manuals

4. Service manuals

Suggested Occupational Experience

Have students adjust, repair, and lubricate secondary tillage machines at the local agricultural machinery dealership following the procedure outlined in the teaching-learning activities.

VI. To (1) identify the parts and types of cultivating machines and understand their functions and to (2) adjust and repair these machines

Teacher Preparation

Subject Matter Content

Cultivation requires a tool to stir the surface of the soil to a shallow depth in such a manner as to destroy young weeds and promote crop growth. Weed control cultivation may start on the prepared seedbed prior to planting or after planting, before the emergence of the plants. Usually cultivation begins soon after emergence of the young crop seedlings, as weeds generally emerge about the same time as the crop.

Cultivating machines are designed to perform the following functions on the soil:

1. Retain moisture by
    a. Killing weeds
    b. Loosening mulch on surface
    c. Retaining rainfall
2. Develop plant food
3. Aerate the soil to allow oxygen to penetrate soil
4. Promote activity of microorganisms in the soil

Several types of cultivators are used by farmers, the type and size depending upon the acreage, kind of crop, soil type and condition, rainfall, type of farming practiced, and kind of power available.

1. Mounted
    a. Central-forward mounted
    b. Central-forward and rear-mounted
    c. Rear-mounted
2. Trailing
3. Lift up or mounted tiller
4. Dragbar
5. Rigid-frame

The dragbar type allows the cultivator teeth to rise over uneven surfaces; whereas on the rigid-frame type the teeth or standards are fastened directly to the frame and are inflexible on uneven surfaces.

The "business end" of the cultivator, those parts that engage and work the soil, are referred to as steels, points, or teeth. More specifically, they are referred to in the following manner:

1. Sweeps
2. Shovels
3. Spikes
4. Disks
5. Knives and hoes

Within each type, manufacturers have designed and built items to perform specific functions.

Sweeps	Use
Blackland sweeps	For use on sticky, blackland soil
Mixed-land sweeps	For high-speed cultivation on most other soils
Planter sweeps	Have prominent wings for clearing beds for planting
Plowing sweeps	For use in blank listing, bursting, and bedding
Duckfoot sweep	For use on deep-rooted weeds, fallowing, and stubble mulching
Shovels	
Spear point	For use in working beds and flat land
Irrigation shovel	For cultivating irrigated land
Chisel-tooth shovel	Use for close, deep cultivation and breaking of hard-pan
Turn shovel	For farrowing

Knives and hoes	Use
Round-turn knife	For cultivating such crops as sugar beets
Square-turn knife	For flat cultivation on beds on flat land
Crescent hoes	For tilling the side of beds of beats and vegetables
Flat hoes	For use when flat work is desirable on such crops as cotton and corn
Mulch hoes	For cutting through fibrous soil without choking off
Furrowers	For digging furrows and trenches

The standards on the cultivator connect the points with the frame of the cultivator. Several types are used on cultivators, each of which is built to perform differently and to conform to the type of farming prevalent in the area.

1. Stiff
2. Spring-trip
3. Friction-break
4. Flexing
5. Regular or high clearance
   (See Machines for Power Farming, pp. 381-382, for a discussion of each type.)

Like cultivator standards, several types of cultivator frames have been built by agricultural machinery manufacturers, the main ones of which are

1. Front-mounted cultivator gangs
2. Rear-mounted tool bar
3. Mounted-frame cultivator or field tiller
4. Wheel-mounted frame or carrier

5. Carrier-type field cultivators

6. Dragbar
   (See Machines for Power Farming, pp. 383-385.)

A variety of attachments have been developed for use on cultivators.

1. Rotary hoes

2. Disk hillers

3. Fertilizer application attachments

4. Seeders

5. Weeder-mulchers

6. Row-crop thinners

In recent years the rotary hoe has been popular as a cultivating tool, because it performs some rather specific functions of soil tillage.

1. It breaks up crusted soils to allow the crop seedling to come through the ground.

2. It up-roots small weeds and exposes weed seedlings to the drying effect of the sun.

3. It aerates and mulches the top soil, thus improving plant growth.

4. If pulled in reverse, it gives a treading action that smashes and pulverizes clods and trash.

As is the case of most other machines, rotary hoes are of either the mounted or trailing type. The hoes are made up of gangs, usually two per section, consisting of an axle and digger wheels.

Diggers are of several types, depending on the type of soil on which they are to be used and the degree of soil penetration desired. They are made of small, angle irons curved and sharpened at one end.

Suggested Teaching-Learning Activities

1. Have students disassemble each type of cultivating machine discussed in the content and learn its parts and their functions. Point out to the students the materials used in constructing each part and the function each part plays in the total operation of the machine.

2. Demonstrate proper and improper operation of each type of cultivating machine under field conditions.

3. Bring to the class cultivating machines that are in need of adjustment and repair. Follow the procedure below when making the needed adjustments and repairs.

   a. Operate the machine in the field to discover any malfunctions in operation.

   b. Inspect the machine, noting worn and broken parts and parts that are out of line or adjustment.

   c. Following the operator's and service manuals, make the necessary repairs and adjustments.

   d. Lubricate the machine for field operation.

   e. Test the machine in the field and make any adjustments necessary for proper operation.

Suggested Instructional Materials and References

Instructional materials

1. Machines for disassembly

b. Machines for use in demonstrating proper and improper field operation

References

1. Farm Machinery and Equipment, pp. 209-234.

2. Machines for Power Farming, pp. 373-397.

3. Operator's manuals

4. Service manuals

Suggested Occupational Experience

Have students adjust, repair, and lubricate cultivating machines at the local agricultural machinery dealership, following the procedure outlined in the teaching-learning activities.

VII. To (1) identify the parts and types of crop planting machines and understand their functions and to (2) adjust and repair these machines

Teacher Preparation

Subject Matter Content

The purpose of the crop planter is to sow seeds in rows or beds, on flat land and in trench bottoms efficiently and in correct amounts at the proper depth.

There are two types of crop planting machines.

1. Row-crop
2. Drill

Row-crop planters are further divided into two large groups.

1. Those that drill seed only
2. Those that drill and plant in check rows

Planters, like other machines, are of the mounted or trailing type. The mounted type may be further divided according to the means of attachment to the tractor.

1. Front-mounted
2. Rear-mounted
3. Semi-mounted
4. Unit runner

With the exception of the unit runner type, almost all planters use a clutch to drive the seed plates, which in turn are driven by the drill shaft. The clutch action permits intermittent movement of the drill shaft so that seeds for hills can be accumulated in the shank valves.

Row-crop planters are made up of the following units.

1. Hopper and seeding mechanisms
2. Hopper-to-opener assemblies
3. Drive and checking devices
4. Fertilizer and other attachments

Four basic hoppers are used on row-crop planters.

1. Single seed
2. Reverse-feed cotton
3. Richmond
4. Duplex

The hopper most commonly used to plant row crops is the Richmond type. It consists of the following parts:

1. Bottom
2. Filler plate
3. False ring
4. Knockout pawl
5. Hopper ring gear
6. Pinion gear
7. Seed plate

Several terms are used to describe the part that leads from the hopper to the furrow openers. Among these are boat, post, shank, and flexible ribbon tube. The furrow openers are held in place by a standard.

Two types of shanks are used on row-crop planters.

1. Those held rigidly in place by the front frame members
2. Those that are free to float with the contour of the field

Some are plain. When this type of planter is used, the seed is dropped directly from the hopper to the soil. Others are valved to form a "V" for the seed to fill in and then release to the soil.

The purpose of the furrow opener is to open the soil at a desired depth for the seed to be sown. Several types of furrow openers are used on row-crop machines, such as:

1. Variable-depth
2. Constant-depth
3. Curved runner
4. Fully curved runner
5. Stub runner
6. Shovel
7. Single-disk
8. Curved double-disk
9. Coulter double-disk

To be in an atmosphere condusive to good germination, the seed must be properly covered. The row-crop planter has a variety of furrow coverers to provide this environment.

1. Open-center press wheel
2. Rubber-tired press wheels
3. Zero-pressure rubber tires
4. Disk coverers
5. Blade coverers
6. Shovels
7. Knife blade

Fertilizer sowing attachments have been developed for use on row-crop planters. These attachments have two types of feeding mechanisms.

1. Star or spur wheel type

2. Plow type
   (See Machines for Power Farming, pp. 340-341.)

The primary purpose of the grain drill is to sow grain in correct amounts and at proper depths. It also pulverizes and firms the soil.

Several types of grain drills have been developed to meet the varying needs of the farmer.

1. Plain

2. Fertilizer

3. Surface

4. Deep-furrow

The plain drill is used primarily for planting grain crops. It is not well adapted to planting grass seed or applying fertilizer. The fertilizer drill sows all the seed that the plain drill plants and also drills or broadcasts fertilizers. The other two types sow the seed at different depths in the soil. The plain or fertilizer type drills can be of either the surface or deep-furrow type.

Several devices are used on grain drills to feed the seed into the seed tube. These devices are

1. Double-run seed feeding device

2. Fluted-roll feeding device
   (See Machines for Power Farming, pp. 350, 352.)

When the double-run feeding device is used, the rate of flow can be controlled in the following way.

1. Select the size of the feed wheel recommended on the drill charts for a certain seeding rate.

2. Change the speed of the wheel by changing gears and sprockets or both.

3. Change the position of the feed gate in the cup.

4. Use reducers below the feed wheel.

The rate of seed flow on the fluted-roll devices is regulated by

1. Moving the fluted rolls endways

2. Adjusting the gates or latches to one of three positions

3. Changing the speed of the feed shaft

Rolling furrow openers are most commonly used as grain drills. Essentially they are disks or coulters that cut trash and lumps and open the soil for seed placement. Several varieties of furrow openers are used on grain drills.

1. Single disk with open-delivery boot

2. Single disk with closed-delivery boot

3. Double-disk coulter

4. Double-disk curved-blade

Furrow openers are guided and pulled by dragbars or drawbars. Their purpose is primarily to

1. Pull and space openers

2. Absorb side thrusts occurring when the openers strike obstructions

After the seed has been sown, seed coverers cover it. These coverers are of several types.

1. Drag chain

2. Drag weights

3. Weighted steel fingers

4. Press wheel attachments

The coverer is attached immediately behind the furrow opener.

A variety of attachments have been developed for use on the grain drill. These are identified and discussed in the operator's manuals for the specific machines. Two of the most important attachments, however, the fertilizer and grass seeding attachments, are discussed in Machines for Power Farming, pp. 363-366.

Sowing seed in proper amounts is a primary function of both the row-crop and drill-type planters. These machines should be checked and calibrated if they are sowing seed improperly. The following techniques should be used when calibrating planting machines:

Row-crop planter

The calibration procedures below use corn as the example crop. The operator's manual gives the specifications to be used when calibrating for other crops.

Step 1: Check planter parts.

Carefully check the power train from the ground drive wheels to the seed plate. Loose or worn sprockets, gears, and chains can affect metering accuracy, particularly on the seed-plate drive and the power train from the drill shaft to the hopper. Replace worn cut-off pawls, knockout pawls, and hopper bottom rings. When replacing worn pawls, check for weak springs.

Step 2: Select proper population for fertility level.

For any field with the proper fertility level, there is a population of stalks at harvest that give the maximum yield of corn. The following table shows the number of kernels to plant for the desired number of stalks per acre at harvest.

Expected yeild per acre	Kernels planted per acre	Stalks at harvest per acre
75 bushels	13,300 kernels	12,000 stalks
100 bushels	16,500 kernels	14,000 stalks
125 bushels	20,000 kernels	17,000 stalks
150 bushels	25,000 kernels	20,000 stalks

Step 3: Read the owner's manual carefully.

The owner's manual tells how to adjust the corn planter to obtain the correct population. It is also an excellent guide for determining the speed of the planter for a given planting rate.

Do not exceed the maximum planting speed recommended in the manual. When this speed is exceeded, the seed plate turns too fast for accurate planting and uniform kernel spacing.

By using seed plates with more cells than the standard 16-cell plate, a faster speed can be used and obtain the same planting rate. The manual will indicate whether plates with more than 16 cells can be obtained for the planter.

Step 4: Match seed to seed plate.

It is desirable to have an average of 100-percent or slightly higher cell fill. A 100-percent cell fill means that, on the average, one kernel is dropped from each cell. If, for example, 16 kernels are dropped in one turn of a 16-cell seed plate, the cell fill is 100 percent. If 12 kernels are dropped, the cell fill is 75 percent. If 20 kernels are dropped, the cell fill is 125 percent. For best results and to avoid damage to the seed as it passes through the hopper mechanism, the cell fill should be 100 percent or slightly higher, up to a maximum of 105 percent.

To be certain that the cell fill is accurate, seed plates should be matched to the seed. These can be matched either on a seed-corn test stand or by a calibration run on the open ground in a lane or barnlot where all the kernels can be counted. Whichever method is used, check the rate at field speed and desired planting rate.

In selecting the correct seed plate, begin with the seed plate recommended on the bag of seed corn. Small variations between seed plates of the same size and seed corn of the same grade can result in serious planting errors. Remove any rust, seed treatment, or rust preventative from cells before making the test.

Step 5: Adjust planter for desired planting rate.

Using the owner's manual and the table below, set the planter to plant the number of kernels desired.

Spacing of Kernels for Planting Rates of	Row Spacing			
	36 inches	38 inches	40 inches	42 inches
12,000 per Acre	14.5	13.7	13.1	12.4
14,000 per Acre	12.4	11.8	11.2	11.7
16,000 per Acre	10.9	10.3	9.8	9.3
18,000 per Acre	9.7	9.2	8.7	8.3
20,000 per Acre	8.7	8.2	7.8	7.5
24,000 per Acre	7.3	6.9	6.5	6.2
28,000 per Acre	6.2	5.9	5.6	5.3

Step 6: Calibrate in a barnlot or roadway before planting.

Planting speed can cause a wide variation in planting rates. For this reason, final calibration must be made at planting speed on a roadway or barnlot where all of the kernels can be counted over a short distance. Leave the planter in a raised position and use a wire or string to engage the seedplate drive. The following table shows how far to drive for various row spacings. Each row is 1/200 of an acre. To obtain the planting rate per acre, count the kernels from each row and multiply by 200.

Row spacing	36 inches	38 inches	40 inches	42 inches
Distance to Drive	72 feet	69 feet	66 feet	63 feet
Kernels to count for planting rates of				
12,000 per Acre	60	60	60	60
14,000 per Acre	70	70	70	70
16,000 per Acre	80	80	80	80
18,000 per Acre	90	90	90	90
20,000 per Acre	100	100	100	100
22,000 per Acre	110	110	110	110

Determine the planting rate for each of the planter rows and list these rates separately, in order to determine whether one of the hoppers is giving a poor drop of the seed. If all of the planter parts seem to be functioning properly and the seeding rate is higher than the rate for which the planter is adjusted, then a smaller seed plate should be used. If the planting rate is not high enough to match the adjusted rate on the planter, a larger seed plate should be used.

To get an accurate measure of the planting rate, make all of the calibration runs at planting speed. The planting rate in these calibration runs will probably be slightly higher than the field rate, even when the seed is perfectly matched to the seed plate. This is due primarily to the reduced slippage of the drive wheels on the smooth surface.

In making the calibration run, allow a few hundred extra kernels to compensate for the difference between the calibration rate and field rate. Suppose that it is desirable to calibrate a planter at 5 miles per hour to drop 18,000 kernels, and it was found that after making a few calibration runs the planter was dropping 18,500 kernels. In the field, this planting rate will be reduced to 18,000 or slightly less, and should be satisfactory.

Step 7: Make a field check.

When the planter has been calibrated to plant a given number of kernels per acre on a roadway or barnlot, the serviceman can be fairly confident that the planter will give approximately the desired planting rate. As a final check, however, dig out several kernels along the row and make an estimate of the average kernel spacing. By checking this spacing with the desired rate, he can determine the accuracy of calibration and make whatever adjustments are necessary on the planter.

How to determine field speed

In planting corn, you must know how fast the planter is moving, especially if granular or liquid chemicals are being applied at the same time. Field speed can be determined in the following way:

1. Carefully mark off a distance of 176 feet in the field.

2. Check the number of seconds required to drive between the markers with a stop watch or watch with a sweep second hand.

3. Divide the time in seconds into 120 for speed in miles per hour.

The chart below lists the time in seconds for speeds up to 7 miles per hour.

Time to Drive 176 Feet	Speed
120 seconds	1 mile per hour
60 seconds	2 miles per hour
40 seconds	3 miles per hour
30 seconds	4 miles per hour
24 seconds	5 miles per hour
20 seconds	6 miles per hour
17 seconds	7 miles per hour

Source of the above listed steps is University of Illinois, College of Agriculture, Circular 840.

Grain drill

1. Adjust the rate of seeding control for the desired amount of seed per acre.

2. Place canvas under furrow openers after the drill is in gear.

3. Jack up the wheels and lower the furrow openers after placing the drill in gear.

4. Place a sufficient quantity of seed in the drill to plant desired acreage (1/10 to 1/4 acre recommended).

5. Compute the number of times the wheels must be turned to plant 1/4 acre.

   Example:

   a. $\frac{\text{43560 sq. ft. per acre}}{\text{Width of drill}}$ Equals feet traveled per acre

   b. $\frac{\text{Feet traveled per acre}}{\text{Circumference of wheel}}$ Equals revolution of wheel for one acre

   c. $\frac{\text{Revolutions traveled per acre}}{4}$ Equals revolution of wheel for 1/4 acre

6. Turn drill wheel desired number of times to plant 1/4 acre.

7. Weigh seed deposited and multiply by 4 to convert to one acre basis. If the required amount of seed was not deposited, adjust according to the type of drill.

In adjusting the fluted type grain drill, first set the feed shaft and gates according to the size of seed being sown. Rate of seeding is set by adjusting the feed shaft shifter, of which there are two in drills having more than 8 disks--one for each half of the drill. Both must be kept in the same position on the feed index plate, which is provided with a row of notches.

The internal double run type feed consists mainly of a feed wheel and a feed gate. The wheel is smaller on one side for planting oats, barley, treated wheat, and other grains. The adjustable gates regulate the size of feed openings. In either situation, adjust to make up the difference in the previous setting and the calibrated amount. Then start the procedure from the beginning.

Suggested Teaching-Learning Activities

1. Have students disassemble each type of crop planting machine discussed in the content and learn its parts and functions. Point out to the students the materials used in constructing each part and the function each part plays in the total operation of the machine.

2. Demonstrate proper and improper operation of each type of crop planting machine under field conditions.

3. Bring a row crop plate hopper before the class and demonstrate what happens when the wrong plates are used to plant a certain crop.

4. Bring to the class crop planting machines that are in need of adjustment and repair. Follow the procedure below when making the needed adjustments and repairs.

   a. Operate the machine in the field to discover any malfunctions in operation.

   b. Inspect the machine, noting worn parts and parts that are out of line or adjustment.

   c. Following the operator's and service manuals, make the necessary repairs and adjustments.

   d. Lubricate the machine for field operation.

   e. Test the machine in the field and make any adjustments necessary for proper operation.

4. Have students calibrate both a row crop planter and a grain drill.

Suggested Instructional Materials and References

Instructional materials

1. Row crop planters and grain drills for disassembly

2. Machines for use in demonstrating proper and improper field operation

3. Machines needing calibration

References

1. Farm Machinery and Equipment, pp. 167-208.
2. Machines for Power Farming, pp. 323-369.
3. Operator's manuals
4. Service manuals

Suggested Occupational Experience

Following the procedures outlined in the teaching-learning activities, have students adjust, repair, and lubricate crop planting machines at the local agricultural machinery dealership.

VIIII. To (1) identify the parts and types of sprayers and understand how they function and to (2) adjust and repair these machines

Teacher Preparation

Subject Matter Content

In order to understand spraying machines and their adjustments, the serviceman must understand the reasons for using sprays, the purposes for their use, and the type and compositions of sprays.

Most pests that menace farmers and ranchers can be grouped into four major areas.

1. Weeds
2. Insects and insect-like creatures
3. Diseases
   a. Bacteria
   b. Viruses
   c. Fungi
4. Nematodes

One must know something of the characteristics of these pests to control them effectively with chemicals.

The basic characteristics of weeds important to chemical eradication programs are

1. Life span of the plants
2. Method of reproduction
3. Type of leaf structure

Weeds are generally classified by life span.

1. Annuals
   a. Complete life cycle in one year
   b. Reproduce only by seed
   c. Broad-leaved plants
2. Biennials
   a. Complete life cycle in two years
   b. Reproduce only by seed
   c. Broad-leaved plants
3. Perennials
   a. Live three or more years
   b. Reproduce by seed or vegatatively
   c. Blade or broad-leaved plants

Annuals and biennials can be controlled by eliminating seed production; but since perennials can reproduce by seeds, roots, rhizomes and/or stolens, they create more difficult control problems.

Insects that are troublesome to plants can best be catalogued as follows for chemical control. Certain pests that are not true insects, such as lice, mites, spiders, and ants, are included here because the damage they inflict and their control are similar to characteristics of insects.

1. Chewing insects, surface, or boring

    a. Root

    b. Foliage

    c. Flower

    d. Seed or fruit

2. Sucking insects

    a. Foliage

    b. Flower

    c. Seed or fruit

Seed insects may be insects that attack the seed

1. In the soil at planting

2. On the maturing plant

3. In storage

Plant diseases can be classified as bacteria, viruses, and fungi. All of these are serious pests to modern agriculture.

Bacterial diseases of plants attack most types of field and horticultural plants. These are one-celled microscopic organisms of a low form of plant life. They gain entrance to plants through wounds and natural openings and attack all parts of a plant. The types of damage can be classified as follows:

1. Galls abnormal growths on a plant part

2. Wilts normally congest the vascular system and affect the entire plant

3. Cankers tissue destruction, causing leaf or tissue lesions

4. Rots fleshy part of plants, (stems, fruit and others) become soft and slimy

5. Abnormal growth

   a. Dwarfing

   b. Deformed parts

   c. Color changes

Virus diseases are also common to plants. They are frequently transmitted by insects and can attack nearly all plant parts. In plants, "yellows" and wilts are common problems. Little is said about this group of diseases since chemicals available to control or treat them are limited. Chemicals can be used to control the insects that cause and spread the disease.

Many plant diseases are caused by fungi, a low form of plant life. Most fungi develop threadlike structures inside and/or on the surface of the plant that interfere with proper plant growth and development. The various fungi may attack several crops or only specific plants; they may attack specific plant tissue or various plant parts. Fungi can be classified as follows:

1. Scabs
2. Rots
3. Rusts
4. Smuts
5. Molds
6. Powder mildews
7. Blights
8. Leaf spots

An increasingly serious pest in crop production in many areas of the United States is the nematode. It is a small roundworm that lives in the soil and frequently enters the plants through the roots. It lives on the plant juices and creates the following types of problems:

1. Galls or knots on roots
2. Stunts or deforms plant growth
3. Causes injury which permits disease to attack plants

Nematodes are not insects, even though they do cause insect-like damage, and are not controlled effectively by insecticides.

The pests discussed on the preceding page are considered undesirable for one or more of the following reasons:

1. They reduce yields of crops or livestock.
2. They compete for food, water, space, and sunlight.
3. They destroy feed, clothing, buildings, and other facilities.
4. They cause or transmit disease.
5. They cause poisonous or toxic conditions.
6. They are an annoyance to man and/or animal.
7. They lower the quality of desired products.

Pesticides can be divided into major categories much like the pests themselves.

1. Herbicides for weeds
2. Insecticides and miticides for insects
3. Bactericides and fungicides for diseases
   (There are no effective chemicals for the control of viruses.)
4. Rodenticides for rodents
5. Nematocides for nematodes
6. Molluscicides for mollusks

Herbicides are classified into three types, depending on their effects on plants.

1. Contact
   a. Kill part of plant covered by chemical
   b. Little or no movement of chemical in the plant

c. Effective on annuals and will not kill roots of biennials or perennials

d. Examples: D N B P and P C P

2. Growth regulators (systemic herbicides)

a. Absorbed by foliage or roots

b. Translocated to all plant parts

c. Chronic; kills slowly

d. Overdose on leaves may kill cells and prevent translocation

e. Effective against annuals, biennials, and perennials

f. Examples: 2, 4-D, M C P A, and Atrazine

3. Soil sterilants

a. Prevent growth of all green plants

b. Varying residual toxicity

Herbicides may be selective or non-selective. A selective herbicide is toxic only to specific plant species; whereas a non-selective herbicide is toxic to all plant species. The ideal herbicide is one that is nearly non-selective; that is, it controls all plants except the desired plant species.

Selective herbicides react differently on various plant species. These factors, which may work independently or in combination with others to control weeds selectively, are

1. Amount of chemical applied

2. Time of application

3. Method of application

4. Chemical and physical properties of the herbicides

5. Genetical or physical properties of the plant

Insect control can be achieved by several methods, of which chemical control is one. Chemical control requires

1. Use of the correct chemical
2. Application of it at the correct time
3. Correct application methods

The four common ways in which insecticides work to kill or control insects are

1. Stomach poisons
2. Contact poisons
3. Repellants
4. Attractants

Stomach poisons must enter the digestive tract of the insect before they are effective. For insects with chewing mouth parts, applying the poison to the surface on which the insect feeds is adequate. Before stomach poisons can work on insects having sucking or syphoning mouth parts, systemic poisons are needed. These are chemicals that become part of the plant or animal tissues from which the insect extracts the juices on which it lives.

Contact poisons are chemicals that can enter the insect by means other than the digestive tract. They may enter through surface tissues or the respiratory tract. These chemicals are most frequently used against insects with sucking mouth parts, although they are generally as effective on insects with chewing mouth parts. Fumigates normally act as contact poisons.

Chemical insect repellants actually do not kill most insects, although they may injure certain types. They are used to keep insects from harming or causing annoyance in a particular place.

An insect attractant, or lure, is a material whose vapor, when reaching the insect, draws the insect to it. There are basically three types of attractants: sex, food, and oviposition lures. These lures may be of synthetic or natural origin. Sex lures seem to be the most effective, but much more research is needed before this method of controlling insects becomes of widespread value.

There are many chemical insecticides available, some for general uses and others for specific uses.

1. Arsenicals

   a. Stomach poison

   b. Reduction of their importance by newer chemicals

   c. Examples: lead arsenate, paris green, white arsenic

2. Fluorine compounds

   a. Stomach poison

   b. Commmonly used to control animal insects

   c. Examples: sodium fluoride, cayloite

3. Clorinated hydrocarbons

   a. Large groups of synthesized insecticides

   b. Stomach poisons; some contact toxicity

   c. Hazardous to use

   d. Examples: aldrin, dieldrin, chlordone, lindone toxophene, methorychlor, DDT

4. Phosphates

   a. Generally more hazardous to use

   b. Contact or stomach poison

   c. Examples: parathion, malathion, systox, diazon, phosdrin

5. Nicotine compounds

   a. One of the older insecticidal materials

   b. Deadly stomach poison

   c. Examples: nicotine sulfate (Black Leaf 40), nicotine bentonite

6. Oil sprays

   a. Used alone or as carriers of other insecticides

   b. Contact poison

   c. Petroleum oils the source

7. Mercury compounds

   a. Extremely toxic

   b. Stomach poison and repellant

   c. Examples: calomel, corrosive sublimate

8. Pyrethrum

   a. One of the oldest and safest materials

   b. Botanical insecticide; derived from genus chrysanthemum

   c. Contact poison

   d. Examples: pyrethrum, allethrin

9. Rotenone

   a. Botanical insecticide; derived from the derris or timbo plant

   b. Contact poison

   c. Toxic to animals; very toxic to fish

10. Phenothinzine and Piperozine

   a. To control internal parasites of livestock

Disease pests are controlled with bactericides and fungicides. There are no effective chemicals on the market for the control of plant viruses; but because certain viruses are transmitted by insects, insecticides that control insects indirectly can control these virus deseases. Fumigation of seed beds has reduced virus diseases in some plants, but it is questionable whether fumigation kills the virus organisms, kills the insects that transmit the virus, or causes the wounds which permitted the virus to attack. Sulfa drugs and antibiotics control certain viruses in livestock.

Plants of nearly all species are attacked by fungi. Seeds, roots, stems, leaves, flowers, and fruit parts--all are susceptible to fungi infection. Considerable progress has been made to control these diseases by the development of resistant varieties and improved cultural practices. Even so, the only practical means of controlling fungi on many plant species is by a sound fungicide program. As with other pesticides, the chemical to use and the time and method of application are critical for most fungi diseases. Frequently several applications of fungicides must be made.

There are five basic types of fungicides.

1. Sulfur and sulfur compounds
    a. Lime-sulfur is common
    b. Tent to be caustic to plants when
        1) Heavy applications are used
        2) Humidity is high
        3) Temperature is high
    c. Should be finely ground
2. Copper compounds
    a. Bordeaux mixture: one of the early fungicides
    b. Several other copper compounds
3. Formaldehyde
    a. Highly poisonous and irritating
    b. Used to treat seed and fumigate storage buildings and soil
4. Mercurial compounds
    a. Used for seed treatment
5. Organic compounds
    a. More effective than older materials

b. Most important group of present-day fungicides

c. Seven major groups of organic fungicides

d. Examples: ferbam, nabam, thiram, captan, gylodin, bioguin, choronil

Nematocides are used to control nematodes, a type of roundworm that generally live in the soil and cause damage to seeds, seedlings, roots, and occasionally to above-ground parts such as mum plants. Control is generally accomplished by fumigation. There are four basic materials used.

1. Methyl biomide

2. Chloropicrin

3. Dichloropropene

4. Ethylene dibromide

These materials are effective in controlling other pests at the same time they are controlling nematodes. Soil should have a temperature above 55°F. and good tilth at time of fumigation.

Pesticides are available in three basic physical forms--solid, liquid, and gas. Each has specific purposes, requires different application methods, and has specific advantages and disadvantages.

There are different forms of pesticides available as solids.

1. Dust, the common type of solid pesticide, has the following characteristics:

   a. Lighter than liquids

   b. Less work in preparation for application

   c. Difficulty in obtaining even application

   d. May lose effectiveness faster than sprays

   e. Impossibility of manufacturing certain pesticides (example, oils)

f. Danger of dust and vapor drift

g. Examples of the use of dust

1) Seed treatment to control fungus
2) Seed flats to control damping off
3) Vegetables and fruit dusted by airplane
4) Power dusters mounted on tractors to dust fruit trees
5) Hand dusters for home gardeners, some with CO_2 rechangeable
6) Dusting livestock for mites, lice, grubs, and other pests
7) Aerosol bombs for moth-proofing

2. Granules: a solid type pesticide

a. Small, free-flowing particles

b. Often mixed or combined with a carrier to provide enough bulk for even distribution

c. Applied by hand or mechanical spreaders

d. Applied as granules; no water needed

e. Fall or roll off leaves, preventing plant injury

f. Difficult to apply as uniformly as sprays

g. Examples of the use of granules

1) Insecticides used to control soil root worms
2) Systemic herbicides applied to soils
3) Insecticides that catch in corn whorls for corn borer control

3. Baits: grain mixtures, pellets, cubes

a. Various solid forms; not dusts or granules

b. Placed by hand where pests are located

c. May be used with bait boxes

d. Act as stomach poisons

Liquid materials are the most common form of pesticides. These materials are available in the following forms:

1. Wettable powders

   a. Sold as powders or dusts

   b. Mixed with water for application

   c. Indissoluble powders; stay in suspension

   d. Agitation required with some to maintain suspension

   e. Improper suspension can cause

      1) Nozzle clogging
      2) Uneven application

   f. Suspension partially maintained by wetting agents

   g. Many available as wettable powders

2. Emulsions

   a. Oil base or oil-like pesticides

   b. Mixed with water for application

   c. One liquid mixed in another, each maintaining its own identity

   d. May require agitation to prevent separation

   e. Generally has a "milky" color

   f. Suspension facilitated by emulsifying agents

3. Salts

   a. Sold as dry materials; dissolve in water

   b. Become homogeneous mixture of the water and salt

   c. Clear spray; may be colored, not cloudy

   d. Salt inseparable from water by mechanical means

   e. Assurance of uniform spray

4. Solutions

   a. Sold as clear liquids; may be colored

   b. Become homogeneous mixture with water

   c. Inseparable materials

   d. Assurance of uniform spray

Some types of pesticides are sold as gases, and are used as fumigants to control nearly all types of pests. Certain solid and liquid materials also vaporize and are used as fumigates.

Several factors influence the time to apply chemical pesticides. Under conditions when these factors tend to conflict with each other, judgment is needed to determine the most appropriate time to apply them. Factors governing timeliness of application are

1. Based on pest prevention rather than cure

2. Applied before the pest can do damage

3. Residue remains on or in edible products

   a. Chemical residue may be harmful to

      1) Humans
      2) Animals
      3) Subsequent crops
      4) Beneficial flora

   b. Residue must be removed or destroyed in processing.

4. They should be applied when the pest is most susceptible

5. They should be applied at a time least damaging to other plants and animals

6. They should be applied at a time when least damage will result to beneficial organisms or to the environment

In the 1952 U. S. Department of Agriculture Yearbook, the function of a sprayer is defined in the following manner:

> The main function of a sprayer is to break the liquid into droplets of effective size and distribute them uniformly over the surface or space to be protected. Another function is to regulate the amount of insecticide to avoid excessive application that might prove harmful or wasteful.

Materials used in insecticide, fungicide, herbicide, and defoliant sprays usually fall into three groups.

1. Inorganic compounds
2. Organic compounds
3. Oils

Several types of power sprayers have been developed to apply these sprays. The National Sprayer and Duster Association classified them in the following manner:

1. Hydraulic
    a. Multiple-purpose
    b. Small general use
    c. High-pressure, high volume
    d. Low-pressure, low volume
    e. Self-propelled, high clearance
2. Hydro-pneumatic
3. Blower
4. Aerosol

The most powerful sprayers are the hydraulic sprayers. The pressure created by the pump forces the liquid through the nozzle, which breaks the liquid into small droplets.

The typical hydraulic sprayer is made up of the following parts:

1. Pump
2. Tank
3. Agitator
4. Sprayer framework
5. Combined pressure regulator and relief valve
6. Pressure gauge
7. Strainers
8. Screen
9. Control valves
10. Piping and fittings
11. Distribution system
12. Power source
    (See diagram in Farm Machinery and Equipment, p. 242.)

In the main, positive displacement pumps are used on most hydraulic sprayers. The speed at which these pumps operate determines their discharge capacity. The following types of pumps are used on hydraulic sprayers:

1. Reciprocating
2. Piston
3. Plunger
4. Rotary
5. Diaphragm

Nozzles break the spray liquid into the desired size of droplets. Several types of nozzles made by manufacturers are designed for applying certain types of sprays and making certain application patterns. Three principle application patterns are used to apply sprays.

1. Hollow cone
2. Solid cone
3. Flat-fan

The selection of the proper nozzle should be based on the following factors:

1. Type of spray job
2. Amount of spray to be applied per acre
3. Row spacing and the number of nozzles used per row
4. Nozzle spacing if complete coverage is desired
5. Spray pattern desired
6. Approximate speed of travel
7. Approximate pressure to be used in spraying

The arrangement of the nozzles can be altered by using pendents, nozzle drops, or drop extensions. These arrangements are described in Farm Machinery and Equipment, pp. 246-247.

Hydro-pneumatic sprayers do not have a pump. The spray liquid is carried in a pressure tank and the spraying pressure is developed by means of an engine-powered air compressor.

Blower sprayers are a comparatively new type sprayer. They are used for treating large acreages of fruit trees, vegetables, and certain other crops. These machines operate in the following manner: a blast of air carries the chemical from the machine to the foliage to be treated; the spray liquid is forced under low pressure into the airstream in small droplets by a group of nozzles on shear plates. (See Farm Machinery and Equipment, p. 253, for example.)

The amount of spray applied to a given area depends on three factors.

1. Forward speed of the sprayer

2. Number of nozzles

3. Rate of discharge of spray

As a sprayer is made ready for use under field conditions, it should be checked for correct rate of application. The operation is called calibration. The essential steps in calibrating sprayers are presented in Farm Machinery and Equipment, pp. 255-258.

Suggested Teaching-Learning Activities

1. Collect samples or have the students collect samples of the various forms of pesticides, dusts, granules, wettable powders, salts, oils, solutions, gases, and other types of pesticides. Suggest that less toxic materials be collected and that they be kept in safe storage.

2. Demonstrate in small amounts the mixing of various pesticides to show emulsions, solutions, and dissolving of salts. Point out the cloudy or milky emulsions and clear solutions. Demonstrate the effectiveness of wetting agents and emulsifiers.

3. Demonstrate the need for good timing in using herbicides for weed control. With the same material at the same rate, treat an area of weeds at emergence, at rapid growth stage, and at full bloom, and note the variation in effectiveness.

4. Through field trips and laboratory or field demonstrations, acquaint the students with common pesticide applicators used in your area.

5. Develop several problems with common pesticide products used in your area to give the students experience in calculating active ingredients and amount to apply per acre.

6. Give students the opportunity to clean dust, granular, and spray applicators properly.

7. Arrange a field trip(s) so that students may observe a commercial operation in application of pesticides.

8. Bring several types of sprayers before the class. Disassemble each simultaneously, pointing out the differences in construction. Have students study these differences and learn the parts of each type.

9. Under field conditions, demonstrate proper and improper adjustment of several types of sprayers.

10. Bring to class examples of each type of spray discussed in the content. Have students compare them.

11. Bring to the class sprayers in need of adjustment and repair of as many types as possible. Follow the procedure below when making the needed adjustments and repairs.

    a. Operate the machine in the field to discover any malfunctions in operation.

    b. Inspect the machine, noting worn and broken parts and parts that are out of line or adjustment.

    c. Following the operator's and service manuals, make the necessary repairs and adjustments.

    d. Lubricate the machine for field operation.

    e. Calibrate the machine.

    f. Test the machine in the field and make any adjustments necessary for proper operation.

Suggested Instructional Materials and References

Instructional materials

1. Machines for disassembly

2. Machines for use in demonstrating proper and improper field operation

References

1. Farm Machinery and Equipment, pp. 237-268.
2. Machines for Power Farming, pp. 398-424.
3. Operator's manuals
4. Service manuals

Suggested Occupational Experience

Have students adjust, repair, and calibrate sprayers at the local agricultural machinery dealership, following the procedure outlined in the teaching-learning activities.

IX. To (1) identify the parts of fertilizer applicating machines and how they function and (2) adjust and repair these machines

Teacher Preparation

Subject Matter Content

In order to understand fertilizer machines, the functions of their parts and make proper adjustments and repairs on these machines, an agricultural machinery service employee must be familiar with the types of fertilizer these machines are designed to apply to the soil.

There are three groups of soil nutrients: (1) primary, (2) secondary, and (3) micro or trace nutrients.

1. Primary plant nutrients (N, P_2O_5, K_2O). They are called primary because soils normally cannot provide them in the large amounts needed for healthy growth.

   a. Nitrogen (N)

      1) Gives dark green color to plants
      2) Promotes rapid growth
      3) Improves quality and protein content

b. Phosphorus (P) is expressed in fertilizer as available phosphate (P_2O_5).

1) Stimulates early root development and growth
2) Hastens maturity, promotes seed production
3) Improves winter hardiness of legumes

c. Potassium (K) is stated in terms of potash (K_2O).

1) Increases vigor and disease resistance
2) Aids in food formation
3) Stiffens straw and stalk parts

2. Secondary plant nutrients (Ca, Mg, S) are required by plants in substantial quantities. Soils are adequate in some areas and lacking in others.

a. Calcium (Ca)

1) Promotes early root formation and growth
2) Encourages seed production
3) Neutralizes poisons produced in plants

b. Magnesium (Mg)

1) Maintain chlorophyll and photosynthesis
2) Formation of sugar, fats, and oils
3) Plays a part in translocating food within the plant

c. Sulfur (S)

1) Is essential ingredient in protein
2) Maintain dark green color
3) Promotes module formation on legumes

3. Micro-nutrients (B, Cu, Fe, Mn, Mo, Zn, Cl) are required by plants in trace amounts. Sandy soils, peats and mucks are most often deficient in them.

a. Boron (B)

1) Increases yield and quality
2) Is associated with calcium utilization

b. Copper (Cu)

1) Important in citrus and vegetable production

c. Iron (Fe)

1) Is associated with formation of chlorophyll
2) Aids in plant respiration

d. Manganese (Mn)

1) Accelerates germination and maturity
2) Aids in photosynthesis

e. Molybdenum (MO)

1) Is used by legumes in nitrogen fixation

f. Zinc (Zn)

1) Is necessary for chlorophyll formation
2) Is vital as a growth regulator

g. Chlorine (Cl)

1) Functions not understood

Excessive amounts of minor nutrients can be as harmful as inadequate amounts. Micro-nutrients are usually deficient in the following types of soil.

1. Muck and peat soils

   a. Boron

   b. Copper

2. Alkaline soils

   a. Iron

   b. Manganese

   c. Zinc

3. Acid soils

   a. Molybdenum

The three major plant foods are nitrogen, phosphorus, and potassium.

Nitrogen is an abundant, inert gas found in the atmosphere. Before it can be used by most plants, it must be combined with oxygen or hydrgoen.

Three groups of nitrogen-carrying materials are used in the fertilizer industry.

1. Inorganic nitrogenous materials

    a. Sulfate of ammonia

    b. Anhydrous and liquid ammonia

    c. Nitrate of soda

    d. Ammonium nitrate

    e. Ammonium phosphate

    f. Calcium nitrate

    g. Nitric phosphates

    h. Nitrate of potash

2. Natural organic nitrogen materials

    a. Plant and animal by-products

    b. Guano

3. Synthetic organic nitrogen materials

    a. Urea

    b. Calcium cyanamid

When making adjustments on fertilizer machines either in the agricultural machinery service department or in the field, it is important that the service employer understand the nature of these fertilizers and their methods of application.

1. Anhydrous ammonia

   a. Toxic, hazardous gas, difficult to store and handle

      1) Can cause serious burns
      2) Can cause death by asphyxiation
      3) Is flammable and explosive
      4) Is stored in steel tanks with a strength of 265 pounds per square inch

   b. Anhydrous ammonia

      1) Is 99.5% ammonia, 81.8% nitrogen (82%)
      2) Is 5% water
      3) Weighs 5.14 pounds at 60°F.

   c. Application

      1) Applied "into" soil at a depth of 4-8 inches depending on soil conditions
      2) Is applied under pressure
      3) Rate of application controlled by valves
      4) Requires special handling and application equipment

   d. Retention and behavior in soil

      1) Little or no loss under normal soil conditions
      2) Some losses in exceptionally sandy, dry, or wet and cloddy soils
      3) Retention of ammonia on clay and organic particles in the soil
      4) May make clay stiffer and more compact, but probably not enough to be significant
      5) Increases pH in zone of application, improves solubility of phosphate slightly
      6) Less leaching than with nitrates

2. Ammonium nitrate

   a. Solid chemical compound containing 33.5% nitrogen

      1) Water soluble, quick acting
      2) Approximately one-half of the nitrogen is in nitrate form and one-half in the ammonia form

b. Has an affinity for moisture, will cake

1) Has protective covering to decrease absorption of water
2) Store in water proof bags

c. Safety precautions with ammonium nitrate

1) Don't smoke or expose to open flames
2) Keep away from steam pipes, electrical wiring, and combustible materials
3) Store in well ventilated building
4) Clean up and discard spilled material
5) Promptly destroy empty bags

d. Application with a dry fertilizer applicator, surface or subsurface

e. Retention and behavior in soil

1) Rapid solubility, rapid uptake by plants
2) Possible leaching of nitrate portion
3) Reduces pH slightly

3. Nitrogen solutions

a. Nitrogen materials that dissolve in water

1) Ammonium nitrate
2) Urea
3) Ammonia

b. Low pressure and non-pressure type

1) Free ammonia in low pressure type
2) Crystallization (salting out) problem in cool weather (See table)

Total Nitrogen Available in Solution	Composition of Liquid Nitrogen by Percent				Total Composition by Percent	Crystallization Temperature (°F)
	Free Ammonia	Ammonium Nitrate	Urea	Water		
41.0%	22.2	65.0		12.8	100	21°
41.0	19.0	58.0	11.0	12.0	100	7°
32.0		44.3	35.4	20.3	100	32°
20.0		57.3		42.7	100	42°
20.0	24.3			75.7	100	-70°

c. Storage and application

1) Non-pressure, no special storage problems
2) Low pressure, in sealed tank with pressure gauge
3) Corrosive to steel; aluminum or fiber glass tanks recommended
4) Possible to apply certain non-pressure fertilizers to soil surface
5) Necessity of putting low-pressure fertilizers into the ground

4. Ammonium sulfate

a. Dry material containing 21% nitrogen, 24% sulfur

b. Does not absorb water or cake

c. Leaves acid residue, lowering soil pH

d. Should be applied to land in bands or broadcast, surface or subsurface

5. Ammonium phosphates

a. Types

1) Mono-ammonium phosphate containing 11 to 16% nitrogen
2) Di-ammonium phosphate containing 16 to 21% nitrogen

b. Dry material fertilizers, well suited for top dressing grasses and legumes

c. Lowers the soil pH

6. Aqua ammonia

a. 20-26% nitrogen, ammonia dissolved in water

b. Similar to anhydrous ammonia, less hazardous

c. Must be pumped, does not supply its own pressure

d. Is applied two or more inches deep with special equipment

7. Sodium nitrate

a. 16% nitrogen, mined or manufactured

b. Dry material, applied in bands or broadcast, surface or subsurface

c. Rapidly available, water soluble

d. Slight increase in soil pH

e. Absorbs water; should be stored in dry place in water-proof bags, will cake

f. Should not be used on heavy clay soils possessing a high pH; may produce a "black alkali" condition

8. Calcium nitrate

a. 16% nitrogen, dry material

b. Absorbs water, store in dry place in water-proof bags

c. Slight increase in soil pH

9. Nitric phosphates

a. 12-20% dry material

10. Natural organic nitrogen materials

    a. Largely insoluble in water, 2-9% nitrogen

    b. Nitrogen released slowly as organic matter decomposes

    c. Favored in some lawn fertilizers

    d. No danger of leaching

    e. Relatively high priced

11. Urea

    a. Dry material, containing 46% nitrogen

    b. Water soluble, favored for foliar spraying

    c. Urea combined with formaldehyde is slow releasing (urea-form)

12. Cyanamid

    a. Dry material, 21-22% nitrogen

    b. Water soluble

Characteristics of the major phosphorous fertilizers and their use must be understood. Most of the phosphorus in soils is in a comparatively insoluble form. Even soluble phosphates are often transformed into less soluble phosphates called "fixed" in many soils. The type of phosphorus to use and method of application are important factors to consider. In general, more phosphorous fertilizer should be added than is required by the growing crop. However, this additional phosphorus is held in the soil for succeeding crops.

1. Rock phosphate

    a. Relatively insoluble, slowly available to crops

    b. Can raise the phosphorus level in soil

    c. Effectiveness improved by fine grinding

    d. Best results on acid soils high in organic matter

2. Superphosphate

   a. Most widely used source of phosphorus

   b. Does not change pH of soil

   c. Phosphorus is soluble in soils

   d. Two types of superphosphate

      1) Single strength, 18-20 percent phosphoric oxide
      2) Triple superphosphate, 40-50 percent phosphoric oxide; often called double, treble, or concentrated superphosphate

3. Ammonium phosphates

   a. Contain nitrogen and 15-33 percent phosphate

   b. Phosphorus nearly all water soluble

   c. Commonly used in complete fertilizers

   d. Common types

      1) Mono-ammonium phosphate--48%, trade name Ammo-phos A
      2) Di-ammonium phosphate--48-53%, trade name Ammo-phos B
      3) Ammoniated superphosphate--18-20%
      4) Ammonium phosphate-nitrate--15%
      5) Ammonium phosphate sulfate--20-39%

4. Nitric phosphates

   a. Contain nitrogen plus 10-22 percent phosphate

   b. Relatively new material, increase in use

5. Liquid phosphoric acid

   a. As indicated, a liquid, 52-54% phosphate

   b. Used in irrigation water or directly sprayed on soil

   c. Lowers pH on alkaline soils

   d. Superphosphoric acid, 75% phosphate

e. More costly than other recommended phosphorous fertilizers

f. Strong acid; should be handled with care

6. Colloidal phosphate

a. Trade mark for a low-grade rock phosphate or phosphatic clay

b. Relatively insoluble, seldom recommended

7. Calcium metaphosphate

a. Is 62-65 percent available phosphate in acidic soils

b. Not recommended on alkaline soils; is insoluble

Other phosphorous fertilizers are available, but in limited or local areas. Their value should be determined by their solubility and relative price as compared to the more common, recommended phosphate fertilizers.

The characteristics of the various potash materials in soil fertility are similar.

1. Muriate of potash (potassium chloride)

a. 50-62% potash, water soluble

b. Most common source of potash fertilizer

2. Sulfate of potash (potassium sulfate)

a. Contains less chlorine than muriate and is favored by tobacco growers

b. 50% potash, water soluble

3. Nitrate of potash (potassium nitrate)

a. Contains nitrogen plus 45% potash

b. Little commercial importance, imported from Chile

4. Potassium-magnesium sulfate

   a. Contains magnesium and 22% potash, both water soluble

   b. Sold under trade name "Sulpo-mag"

Soils contain large quantities of potassium, but it is largely unavailable to plant growth. Liming increases the availability of potassium and also reduces potassium leaching.

Fertilizers are sold in three forms--dry, liquid, and gaseous. Anhydrous ammonia is the only gaseous fertilizer. They may be straight materials, containing only one major nutrient, mixed fertilizers containing all three major nutrients of nitrogen, phosphorus and potassium. Over 60% of all fertilizers sold are mixed fertilizers. Dry fertilizers can be granulated, mixed, chemically blended, or made as a combination of the three.

1. Granulated fertilizers are converted into granules of uniform size, each containing the ingredients in the same proportion. This is called pelleting.

2. Chemically blended materials chemically react to form materials of homogenous composition. These are then made into granules.

Fertilizers differ in their grade analysis. The common classifications are

1. Ordinary grade, containing a total value of less than 20 percent nitrogen, phosphate, and potash

2. High grade, containing 20-30 percent total plant food, such as 6-12-12

3. Concentrated grade, containing over 30 percent total nutrients, such as 12-12-12

The trend is to concentrated grade fertilizers for several reasons.

1. Economical transportation, handling, bagging, and storage

2. Reduced salt toxicity and less material needed to supply the needed amount of plant food

Lower grade fertilizers, however, generally contain more secondary and trace-elements and have a better physical condition. Concentrated liquid fertilizers are more likely to crystalize or "salt out."

As the agricultural machinery service employee makes adjustments and repairs on fertilizing machines, he will be confronted with many questions concerning the content of fertilizers. He should understand the composition of commercial fertilizer well enough to answer these questions. He should know

1. The meaning of the numbers on a bag of fertilizer
2. Fertilizer ratios
3. How to compare values of various fertilizers
4. How to change plant food percent to elemental percent

The numbers on the bag refer to the percent of the three primary plant nutrients--nitrogen, phosphorus, and potassium--in that order in the bag, and is the guaranteed analysis. A 6-24-12 fertilizer contains

1. 6 percent nitrogen (N)
2. 24 percent available phosphoric oxide (P_2O_5)
3. 12 percent soluble potash (K_2O)

This would be a 42 unit (6 + 24 + 12) fertilizer and has a 1-4-2 ratio, determined by dividing all the numbers by the smallest. A 4-16-8 fertilizer would have the same 1-4-2 ratio but would contain 28 units of fertilizer. Assuming a customer wanted to apply 300 pounds of 3-16-8 per acre, but found that it was not available, 200 pounds of 6-24-12 would supply the same amount of primary nutrients; 12 pounds of nitrogen, 48 pounds of phosphoric oxide, and 24 pounds of potash.

Mixed fertilizers often contain secondary or trace elements in addition to the primary elements. When a certain level is guaranteed, the amount must be stated on the bag. A popular grade in the orange country is 4-6-8-3-1-1½, with the last three numbers standing for magnesium, manganese, and copper. Where the amount is not guaranteed, just the fact that the nutrient is added is sufficient. In certain areas 0-15-45 B is a popular alfalfa fertilizer, with the B indicating that boron is added. Other fertilizers are sold as trace element fertilizers as "5-20-20 with trace elements added."

The principal ratios and grades of mixed fertilizer sold in the United States are listed below. These make up over seventy percent of the mixed fertilizer tonnage used annually.

Ratio	Grades
1-2-2	5-10-10; 6-12-12; 8-16-16
1-4-4	4-16-16; 3-12-12; 5-20-20; 6-24-24
1-1-1	12-12-12; 10-10-10; 8-8-8
1-2-3	5-10-15; 4-8-12
1-2-1	5-10-5; 10-20-10
1-4-2	6-24-12
1-3-3	3-9-9
0-1-1	0-20-20
0-1-3	0-10-30; 0-15-45; 0-12-36

Several types of machines have been developed to apply fertilizers.

1. Granular

2. Gas and liquid

Granular fertilizer applicators are manufactured in a variety of types. These include

1. Attachments for row-crop planters

2. Attachments for grain drills

3. Attachments for cultivators

4. Attachments for chisel plows

5. Machines that broadcast fertilizer

Fertilizer attachments used on a row-crop planter are of two types, based on the type of feeding mechanism.

1. Star or spur wheel type

2. Plow type
   (See Machines for Power Farming, pp. 340-341.)

A separate compartment for applying fertilizer is used on grain drills. The fertilizer granules are placed in a hopper similar to the seed hopper. The star finger feed wheels, driven by two bevel gears, moves the fertilizer granules to a special shed at the front of the hopper. This shed is made up of a series of removable back plates that cover the fertilizer drop openings. (See Machines for Power Farming, pp. 363-365.)

On cultivators and chisel plows, the fertilizer granules are fed into a metering device from a hopper similar to a row-crop planter hopper. From the metering device, the fertilizer is dropped into feeder tubes that place the fertilizer in the furrow left by the cultivator or chisel shovels.

The end-gate trailing type of fertilizer distributor is the most commonly used broadcast applicator. The fertilizer granules are placed in ahopper where it is fed into the fertilizer drop openings by a rotor in the bottom of the hopper. An agitator is used to keep the fertilizer from bridging in the hopper and to break down any lumps or clods that may be in the fertilizer. Some broadcasters use a scattering board to broadcast the fertilizer more thoroughly. This board is located directly below the fertilizer drop openings in the bottom of the hopper. (See Machines for Power Farming, pp. 283-286.)

With the advent of gas and liquid fertilizers came the development of new and different types of fertilizer applicators. These applicators force the gas or liquid into the soil under high pressure. They are equipped with a tank, pressure hoses, carrying tubes, and shovels for opening the soil. The carrying tubes are connected to a small pipe welded to the rear side of the chisel knives or shovels. As the shovels enter and penetrate the soil to the desired depth, the gas or liquid fertilizer is forced out through the pipe into the soil.

Gas and liquid fertilizer applicators can be calibrated to control the amount of fertilizer being applied. This procedure is outlined and discussed in Farm Machinery and Equipment, pp. 284-286.

Suggested Teaching-Learning Activities

1. Using fertilizer applicators discussed in the subject matter content, demonstrate how each machine works in the soil. After demonstrating proper operation of each type of machine, throw the machines out of adjustment and have the students observe the results.

2. Have students disassemble each type of fertilizer applicator discussed in the content and learn their parts. Point out to the students the materials used in constructing each part and the function each part plays in the total operation of the machine.

3. Bring to the class fertilizer applicator machines that are in need of adjustment and repair of each type discussed in the subject matter content. Follow the procedure below when making the needed adjustments and repairs.

   a. Operate the machine in the field, noting any malfunctions in operation.

   b. Inspect the machine, noting worn and broken parts and parts that are out of line or adjustment.

   c. Following the operator's and manufacturers manuals, make the necessary repairs and adjustments.

   d. Lubricate the machine for field operation.

   e. Test the machine in the field and make any adjustments necessary for proper operation.

Suggested Instructional Materials and References

Instructional materials

1. Machines for disassembly

2. Machines for use in demonstrating proper and improper field operation

References

1. Machines for Power Farming

2. Farm Machinery and Equipment

3. Operator's manuals

4. Manufacturer's service manuals

Suggested Occupational Experience

Have students adjust, repair, and lubricate fertilizer applicators at the local agricultural machinery dealership under the supervision of a skilled mechanic, following the procedure outlined in the teaching-learning activities.

X. To prepare and paint tillage, planting, spraying, and fertilizing machines after they have been repaired

Teacher Preparation

Subject Matter Content

If the person being taught this module has not been taught the competency on preparing and painting the tractor in the module on "Tractor Repair," he should be taught that competency at this time. The procedures to be followed when painting these machines are the same as those to follow when painting a tractor.

Suggestions for Evaluating Educational Outcomes of the Module

The following criteria should be used to evaluate the educational outcome of this module.

1. Attentiveness in class and participation in laboratory activities
2. The ability of the student to use the operator's and service manuals
3. The ability of the student to perform the repair and adjustment activities on machines. As a final outcome it is suggested that each student completely recondition a machine in need of repairs and adjustment.
4. Employers evaluation of the ability of the student to adjust, repair, and service machines in his dealership.

Sources of Suggested Instructional Materials and References

1. Knuti, Korpi, and Hide. Profitable Soil Management. Englewood Cliffs, New Jersey: Prentice Hall, Inc., 1962.
2. Smith, N. P. Farm Machinery and Equipment, Fifth Edition. New York: McGraw-Hill, 1964. Price: $10.50.
3. Stone, A. A. and Gulvin, H. E. Machines for Power Farming. New York: John Wiley and Sons, Inc., 1957. Price: $5.95.
4. Operator's and service manuals from major line agricultural machinery manufacturers.

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ADJUSTMENT, MAINTENANCE, AND REPAIR OF CROP HARVESTING MACHINERY

One of Sixteen Modules in the Course Preparing for Entry in
AGRICULTURAL MACHINERY - SERVICE OCCUPATIONS

Module No. 11

The Center for Research and Leadership Development

in Vocational and Technical Education

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Development Group National Task Force
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(3) Utilization of Material:
Appropriate School Setting Post high school
Type of Program General post high school class in agricultural machinery
Occupational Focus Agricultural machinery service occupations
Geographic Adaptability Nationwide
Uses of Material Instructor course planning
Users of Material Teachers

(4) Requirements for Using Material:
Teacher Competency Background in agricultural machinery
Student Selection Criteria Post high school, mechanical aptitude, high school background, goal in agricultural machinery service occupation.
Time Allotment Estimated time listed in module. (P)

Supplemental Media --
Necessary x
Desirable ____ (Check Which)

Describe Suggested references given in module. (P)

Source (agency)
(address)

ADJUSTMENT, MAINTENANCE, AND REPAIR OF CROP HARVESTING MACHINERY

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ADJUSTMENT, MAINTENANCE, AND REPAIR OF CROP HARVESTING MACHINERY

Major Teaching Objective

To develop (1) an understanding of crop harvesting machines and their parts, and (2) the ability to adjust, repair, and maintain these machines.

Suggested Time Allotments

At school		
Class instruction	48 hours	
Laboratory experience	150 hours	
Total at school		198 hours
Occupational experience		102 hours
Total for module		300 hours

Suggestions for Introducing the Module

Crop harvesting machines are the reapers of the farmer's toil. They are extremely important to him. They must operate properly and efficiently if he is to maximize his profits and minimize his expenses. In relying heavily on these machines to bring in his crop, he is also relying heavily on the service department of the agricultural machinery dealership and its employees to keep these machines functioning properly. In order to keep these machines functional, these employees must know the types and functions of harvesting machines, their relationship to the crop they are designed to harvest, and how to adjust and repair them when they need it.

Diversity in types of machines used to harvest crops in various parts of the country exists. Different features exist on the same machine because of design differences developed by major line agricultural machinery manufacturers. Some harvesting machines are built to different degrees of specialization. Therefore, it was deemed most wise to use the operator's and manufacturer's service manuals as the basic repair and adjustment references. Only those machines used in all parts of the country have been included in this module. The subject matter content presented in each competency provides the necessary background information needed to understand how and why to make these adjustments and repairs. The fact that certain machines have been omitted from this module doesn't mean that they should not be studied. These machines should be studied during training schools held by the manufacturer after the student has been employed.

The following techniques should be used to create interest in the module.

1. Identify machines on farms in the community that are out of adjustment and are in need of repair. Take students on a tour

of these farms and demonstrate the operation of these machines. Have students attempt to identify what part or parts are out of adjustment and how they should be properly adjusted.

2. Place parts from several machines around the classroom and have students attempt to identify them.

3. Using a panel composed of a farmer, agricultural machinery dealership manager, and a mechanic, discuss the importance of proper adjustment and repair of crop harvesting machines.

Competencies to be Developed

I. To understand how to use operator's and service manuals when adjusting, maintaining, and repairing agricultural machinery

Teacher Preparation

Subject Matter Content

If the person being taught this modules on "Adjustment, Maintenance, and Repair of Crop Harvesting Machinery" has not been taught the competency on using operator's and service manuals included in the "Adjustment, Maintenance, and Repair of Tillage, Planting, Spraying, and Fertilizing Machinery," they should be taught that competency at this time.

II. To select and use proper lubricants for agricultural machines

Teacher Preparation

Subject Matter Content

If the person being taught this modules on "Adjustment, Maintenance, and Repair of Crop Harvesting Machinery" has not been taught the competency on understanding agricultural machinery lubrication included in the module on "Agricultural Machinery Assembly and Lubrication," they should be taught that competency at this time.

III. To (1) identify the parts of hay harvesting machines and understand their functions and (2) adjust and repair these machines

Teacher Preparation

Subject Matter Content

An understanding of the operation of hay harvesting machinery is of utmost importance to a farm machinery mechanic and mechanic's

helper. These machines are used in all parts of the country and agricultural machinery service employees will be required to service and repair these machines each year.

The common hay harvesting machines include mowers, hay conditioners, rakes, and balers.

Mowers, in the main, are used to cut native grasses and other hay crops.

There are several types of mowers determined by the manner in which they are attached to the tractor.

1. Trail

2. Integral rear-mounted

3. Side-mounted or central-mounted

The above types of mowers can be further divided according to whether they are of the pitman or pitmanless type of mower.

The pitmanless mower knife is driven by either single or double counterbalance wheels permitting a smoother, faster knife speed. (See reference Farm Machinery and Equipment, pages 293 and 294, for an example of a pitmanless mower.)

The pitman on the pitman type mower is a rigid connecting link between the source of power and the mower knife. It connects rotary motion into straight-line motion. (See reference Machine for Power Farming, pages 237 and 238, for a discussion of the pitman and its function.)

A mower is made up of the following parts:

Part	Function
Frame	That part that supports the drive and cutter bar mechanism
Drag bar	That part that extends from the frame to the yoke
Yoke	The part to which the cutter bar is hinged
Pullbar	That part of the mower that keeps the yoke and cutter bar forward as they drag on the ground

Part	Function
Cutter bar knife	That part which actually cuts the hay
Knife bar	That part of the cutter bar which supports the knife
Knife sectors	The triangle shaped pieces on the knife
Guards	The pointed parts on the cutter bar that parts and guides the hay to the knife sectors
Ledger plate	That part that is riveted to the guard and forms one half of the cutting unit
Wearing plate	That part which supports the rear side of the knife
Knife chips	Those parts that hold the knife sections down close to the ledger plate
Grass hand and stick	Those parts which divide and rake the cut hay away from the cutter bar
Inside and outside shoes	Those parts which support the inner and outer end of the cutter bar when in operation

Several adjustments are common to all mowers. These include:

1. Angle of cut
2. Load or cutter bar adjustment
3. Register
4. Guard alignment
5. Cutter bar tilt

These adjustments should be made according to the specifications set down in the operator's and manufacturer's service manual for the machine needing adjustment.

Hay conditioners prepare hay for storage or feeding by means of crushing, flailing, or crimping.

The three types of conditioners commonly used to prepare or condition hay are:

1. Smooth roll

2. Corrugated roll or crimper

3. Flail type

In the smooth-roll type, the hay is picked up and fed through two rollers where it is completely crushed. The rollers may be either both rubber or one rubber and the other steel.

The corrugated roll or crimper type conditioner is usually equipped with either two malleable iron rolls, tapered flutes that mesh together, or slotted bar rolls. As the hay passes through the rolls, it is crimped at regular intervals but not completely crushed.

On the flail type conditioner the shear bar is removed and the swinging hammers or knives partially chop the hay.

Modern agricultural hay loaders and balers require that the hay be in a loose, fluffy, continuous windrow before these machines are able to carry out their phase of the hay harvesting operation. In many cases the hay is moved into windrows immediately after it has been cut, requiring turning in order for the hay to come out properly. The side-delivery rake was developed to meet these requirements.

Several types of side-delivery rakes are commonly used today. The type of rake is determined by the type of reel construction used on the rake. Reel types are:

1. Cylindrical reel

2. Parallel bar

3. Side-stroke

4. Finger-wheel

Each type of rake given above is discussed in the reference Farm Machinery and Equipment, pages 302-306.

The purpose of the hay baler is to pick up hay from a windrow and compress it into a bale.

Two types of balers used to bale hay are:

1. Pickup automatic self-tying balers which make rectangular bales

2. Pickup automatic baler making round bales

Four processes involved in making a bale with a baler are:

1. Pickup

2. Feeding

3. Compressing

4. Tying

The usual type of pickup mechanism on the baler consists of a drum or cylinder with spring steel teeth. The cylinder rotates in the opposite direction of the motor of the baler, lifting the hay and moving it into the machine.

At least four main methods of feeding the hay into the compressing chamber are commonly used on balers. They are:

1. Auger and packer fingers

2. Spring teeth and feeder arms

3. Auger and feeder head

4. Carrier-roller feed

The feeding mechanism on the baler feeds the hay into the compressing chamber where the hay is pressed into a bale. The compressing mechanism is composed of five parts:

1. Plunger

2. Bale chamber

3. Tension bars or rails

4. Retaining plates

5. Metering wheel

On the rectangular bale, the plunger is a rectangular framework that pushes against the hay as it is fed into the compressing chamber. The plunger has a set of knives along the side of the

plunger that is situated next to the feeding mechanism. These knives shear off the hay as it is fed into the compressing chamber making a neat, smooth bale.

The bale chamber is the long rectangular box into which the plunger forces the hay. The tension bars or rails are located in the chamber and offer resistance to the plunger action making a tight bale.

The retaining plates are located in the compressing chamber just out of reach of the plunger. They prevent the bale from moving back toward the plunger after each compression stroke.

The metering wheel is located on the compressing chamber and has spokes that make contact with the hay. As the hay moves through the compressing chamber, it turns the metering wheel. After making a complete turn, the metering wheel engages the tying mechanism.

The last function performed by the baler before it releases the bale is that of tying the bale. The tying function is described on pages 482 and 484 of Machines for Power Farming and 309-311 of Farm Machinery and Equipment.

On the round baler, the hay is fed into a series of rolling belts. The lower set of belts rotate in the opposite direction from that of the upper series of belts. The hay is turned in a circular motion forming a round bale. After the bale becomes so large, it trips the trip rollers and releases the bale. (See Farm Machinery and Equipment, page 312, for an illustration of how the roller baler operates.)

Suggested Teaching-Learning Activities

1. Have students disassemble each type of hay harvesting machine discussed in the content and learn their parts. Point out to the students the materials used in constructing each part and the function each part plays in the total operation of the machine.

2. Demonstrate proper and improper operation of each of the hay harvesting machines under field conditions.

3. Bring to the class hay harvesting machines that are in need of adjustment and repair of each type discussed in the subject matter content. Follow the procedure below when making the needed adjustments and repairs.

   a. Operate the machine in the field noting any malfunctions in operation.

b. Inspect the machine noting worn and broken parts and parts that are out of line or adjustment.

c. Following the operator's and manufacturer's service manuals, make the necessary repairs and adjustments.

d. Lubricate the machine for field operation.

e. Test the machine in the field and make any adjustments necessary for proper operation.

Suggested Instructional Materials and References

Instructional materials

1. Machines for disassembly

2. Machines for use in demonstrating proper and improper field operation and in need of repair and adjustment

References

1. Machines for Power Farming, pp. 427-491.

2. Farm Machinery and Equipment, pp. 289-315.

3. Operator's manuals

4. Manufacturer's service manuals

Suggested Occupational Experiences

Have students adjust, repair, and lubricate hay harvesting machines at the local agricultural machinery dealership under the supervision of a competent mechanic following the procedure outlined in the teaching-learning activities.

IV. To (1) identify types and parts of forage harvesting machinery and understand their functions and (2) adjust and repair these machines

Teacher Preparation

Subject Matter Content

The primary purpose of forage harvesting machinery is to chop field crops and place the chopped crop in a wagon. Two types

of forage harvesters have been developed to accomplish this purpose.

1. Field chopper

2. Flail chopper

The field chopper is by far the most versatile of the two types. This versatility comes from its ability to be adapted to a variety of crop or forage production methods. For example, a unit has been developed for use in harvesting row crops, a unit for picking up forages in the windrow, etc. (See Farm Machinery and Equipment, page 32, for examples of unit attachments for the forage chopper.)

There are three types of field choppers used by farmers.

1. Tractor-drawn

2. Tractor-mounted

3. Self-propelled

The basic unit of the field chopper is made up of the following parts:

1. Wheels

2. Axle

3. Frame

4. Cutter head

5. Blower

6. Feeding mechanism

This unit is powered through the PTO and the tractor. The power from the PTO shaft is carried to the basic unit through the PTO shaft in the harvester.

Three processes are involved in the operation of the forage harvester.

1. Cutting and feeding

2. Chopping

3. Blowing

The feeding and cutting mechanism will vary according to the type of unit attachment that is being used on the harvester. If a row crop unit is being used, an oscillating sickle is used to sever the plants. The plants are moved back toward the chopping unit. If a broadcast unit attachment is used, a mower-like cutter bar cuts the crop. A reel is used to throw the severed plant against an apron which carries the forage back to an auger. The auger in turn carries the material to the chopping unit. If a windrow pick-up is used, revolving fingers lift the forage from the windrow and move the hay to the auger. The auger in turn moves the forage to the chopping mechanism.

Two principle types of cutter heads are used on forage harvesters.

1. Flywheel

2. Cylinder

The flywheel-type cutter head performs two functions, chopping and blowing. The blower paddles are separate from the cutter knives. As the wheel turns, the knives cut the forage and the blower paddles blow the chopped forage up and out of the blower spout.

The cylinder type of cutter head has knives designed to both cut and blow, however, some require a blower to force the chopped forage out of the harvester. (See Farm Machinery and Equipment, page 322 for an illustration of both types of cutter heads.)

The flail type harvester uses free-swinging chains, hammers, or knives to severe the plants through a beating or cutting action. The chopped hay is drawn into the blower fan and blown through the blower spout into the wagon.

Suggested Teaching-Learning Activities

1. Have students disassemble each type of forage harvesting machines discussed in the content and learn their parts. Point out to the students the materials used in constructing each part and the function each part plays in the total operation of the machine.

2. Demonstrate proper and improper operation of each of the types of forage harvesting machines under field conditions.

3. Bring to the class forage harvesting machines that are in need of adjustment and repair. Follow the procedure below when making the needed adjustments and repairs.

   a. Operate the machine in the field noting any malfunctions in operation.

   b. Inspect the machine noting worn or broken parts and parts that are out of line or adjustment.

   c. Following the operator's and manufacturer's service manuals, make the necessary repairs and adjustments.

   d. Lubricate the machine for field operation.

   e. Test the machine in the field and make any adjustments necessary for proper operation.

Suggested Instructional Materials and References

Instructional materials

1. Machines for disassembly

2. Machines for use in demonstrating proper and improper field operation and the need of repair and adjustment

References

1. Machines for Power Farming, pp. 492-515

2. Farm Machinery and Equipment, pp. 317-328

3. Operator's manuals

4. Manufacturer's service manuals

Suggested Occupational Experiences

Have students adjust, repair, and lubricate forage harvesting machines at the local agricultural machinery dealership under the supervision of a competent mechanic following the procedures outlined in the teaching-learning activities.

V. To (1) identify the parts of grain harvesting machines and understand their functions and (2) adjust and repair these machines

Teacher Preparation

Subject Matter Content

The principal grain harvesting machine in use today is the combine. The combine harvests, threshes, and cleans grain all in one operation.

There are two types of combines in use on farms today.

1. Pull type
2. Self-propelled

The pull type is drawn by a tractor. The smaller pull type combines are powered by the PTO of the tractor, whereas the larger combines are powered by an auxiliary engine mounted on the combine.

Self-propelled combines are powered by industrial-type engines and are operated by one man. They are provided with a gear-shift to give desired field and road speed. The combine is steered by a large steering wheel that turns the rear wheels. The travel and operation of the combine is controlled by a transmission and separator clutch. The cutter bar and platform can be raised or lowered to meet changing field conditions from a lever located on the steering shaft. The wheels are adjusted hydraulically to conform to the slope of the land which keeps the threshing, separating, and cleaning units level insuring proper machine action.

The combine performs the following functions.

1. Cutting the standing grain
2. Feeding the cut grain to the cylinder
3. Threshing the grain from the stalk or stem
4. Separating the grain from the straw
5. Cleaning the grain by removing chaff and other foreign matter
6. Elevating the grain from the combine to the holding bin and from the holding bin to the truck

The cutting mechanism cuts the standing grain. The cutting mechanism consists of two parts.

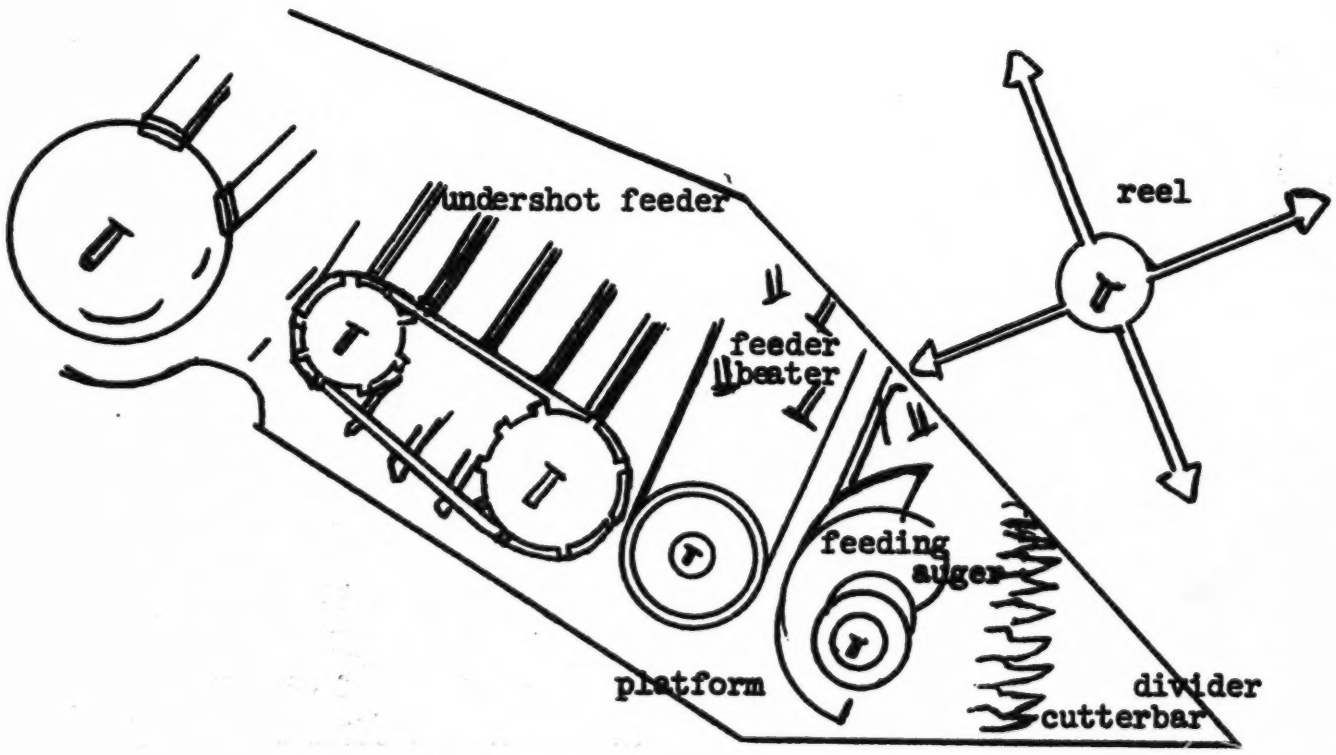
1. Cutter bar

2. Reel

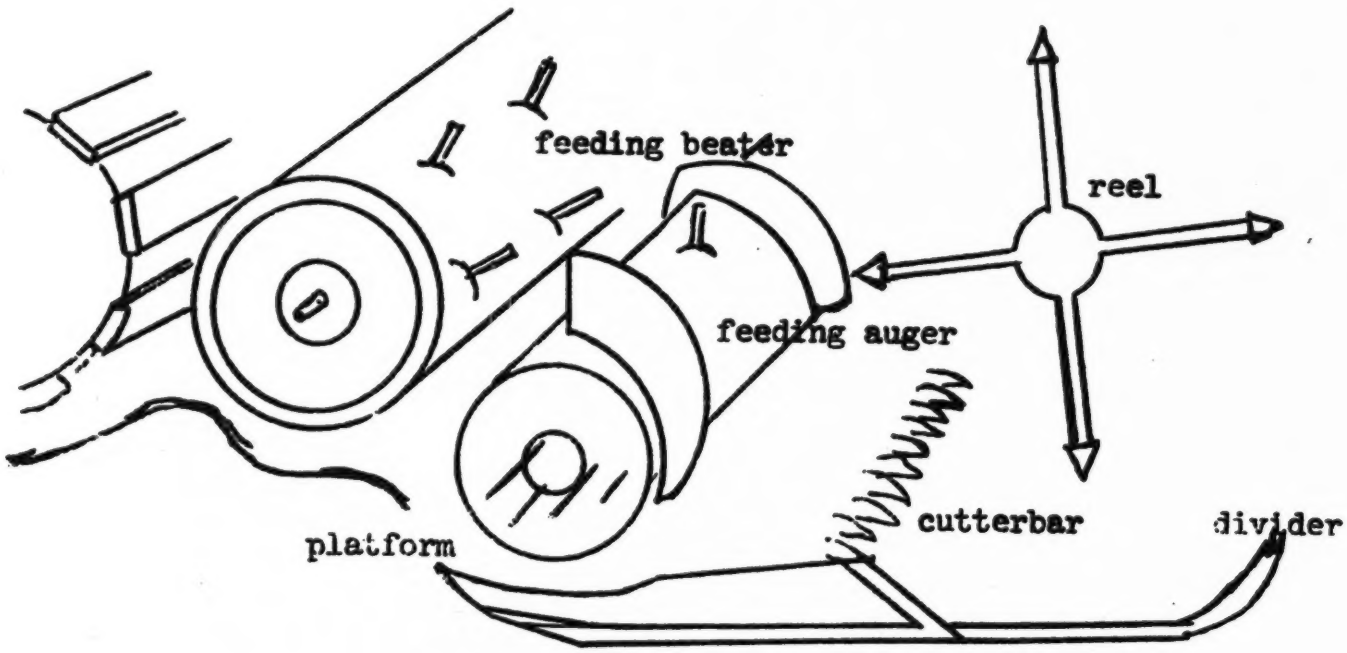
The cutter bar severes the grain heads from the plant and the reel sweeps the heads back onto a canvas or auger table. The knife in the cutter bar extends the full width of the cutter bar and is powered by the rocker arm pitman. The knife sections are serrated.

The reel is located above the cutter bar. It may have as many as six wood bats on the reel to sweep the grain into the elevating platform. It can be adjusted to the height of the crop and on some of the late model machines this adjustment is made through the use of hydraulic cylinders. Common cutting and feeding mechanisms used on combines are illustrated below.

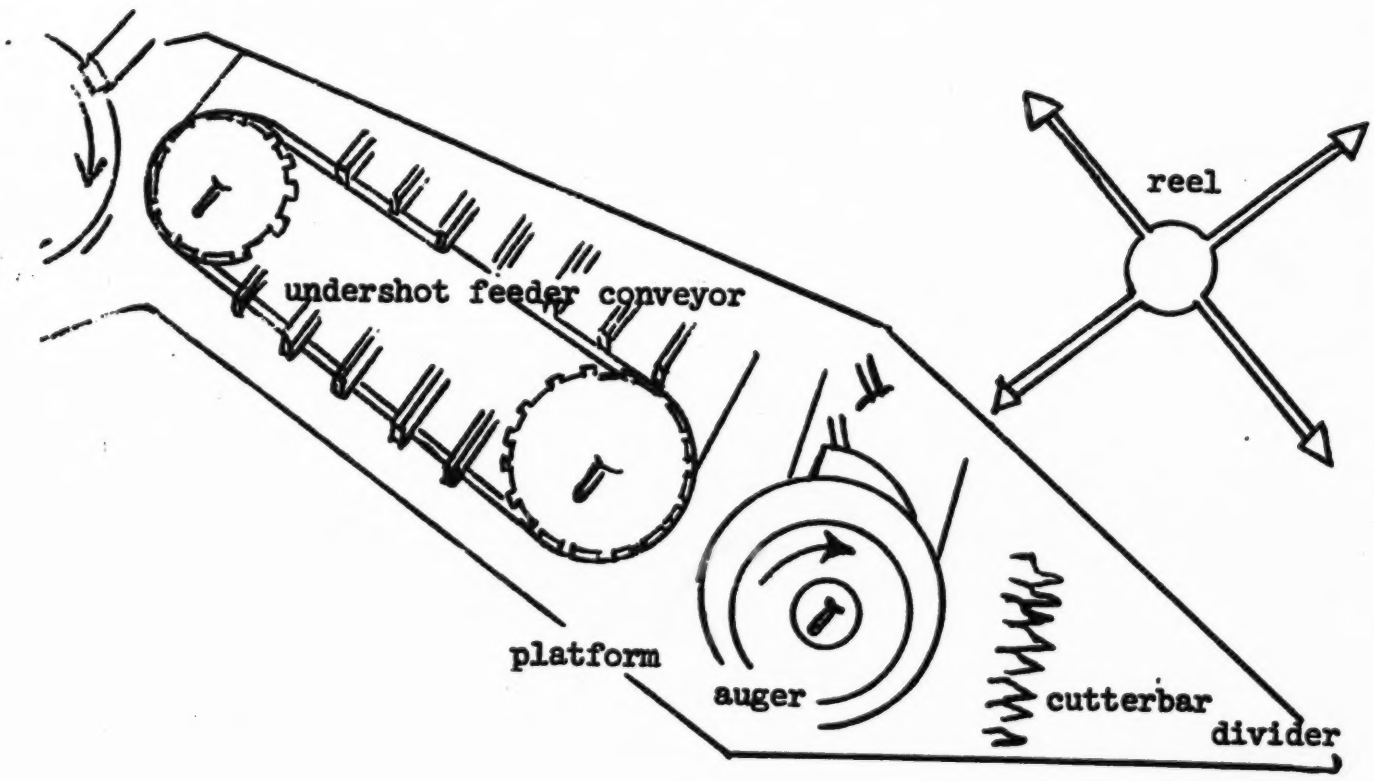
Cutting and feeding mechanism using a feeding auger, feeding beater, and undershot feeder



Cutting and feeding mechanism
using a feeding auger and feeding beater



Cutting and feeding mechanism
using a feeding auger and undershot feeder



The cutting and feeding mechanism is made up of the following main parts:

1. Cutter bar: The cutter bar works like a series of shears running through the field to cut the grain. This is accomplished by knife sections reciprocating (working back and forth) over ledger plates which are held in place by guards. Hold down clamps, wearing plates, and shims are used to keep the knife flat on the ledger plates.

   The sickle bar is usually driven by a pitman drive assembly.

   Power will usually be supplied to the pitman crank by means of a series of belts and chains.

2. Reel: The reel slats gather in the crop, hold it until it has been cut by the knife, and then move it onto the platform. The reel must be square, level, and at the proper height and position to feed the grain uniformly and steadily. The reel may be ground driven or power driven.

3. Platform: The platform holds the cutter bar and feeding mechanisms.

4. Cutting platform auger: The cutting platform auger moves the cut grain to the center of the platform where the retractable auger fingers feed the grain into the feeder conveyor or the feeder beater depending on the design of the combine.

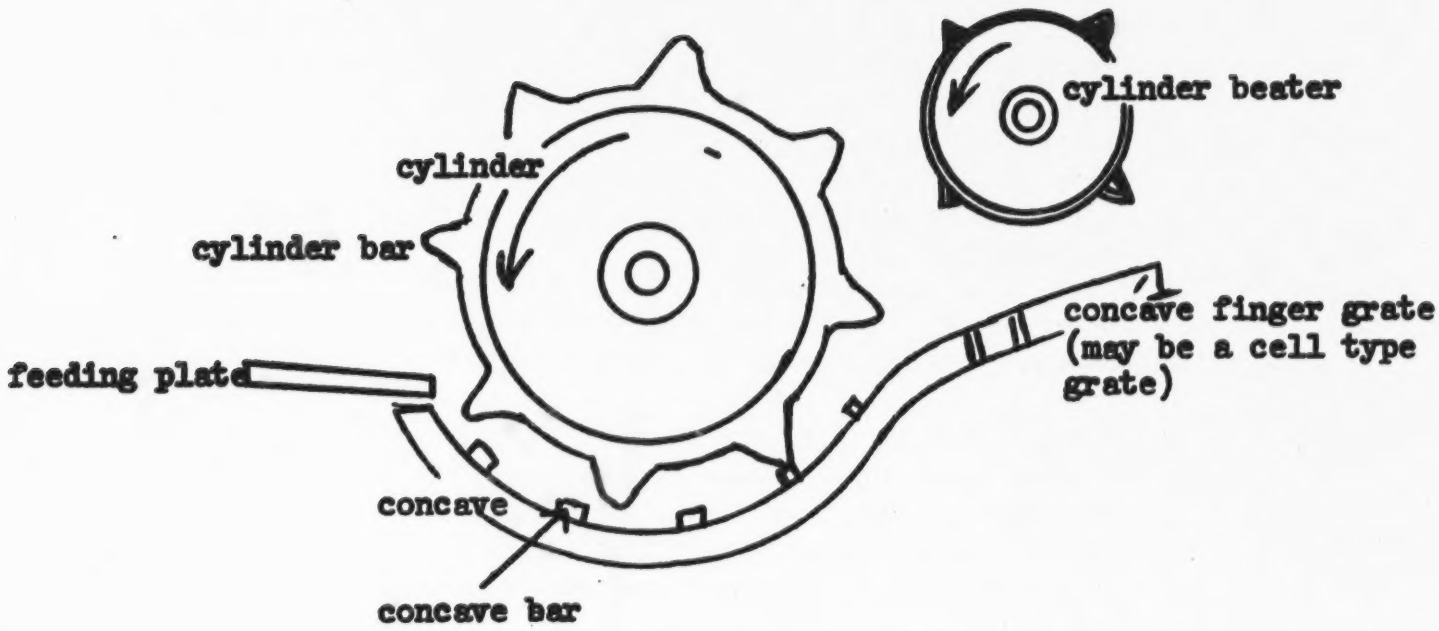
5. Retractable finger feeder beater: In some combines the cutting platform auger is followed by a retractable finger feeder beater which moves the grain into either the feeder conveyor or into the threshing unit.

6. Feeder conveyor: The feed conveyor or feed rake, as it is sometimes called, is designed to feed the grain in a steady even flow into the threshing unit. Proper feeding into the threshing unit will cause less clogging.

7. Feeder beater: Some models of combines will have a feeder beater which takes the grain from the feed conveyor and feeds it uniformly into the threshing unit.

The function of the threshing mechanism of the combine is to thresh the grain from the heads. This is done by passing the grain between a rapidly revolving cylinder and a stationary surface. Underneath is the concave. The rubbing action on the grain caused by the bars on the cylinder passing over the concave channel bars causes the grain to be removed from the head.

Threshing Mechanism



The design of some of the parts shown on this diagram will vary according to the type of combine. Some combines will not have a separate shelling plate and may not have finger grates.

The main parts of the threshing mechanism are:

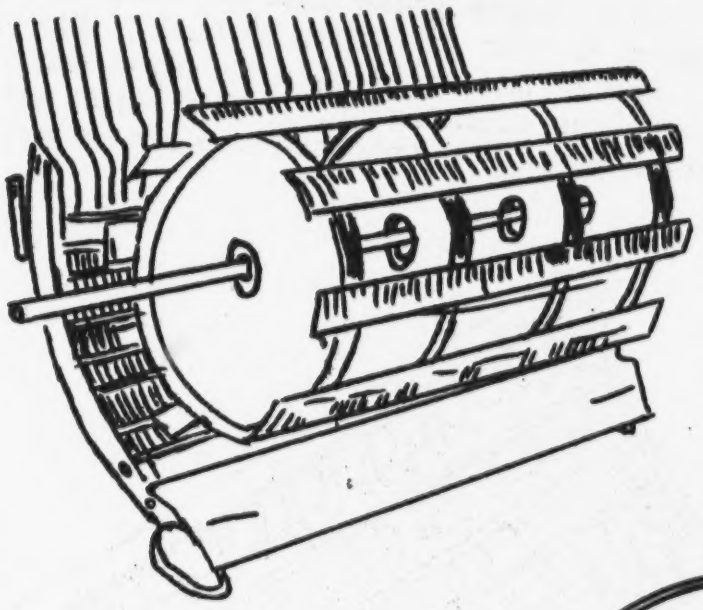
1. Cylinder: The cylinder will have either bars or spikes that will cause the rubbing of the grain against the concave.

    a. Rasp bar cylinder: The cylinder bars are rasp shaped as shown in the illustration.

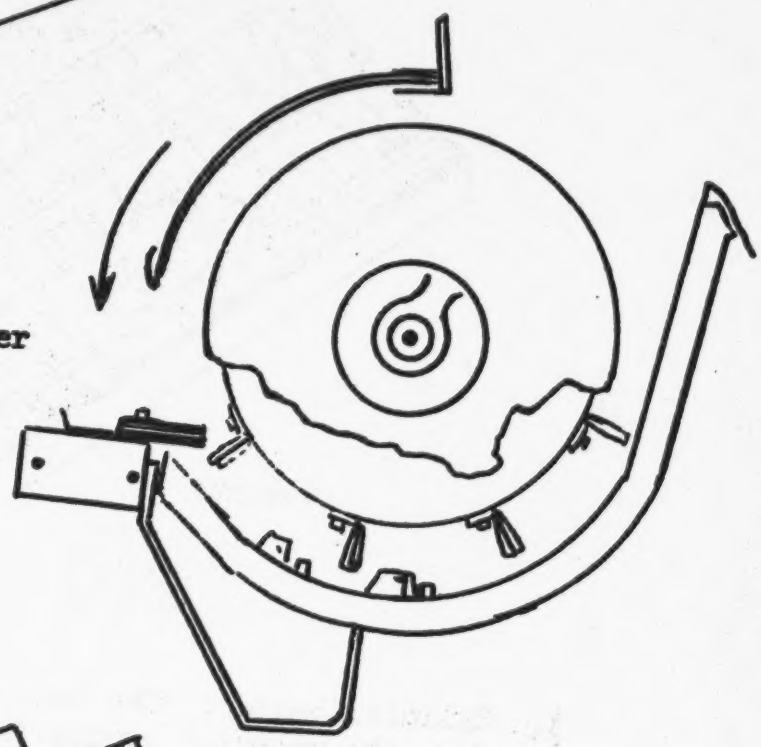
    b. Rub bar cylinder: The cylinder bars are angle shaped and faced with rubber.

    c. Spiked tooth cylinder: The cylinder has spikes instead of bars. This type is not suited for corn harvesting.

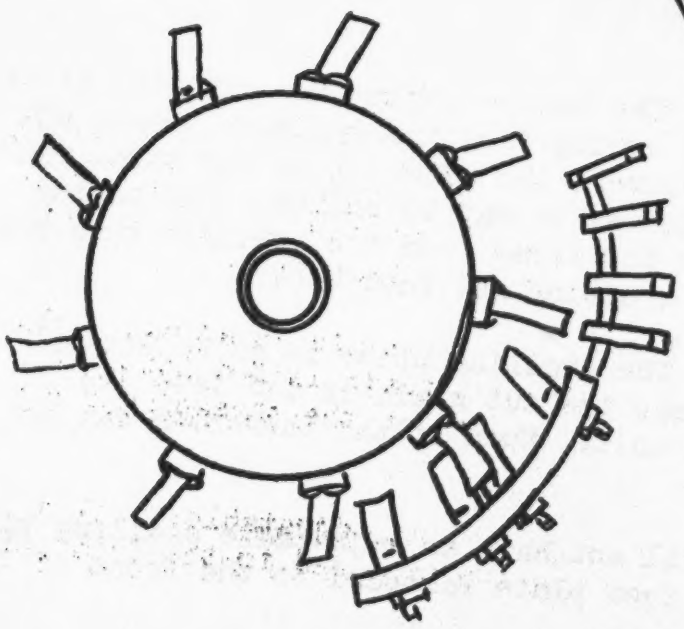
The following diagrams illustrate the types of cylinders mentioned on the preceding page:



Rasp bar cylinder

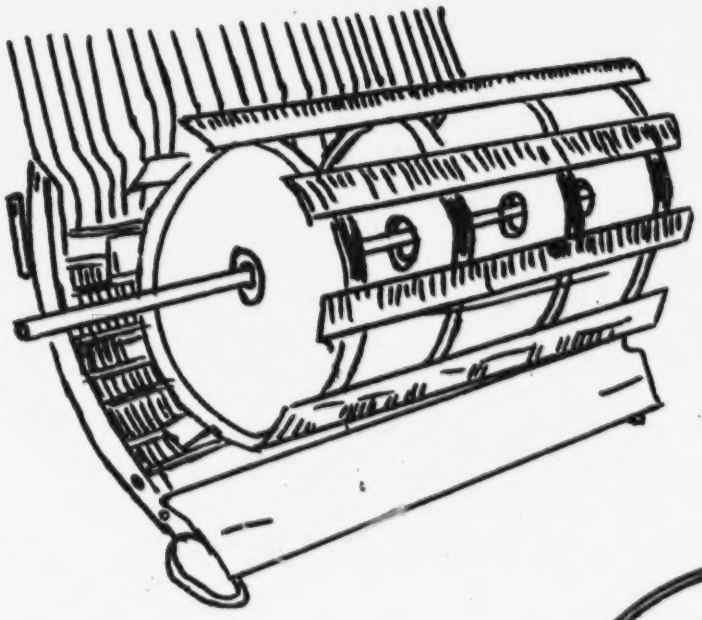


Rub bar cylinder

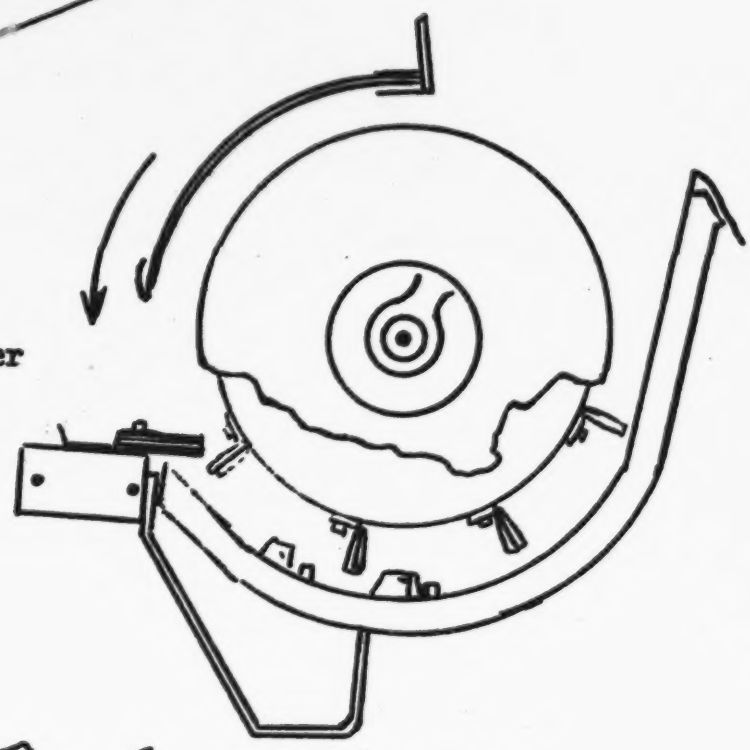


Spiled tooth cylinder

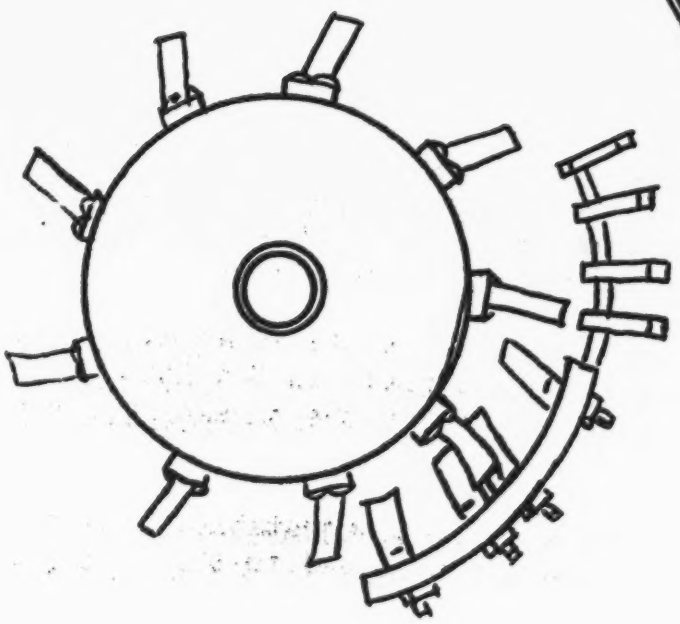
The following diagrams illustrate the types of cylinders mentioned on the preceding page:



Rasp bar cylinder

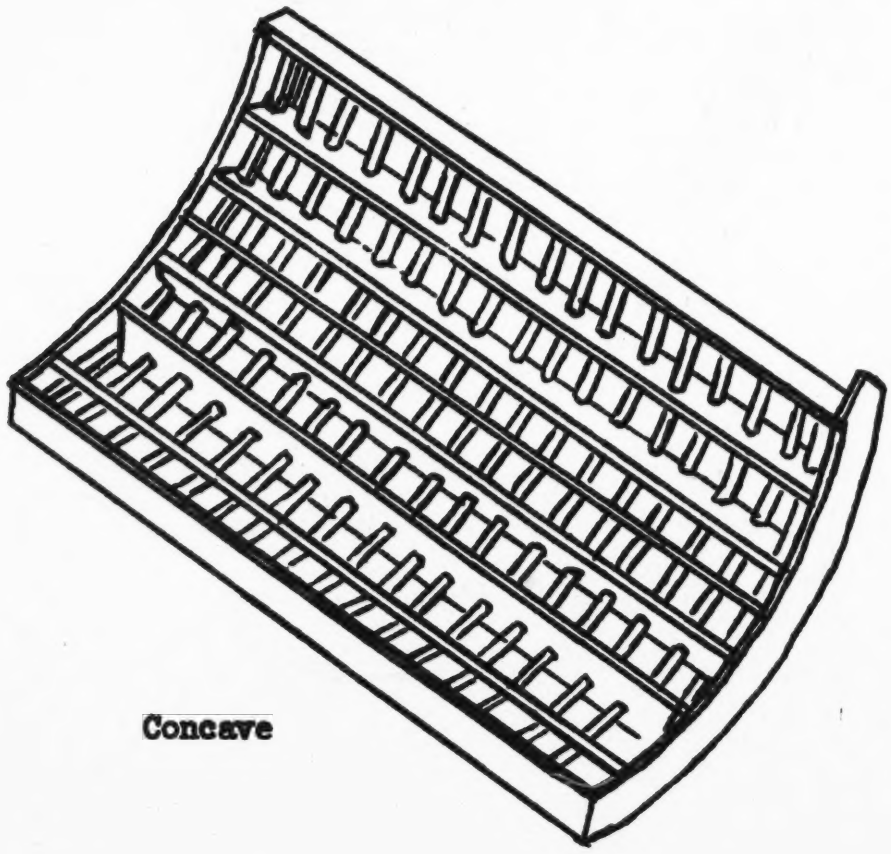


Rub bar cylinder



Spiled tooth cylinder

2. Concave: The concave is the stationary part that the cylinder works against in the threshing action. It is the rubbing action between the cylinder bars and the concave bars that removes the seed from the head or pod. Except for the Allis-Chalmers combine, the concave is a grate composed of rods and bars or wires. It is at the concave grate and finger grate that as much as 90% of the grain is separated from the straw or husk. The separated grain falls through the grate onto the shoe pan where it is delivered to the cleaning unit. The straw and the remaining grain passes on into the separation mechanism.



Concave

3. Cylinder beater: The beater behind the cylinder slows down the material coming from the cylinder, tears apart the straw, and delivers the material to the straw rack or the straw walker as it may be called. The beater helps in cleaning the straw from the cylinder thus preventing cylinder wrapping and feed back.

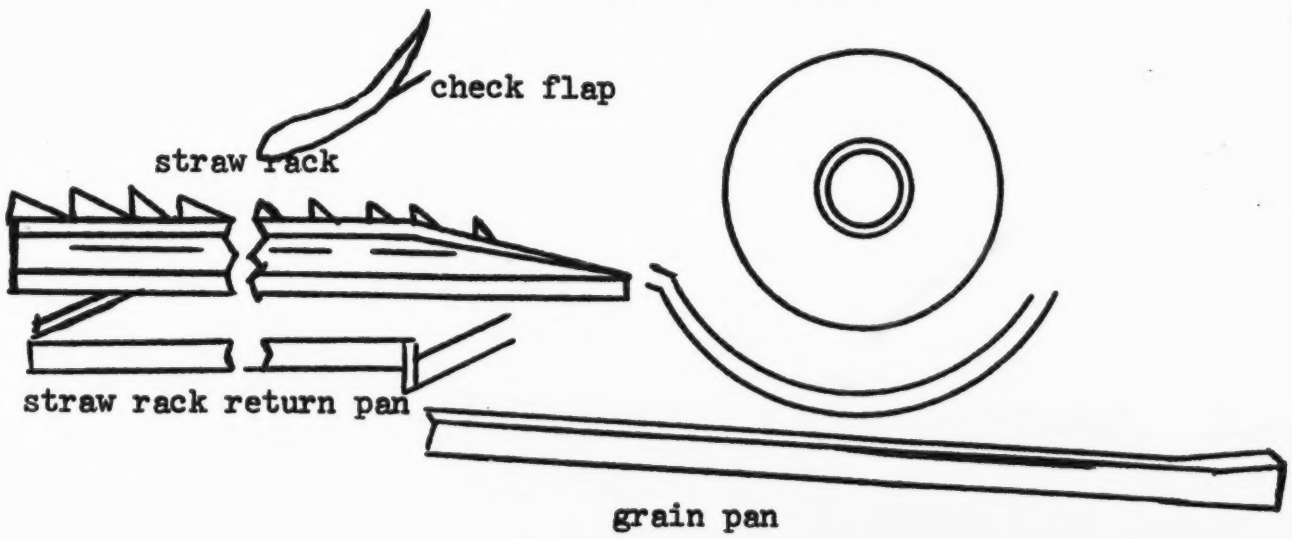
4. Shelling plate: The shelling plate is an adjustable plate located where the cut grain is fed into the cylinder concave unit. Much of the threshing can be done here.

   Some combines will not have an adjustable shelling plate, but will have a feed plate fastened to the front of the concave.

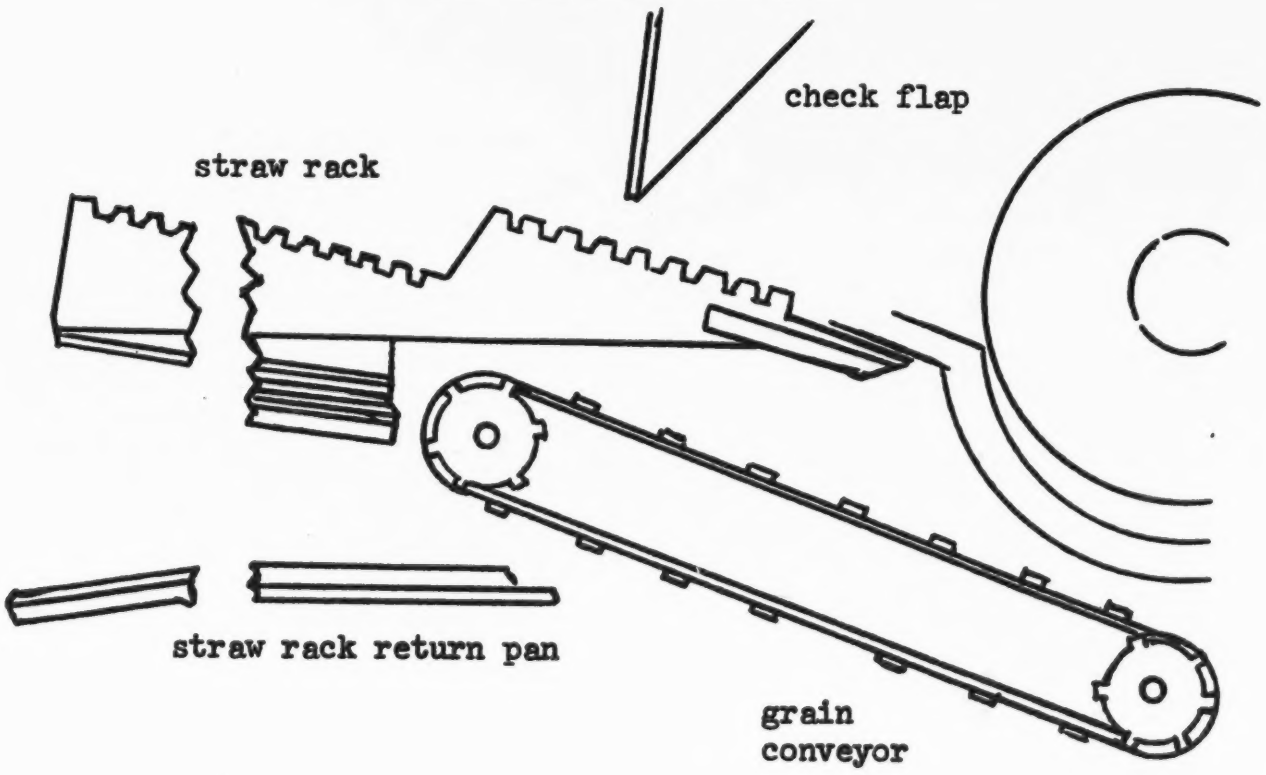
The separating mechanism agitates the straw after it comes from the threshing unit. This shakes out the loose grain remaining in the straw and delivers it to the cleaning unit. Since the threshing unit separated up to 90% of the grain, only about 10% remains to be separated in this unit. The straw is carried out of the combine by the rack.

There are several designs used to collect the grain from the straw rack and concave grate. These are illustrated below.

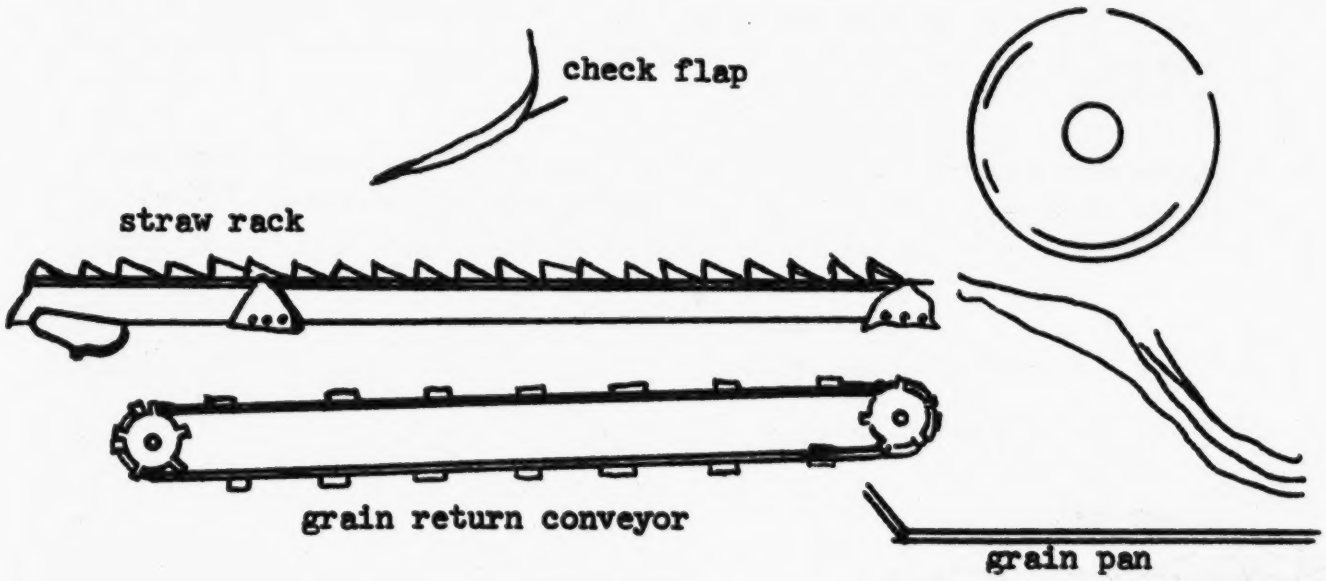
Separating mechanism using straw rack return pan under the straw rack



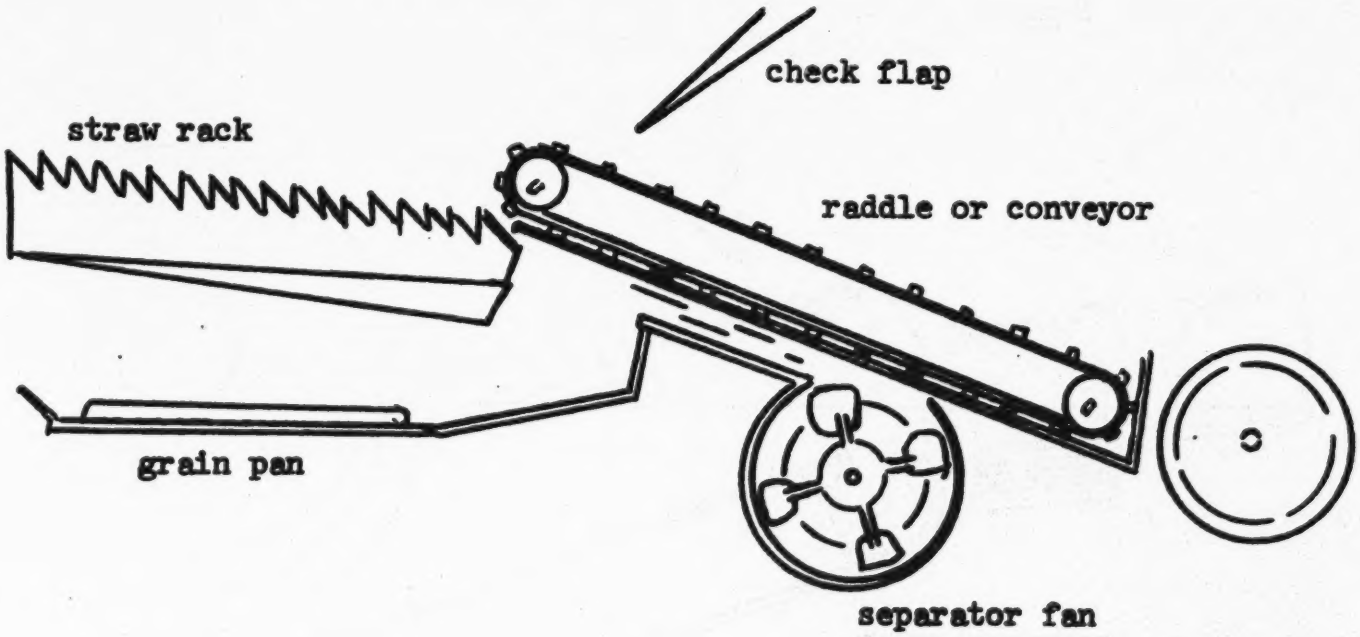
Separating unit using straw rack return pan and grain conveyor



Separating unit which uses a grain return conveyor under the straw rack



Separating mechanism which uses a grain return pan under the straw rack. A cleaning fan is also used in the separating section of this combine.

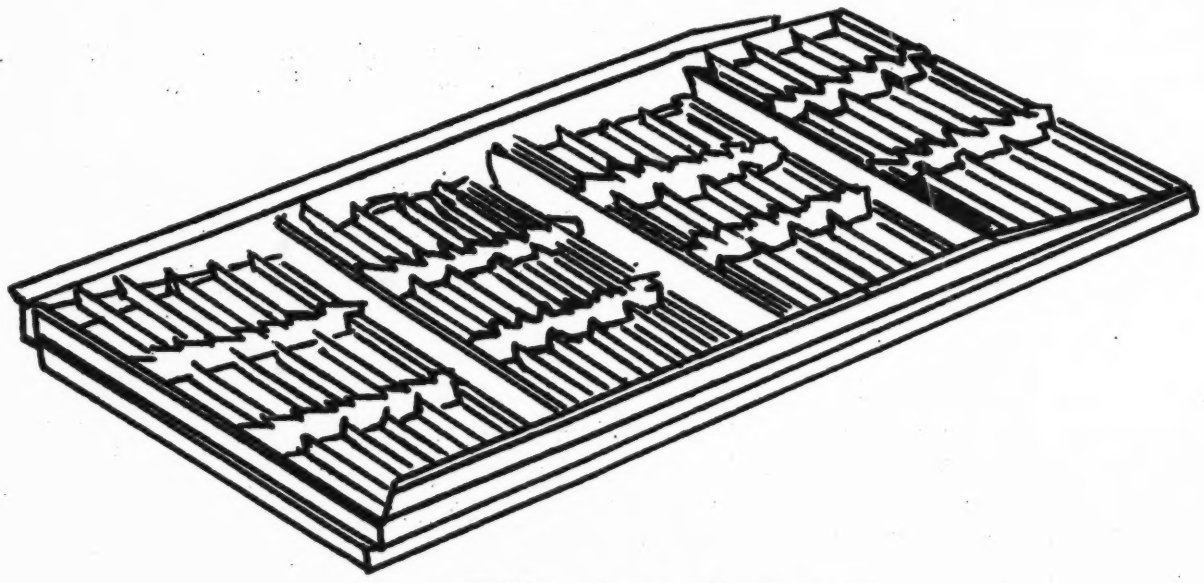


The main parts of the separating mechanism are:

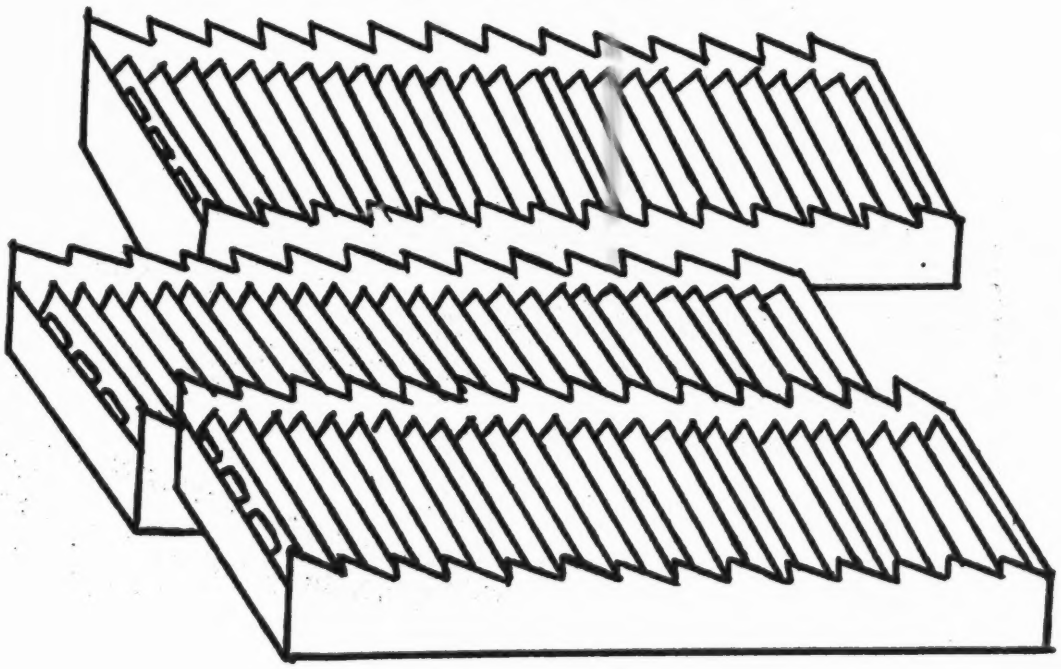
1. Concave grate and finger or cell grate which has been described in the threshing unit.

2. One-piece straw rack: The straw rack is a one-piece unit with risers pointed toward the rear of the combine. The straw rack is mounted on cranks located at the front and rear, which give it an oscillating motion. As the rack moves rearward and upward, the straw is tossed up and to the rear. As the rack returns forward and downward, the straw stays in mid-air for a short time and then falls onto a section of the rack nearer the end of the combine. In this way the straw moves step by step out of the combine. This tossing action causes the grain to be separated from the straw.

One-piece straw rack



Walker type straw rack



3. Walker type straw rack: Some large combines may use a walker type straw rack which operates on the same principle as the rack. The straw walker has three or more narrow sections placed side by side. Each section is mounted on multiple throw cranks located at the front and rear. The crank throws for each section are equally spaced around the circle of rotation; thus, the sections do not operate as a unit as the rack does.

4. Grain return pan: The grain return pan is located under the straw rack. It catches the grain as it falls through the rack and moves forward to the grain pan. The straw walker usually has a return pan under each unit.

5. Grain return conveyor: In place of the grain return pan some combines will use a conveyor to catch the grain and move it forward.

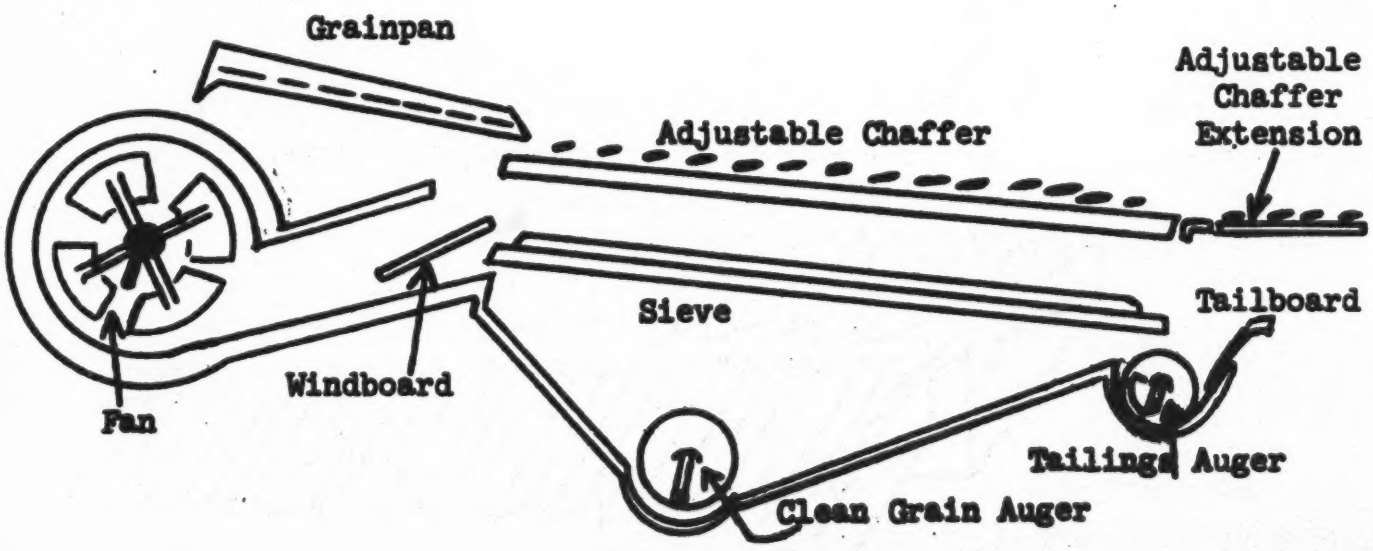
6. Grain pan: The grain pan is usually located under the forward part of the straw rack behind and below the cylinder. Its function is to catch the grain from the concave and cylinder grates and from the grain return pan or conveyor for delivery to the cleaning unit.

7. Grain conveyor: Some combines will use a conveyor in place of the grain pan to collect and deliver grain to the cleaning unit.

8. Check flaps or curtains: The check flaps or curtains deflect the straw and grain onto the rack as the full length of the rack is used for separation. They should not be in the way of the straw as the rack moves it to the rear.

The function of the cleaning mechanism is to separate the clean grain and send it to the grain tank, return the tailings (partially threshed heads) to the cylinder for rethreshing, and move the remaining material out of the combine. This is accomplished by means of gravity and air blast.

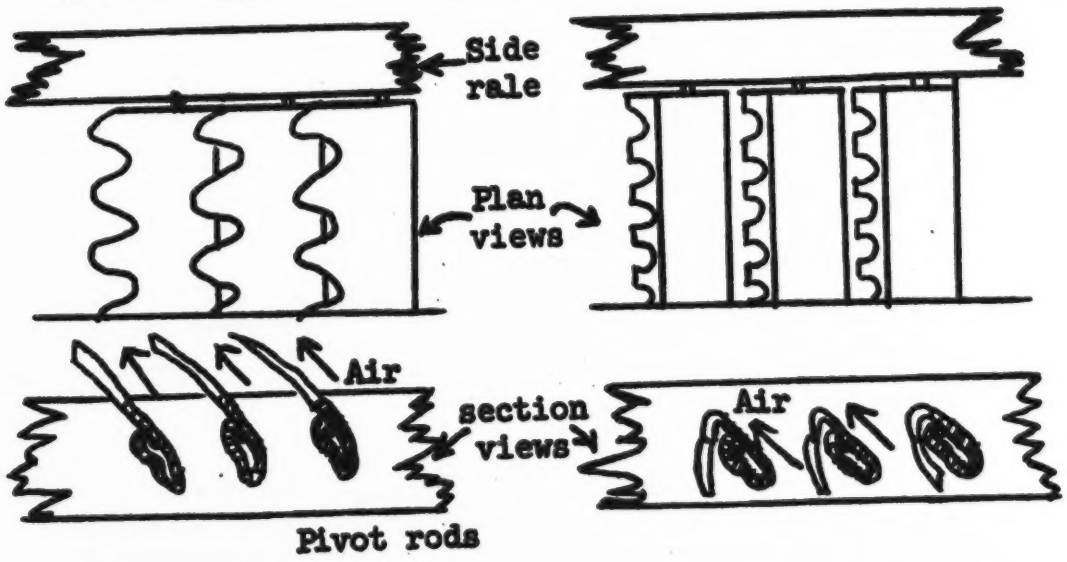
Cleaning unit



1. Adjustable chaffer: The adjustable chaffer acts as a sieve. It is made up of a series of cross pieces mounted on rods and fastened together so they can be moved at the same time to adjust the size of the openings.

   Side and flat views of the chaffer showing how the lips may be adjusted to control the amount and kind of materials passing through.

   Partial views of two types of adjustable chaffer sieves



2. Chaffer extension: As the name suggests, this is an extension of the chaffer. In addition to having adjustable lips, the chaffer extension will also swing up and down on the end of the chaffer. The unthreshed portions of grain heads fall through the chaffer extension into the tailings auger and the bulky material passes over the chaffer extension and out of the combine.

3. Sieve: The sieve is like the chaffer except that the lips and openings are smaller. The final job of cleaning is done here. The material that is too large to pass through the sieve is carried over the tailings auger and returned to the cylinder for rethreshing.

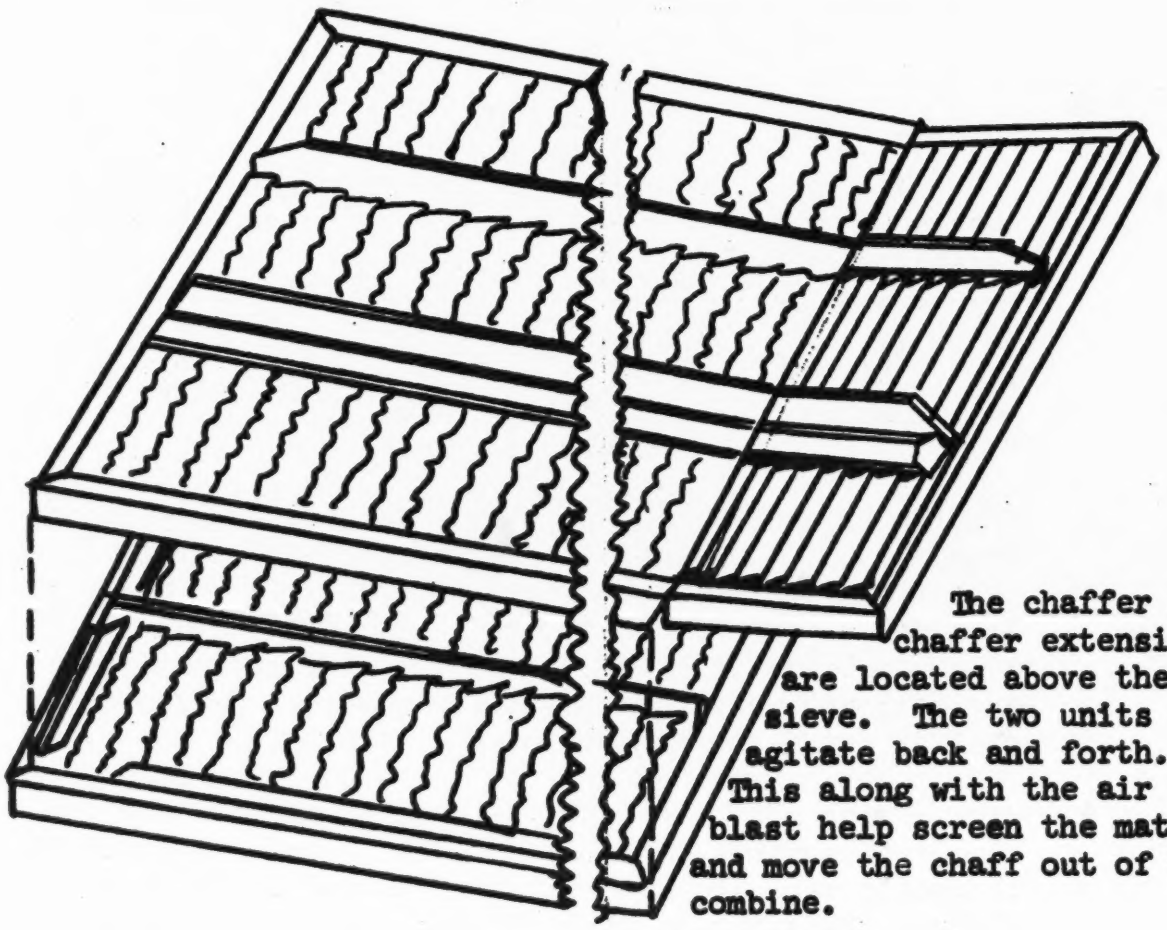
4. Special chaffer and sieve equipment: Many combines will have special screens available for some crops that are difficult to clean.

5. Cleaning fan: The fan furnishes a blast of air. The strength of the air blast is controlled by the speed of the fan and by shutters in the air intake. The direction of the air blast is controlled by windboards. The function of the air blast is to keep the material "alive" on the chaffer and sieve. The air blast should be

strong enough to lift the chaff slightly off the chaffer and sieve, but not strong enough to blow grain out of the combine.

6. Clean grain auger and clean grain elevator: The clean grain auger collects the cleaned grain and augers it to the clean grain elevator which delivers the clean grain to the grain tank.

7. Tailings auger and tailings elevator: The tailings auger collects all of the material which comes off the lower sieve plus any material which falls through the extension chaffer.



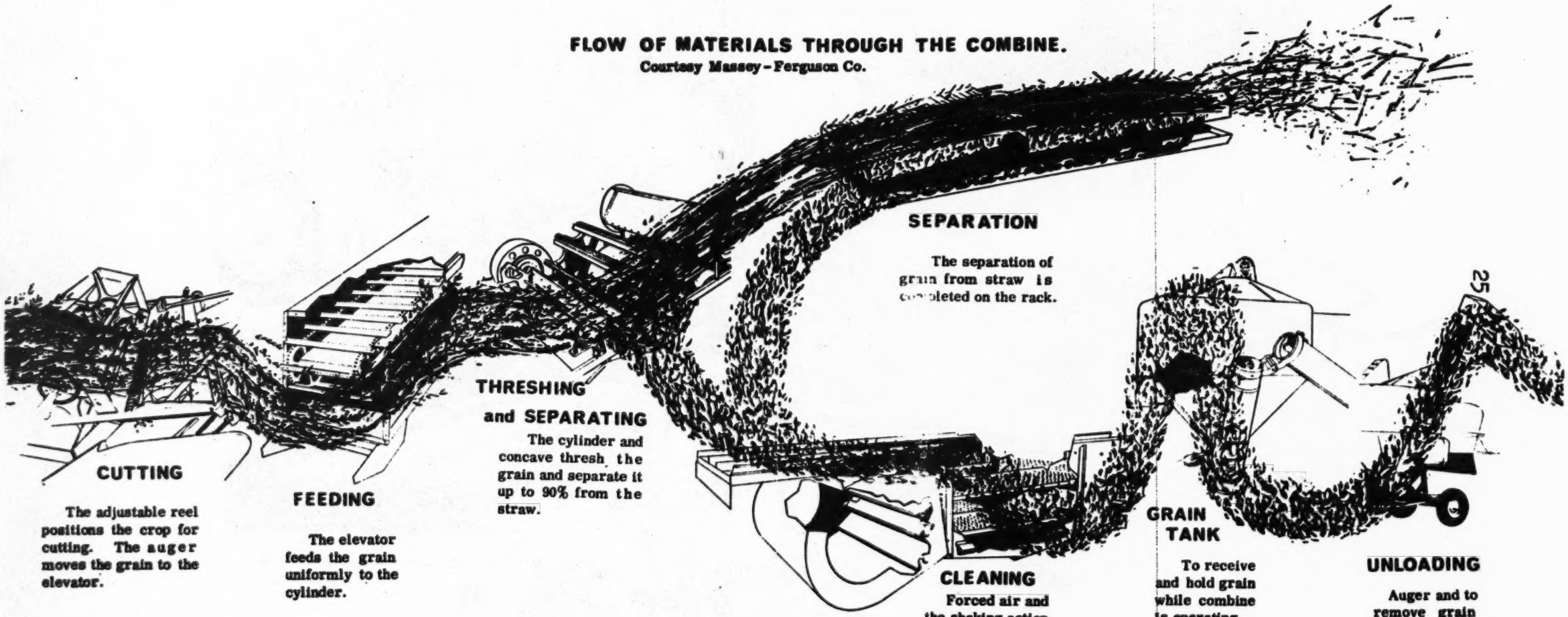
The chaffer and chaffer extension are located above the sieve. The two units agitate back and forth. This along with the air blast help screen the material and move the chaff out of the combine.

8. Tailboard: The tailboard keeps the unthreshed material from being carried out of the rear of the combine while still allowing the chaff to be blown out. It may be raised or lowered as needed.

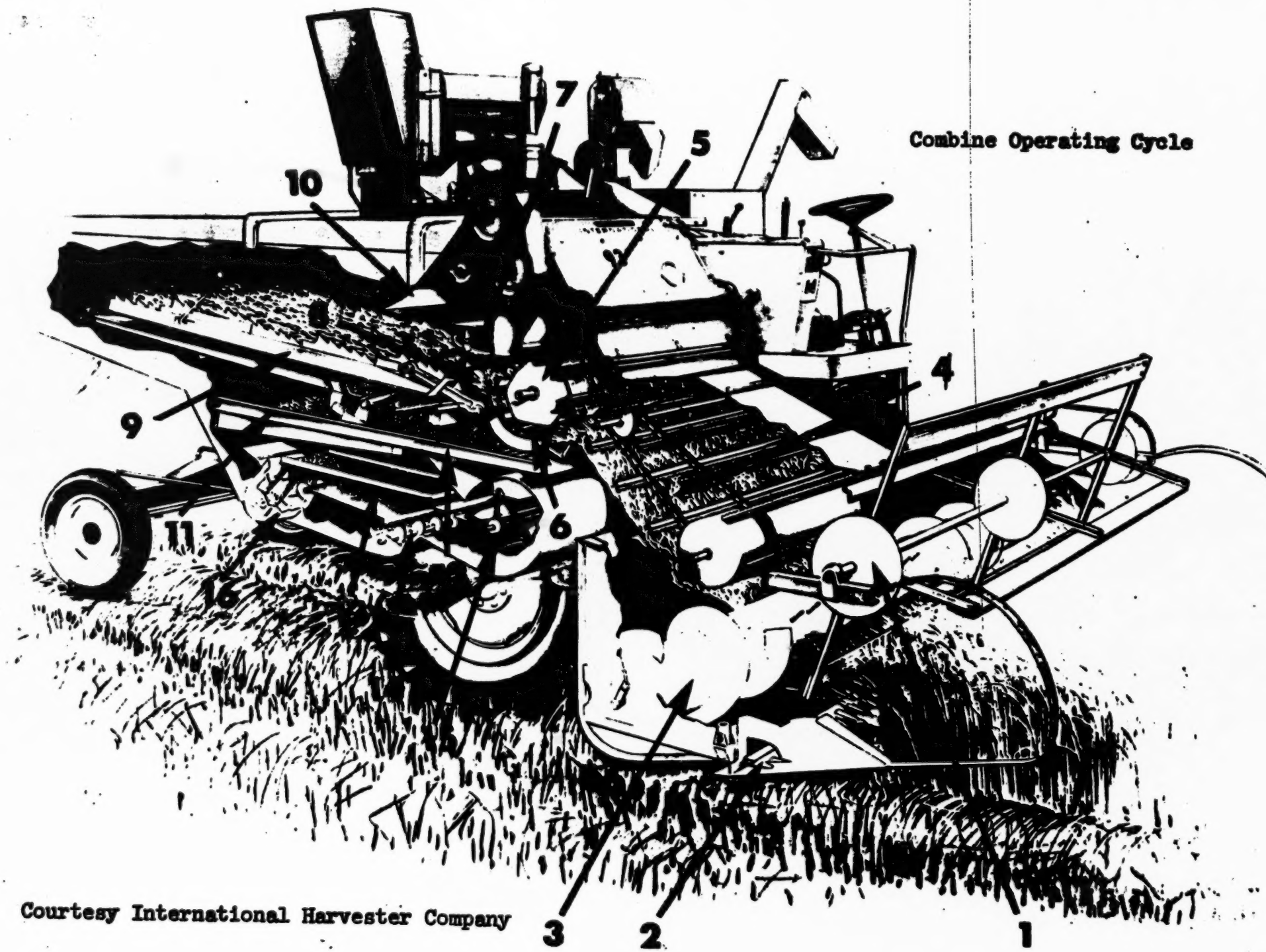
The following illustrations and description show the operation of the combine and the flow of the grain through it.

FLOW OF MATERIALS THROUGH THE COMBINE.

Courtesy Massey-Ferguson Co.



Combine Operating Cycle

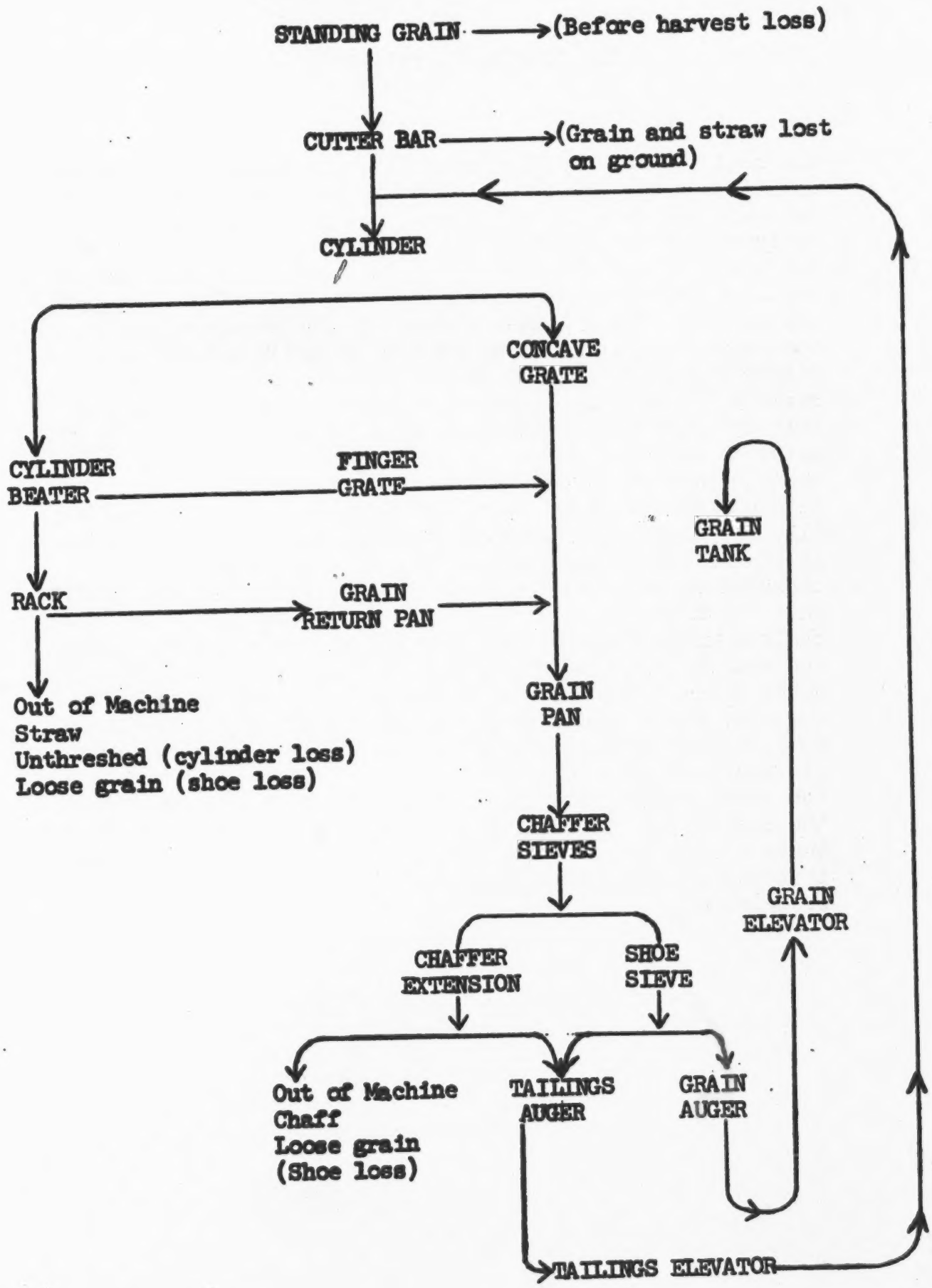


Courtesy International Harvester Company

The Combine Operating Cycle

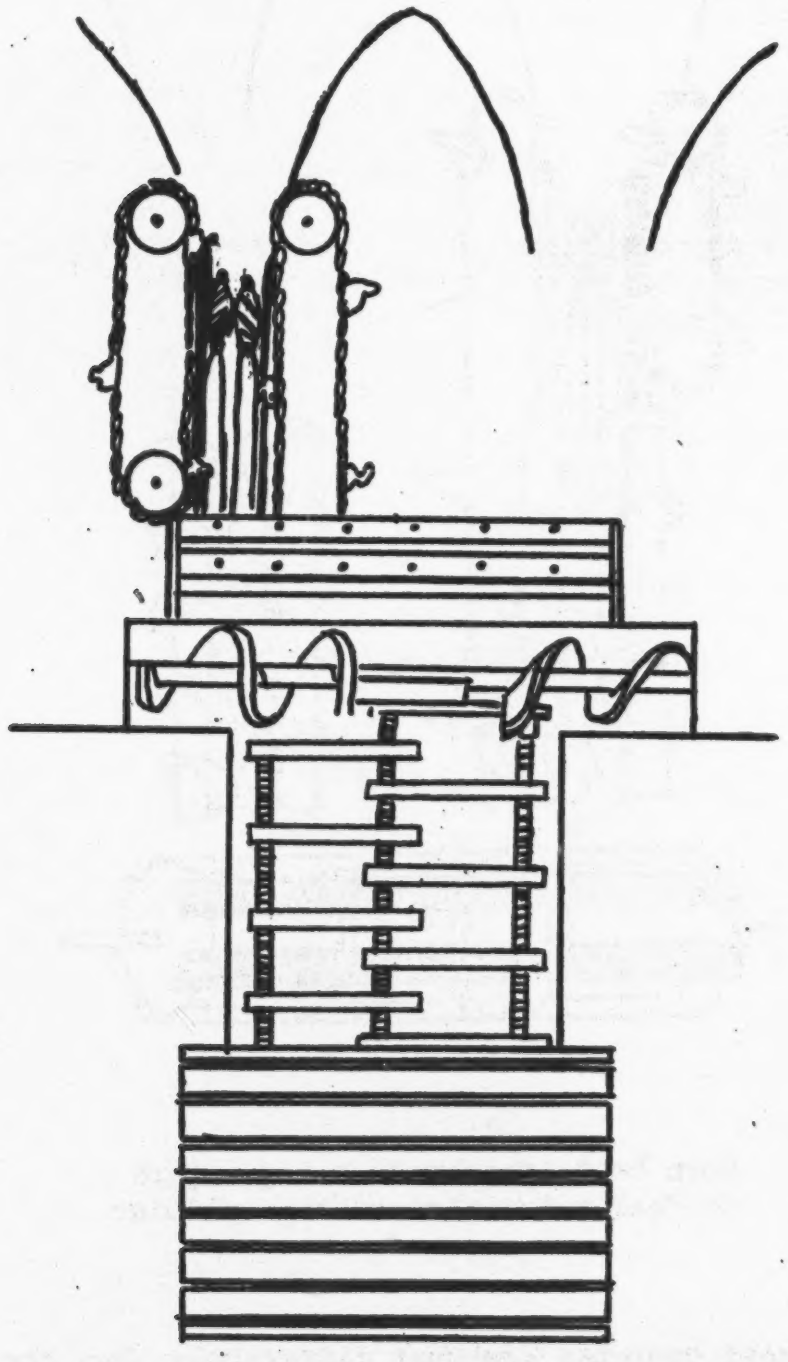
The reel (1) momentarily holds the crop against the guards until the knife (2) cuts the stems, and then it sweeps the cut material onto the platform. The platform auger (3) delivers the cut grain to the feeder (4) which carries the cut grain to the cylinder (5). The grain is rubbed out of the head between the rotating cylinder (5) and the concave grates (6). The cylinder beater (7) strips the cylinder, continues separating loose kernels of grain through the finger grate (8) then moves the material onto the straw rack (9) where final separation takes place. The adjustable cylinder beater check flap (10) regulates the flow of material over the racks. The grain pan (12) catches the grain separated at the concave, cylinder beater grate, and return from the straw racks and delivers it to the chaffer (11). The cleaning fan (15) supplies the wind blast which is the medium of separation. The shoe and sieve (13) operates in the direct opposite to the grain pan and chaffer which assures double action cleaning (as the grain pan and chaffer moves forward, the shoe and shoe sieve move toward the rear.) The shoe sieve (13) is where the final cleaning takes place. The threshed grain falls through the chaffer and shoe sieve, and into the grain trough (14) where it is moved to the grain elevator by the grain auger. The grain elevator conveyor chain then delivers the clean grain to the grain tank. Unthreshed heads will move rearward across the chaffer and shoe sieve and drop into the tailings return auger trough (16). From this point, the unthreshed heads are returned by the tailings elevator to the cylinder for rethreshing.

COMBINE FLOW CHART

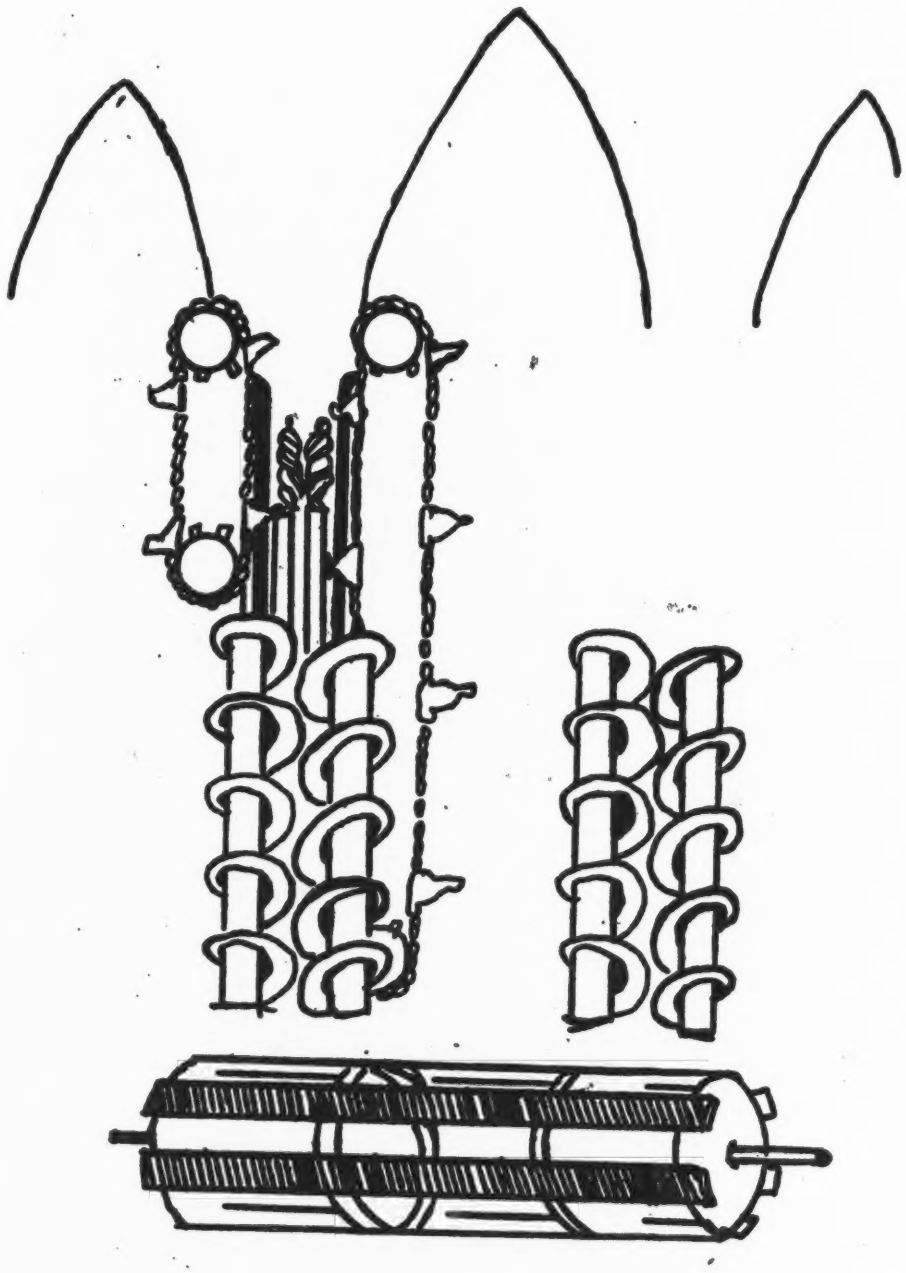


The combine can be converted from small grain to shelled corn harvesting by exchanging the small grain cutting and feeding unit for the corn head attachment.

The corn head snaps the ears from the stalks and feeds them into the cylinder for shelling in the manner illustrated below.

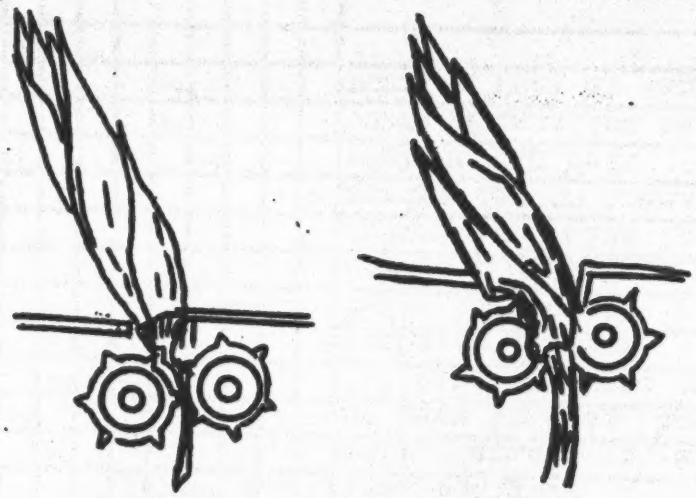


Corn head attachment using a conveyor to feed material into the cylinder



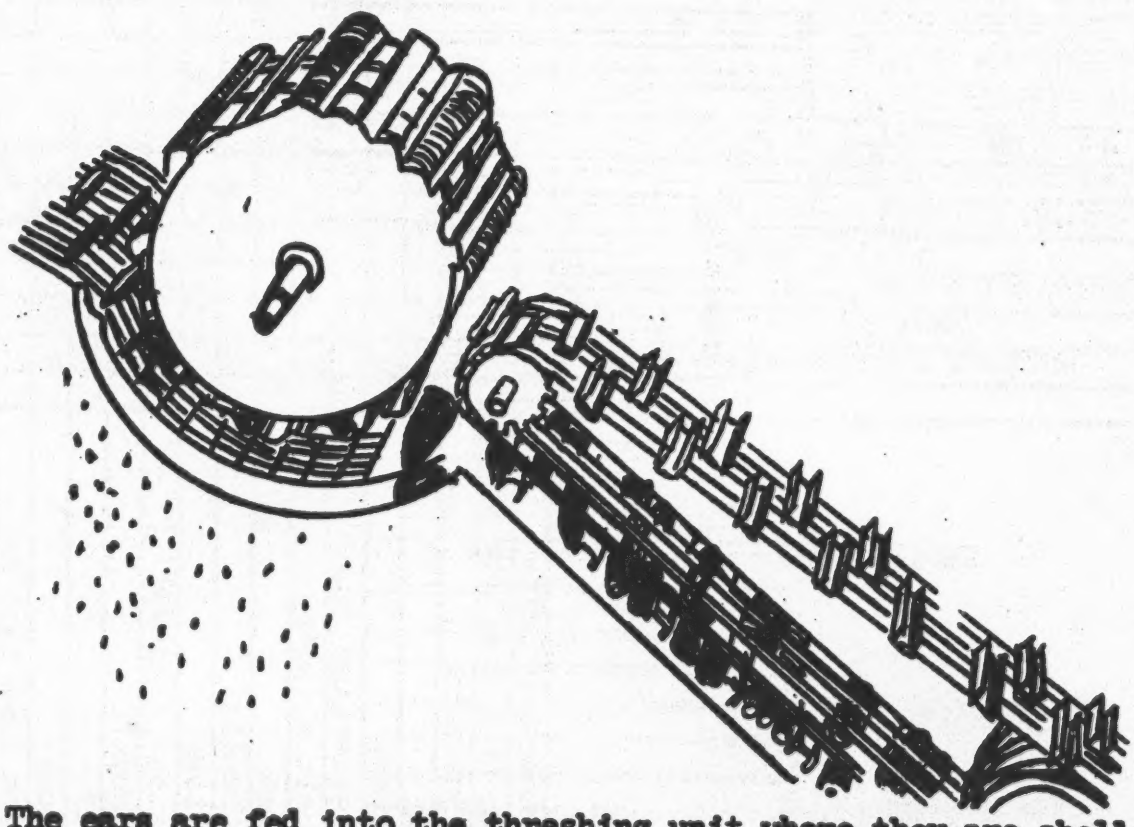
Corn head attachment using augers
to feed material into the cylinder

The corn head operates somewhat differently than the corn picker. The stalks of corn are pulled straight down through the stalk rolls. Snapping bars or stripper plates snap the ears off at the shanks. This action is illustrated on the following page.



Since the ears do not come in contact with the rolls, as in the picker, there is much less shelling in this area.

From the snapping mechanism, the ears are then fed into the cylinder for shelling.



The ears are fed into the threshing unit where they are shelled by the rubbing action of the rotating cylinder against the concave.

A variety of problems are common to all combines. On the following page these problems are identified and possible ways of correcting them are shown.

Courtesy, Massey - Ferguson Limited

Mechanical

SERVICE HINTS

PROBLEMS \ CORRECTIONS	adjust table balance springs	adjust table lift arms	adjust and lubricate drag links	adjust unloader belt	adjust belt clearance at motor pulley	belt not adjusted at transmission pulleys	clean radiator screen and core	check oil level in hydraulic pump	check pump drive belt for non slippage	control arm on speed valve not adjusted	check speed yoke for straightness	check for hydraulic oil leaks	check timing at distributor	check rear tire pressure	check to see that shoe does not hit body	damaged hydraulic lines or fittings	dealer service required	fill fuel tank	fill radiator	gears damaged in vari speed valve	no harm to pump (characteristic)	"O" ring on speed cylinder damaged	recharge battery	refer to operator's manual	remove stalks from sieves	restrictor valve in speed cylinder	spring can on transmission pulley weak	tighten fan belt	turn on ignition switch	turn on fuel at tank
belt slipping on traction drive					X	X																					X			
combine not coming to a complete stop					X					X																				
cylinder chain adjustment																								X						
engine overheating							X						X						X									X		
engine will not start													X					X					X						X	X
gears clash when selecting gears					X					X																				
grain unloading belt slipping				X																										
ground speed uneven								X			X									X		X								
knocking in pump (Bendix)																					X									
machine hard to steer			X											X										X						
machine hard to steer (hydraulic)			X					X	X			X		X		X								X						
sieves being damaged															X									X	X					
table will not lift.		X	X					X	X			X					X													
table will not lower		X	X					X	X								X													
vari-speed will not move machine								X	X	X		X					X			X						X				

Mechanical Problems Service Hints

Courtesy, Massey - Ferguson Limited

Threshing

SERVICE HINTS / PROBLEMS	CORRECTIONS	adjust auger fingers	adjust concave or cylinder	adjust cylinder cut off bar	adjust cylinder speed	adjust drive belt (flat)	adjust elevator chains	adjust fan mill speed	adjust feeder chain	adjust reel speed	check "key" shaft or drive	adjust sieves	adjust slip clutches	adjust table auger speed	adjust table auger	adjust upper sieve extension	adjust rack speed	adjust rack drive belt	adjust windboards	check curtain in body	check for plugged concave	check space between walkers	check front beater speed	close shutters on fan mill	crop too green	ground speed too fast	install filler plates	knife not centering	knife sections need replacing	ledger plates dull	machine running too slow
back feeding			X	X	X	X			X		X						X	X					X								
cracked grain			X		X		X																								
cylinder plugging			X	X	X																										
excess chaff					X			X			X	X																			
excess gleanings			X		X			X			X	X				X			X												
elevator to cylinder plugging				X					X				X	X																	
elevators stopping							X						X												X						
grain bunching in front of auger		X												X	X										X						
loss of grain over shoe			X		X	X		X			X	X																			
loss of grass seed over shoe			X		X	X		X			X	X												X		X	X				
loss from table		X				X				X				X																	
loss over walkers			X		X											X			X			X	X	X							
overthreshing			X		X																										
ragged stubble																												X		X	X
straw gathers on windscreen		X								X				X																	
straw spreader spreads unevenly											X							X													
unthreshed heads			X		X																								X		

Threshing Problems Service Hints

Suggested Teaching-Learning Activities

1. Bring a combine before the class disassembled to the point where all the movable parts can be seen, but yet, still functional. Demonstrate the operation of these parts before the class.

2. Have students disassemble a combine completely and learn its parts and their functions.

3. Demonstrate proper and improper combine operation under field conditions.

4. Bring to the class several combines of different makes that are in need of adjustment and repair. Follow the procedure below when making the needed adjustments and repairs.

   a. Operate the machine in the field noting any malfunctions in operation.

   b. Inspect the machine noting worn and broken parts and parts that are out of line or adjustment.

   c. Following the operator's and manufacturer's service manual, make the necessary repairs and adjustments.

   d. Lubricate the machine for field operation.

   e. Test the machine in the field and make any adjustments necessary for proper operation.

Suggested Instructional Materials and References

Instructional materials

1. A combine for complete disassembly

2. Machines for use in demonstrating proper and improper field operation

References

1. Machines for Power Learning, pp. 517-539.

2. Farm Machinery and Equipment, pp. 329-341,

3. Combines and Combining, pp. 1-77.

4. Operator's manuals

5. Manufacturer's service manuals

VI. To (1) identify types and parts of corn harvesting machines and understand their functions and (2) adjust and repair these machines

Teacher Preparation

Subject Matter Content

The purpose of corn harvesting machines is to remove the corn ears from the standing stalks.

Three kinds of machines have been developed to perform this function.

1. Corn snapper
2. Corn picker
3. Corn picker-sheller

The corn snapper is the simplest machine in that it only snaps the ears from the stalk, but does not remove the husks from around the ears. The corn picker is the most commonly used corn harvesting machine. It snaps the ear from the stalk and removes the husks from the ears. The fairly new corn harvesting machine is the picker-sheller. It performs both the snapping and husking activities and, in addition, shells the corn.

The types of pickers are classified by the way they receive power.

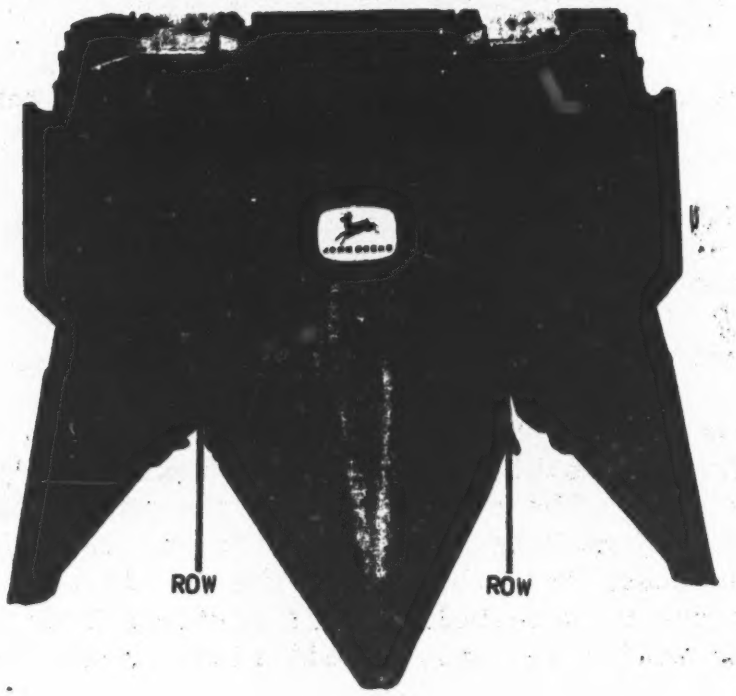
1. Pull-type -- tractor-drawn and driven by the PTO
2. Mounted-tractor -- mounted and driven by the PTO
3. Self-propelled -- driven by its own source of power

The corn picker is composed of several mechanisms that perform specific functions.

1. Gathering mechanism
2. Snapping mechanism
3. Husking mechanism
4. Cleaning mechanism
5. Shelling mechanism

The purpose of the gathering mechanism is to gather and guide the corn stalks into the snapping rolls. The gathering mechanism is made up of the following parts.

1. Points
2. Gathering chains
3. Dividers

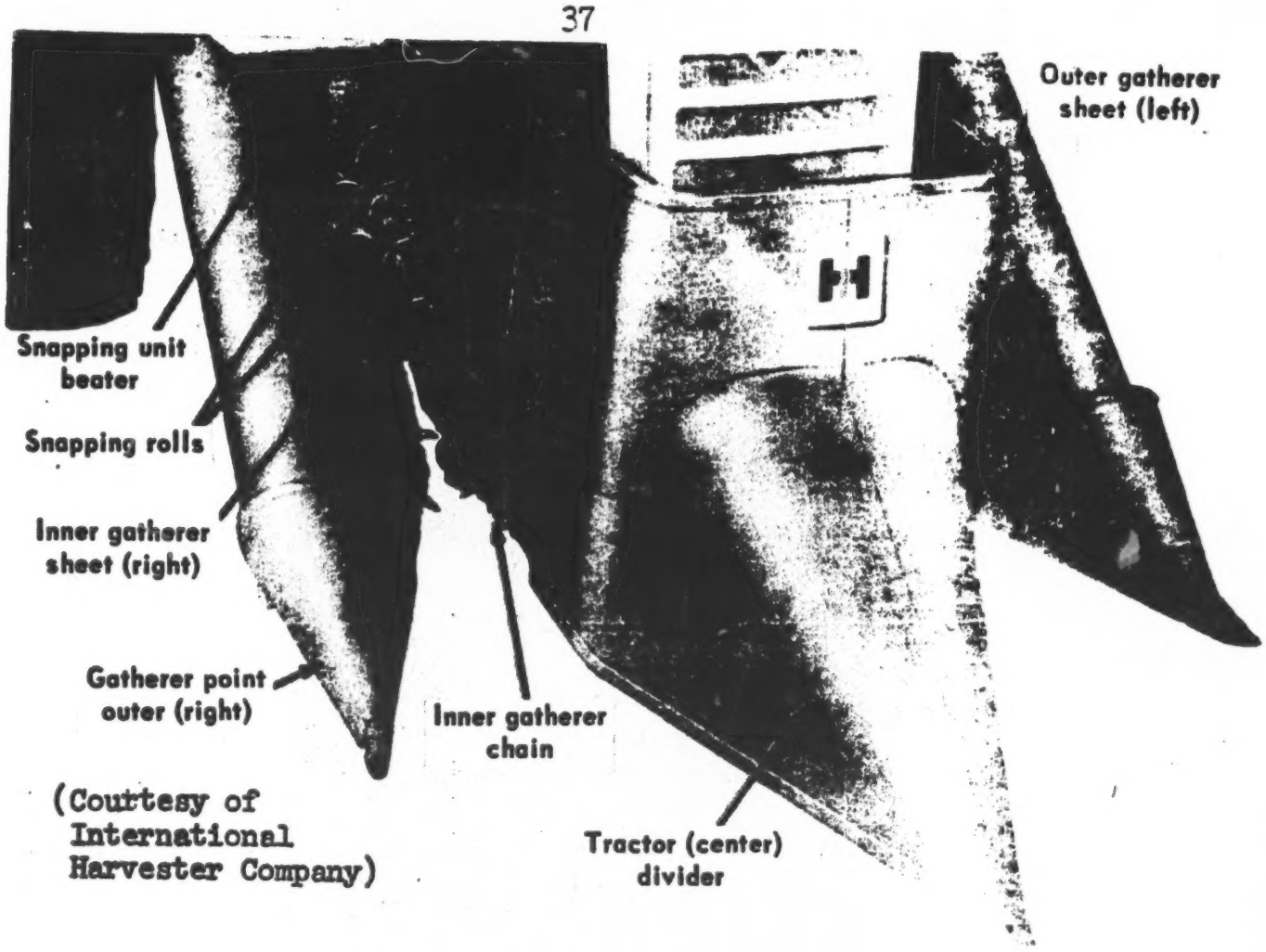


The Gathering Mechanism

1. Gathering points (Courtesy of John Deere Co.)
2. Gathering chains
3. Divider

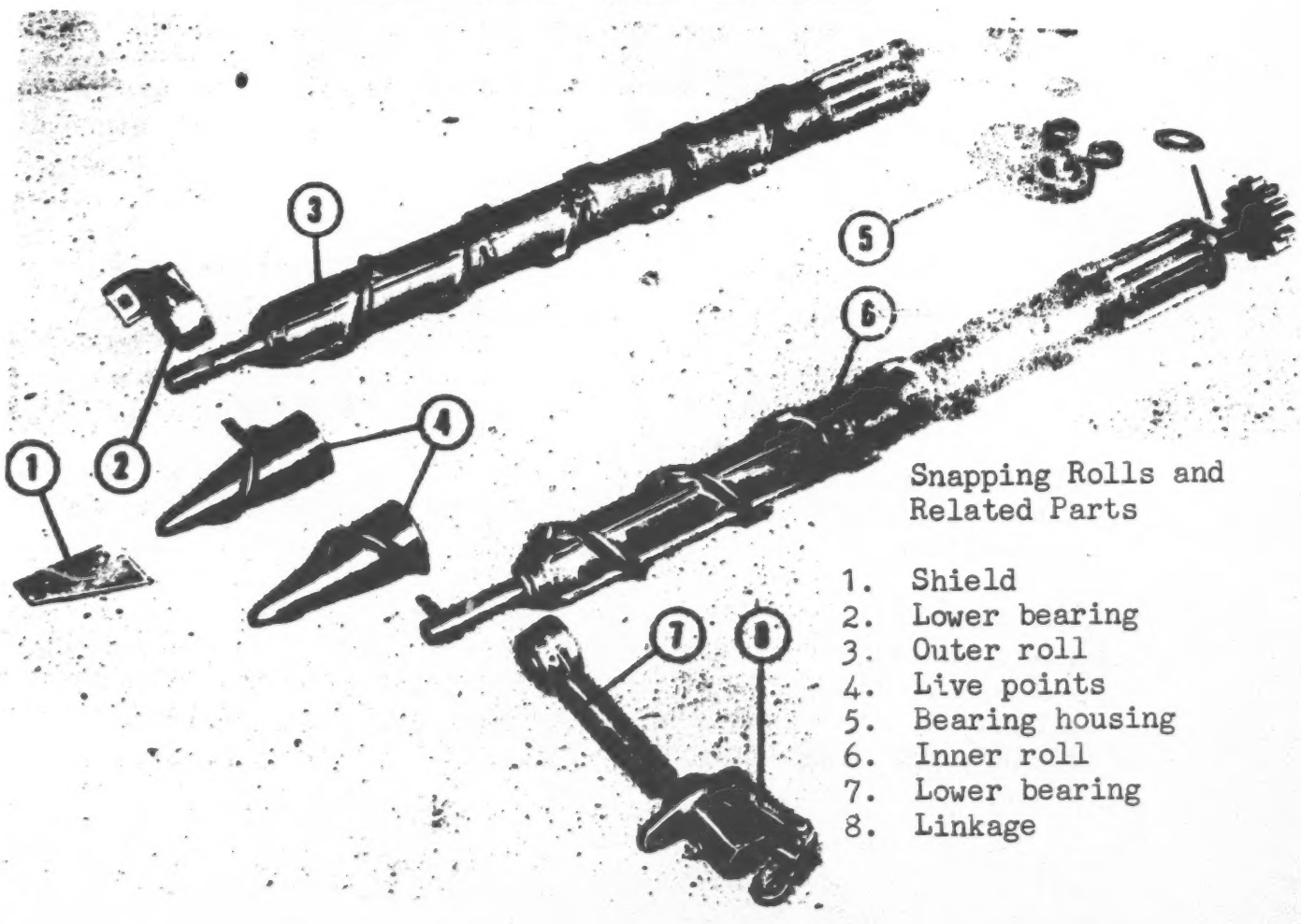
The gathering points direct the stalks into the throat of the gathering mechanism and up to the gathering chains. The gathering chains pull the stalks into the snapping rolls.

The snapping mechanism removes the corn ears from the corn stalk. This function is performed by two long, closely spaced rolls. The rolls slant upward and turn toward each other at a high speed. The snapping rolls are equipped with spiral lugs which grip onto the corn stalks and pull them down through the rolls. As the stalks are pulled down through the snapping rolls, the corn ear is pinched off the stalk and conveyed on to the husking rolls. The following illustrations show the gathering and snapping mechanisms and the parts breakdown of the snapping rollers.



(Courtesy of International Harvester Company)

GATHERING AND SNAPPING MECHANISMS



Snapping Rolls and Related Parts

1. Shield
2. Lower bearing
3. Outer roll
4. Live points
5. Bearing housing
6. Inner roll
7. Lower bearing
8. Linkage

After the ears have been snapped from the stalks, they are conveyed to the husking rolls. The husking rolls operate in pairs. One wall is usually rubber or rubber coated and the rolls rotate toward each other, similar to the action of the snapping rolls. The rolls are corrugated allowing the rolls to grasp and pull the husks from the ear. The husking mechanism of a corn picker is illustrated below.

Two types of husking rolls are commonly used on corn pickers.

1. Continuous or combination

   This type of husking roll is a continuation of the snapping roll. (See Farm Machinery and Equipment, page 347, for an illustration of this type of husking roll.)

2. Separate husking rolls (Illustrated above)

The corn ears are held against the husking rolls by a pressure plate allowing for a good clean job of husking with a minimum of shelling of kernels from the cob.

The cleaning mechanism on the corn picker consists of ejecting rolls and augers that remove trash and husks from the husking rolls, and discharge it to the ground and a fan that delivers a blast of air to blow off loose husks, leaves, pieces of stalks, and other trash.

As the husking rolls remove the husks from the ear, kernels may be shelled from the cob. These kernels drop onto the corn saver and are elevated into the wagon. The corn saving mechanism consists of a screen and a chain carrier. The chain carrier rakes off husks and trash keeping the screen clear.

The picker-sheller type of corn picker has an added mechanism, the shelling mechanism. Its function is to shell the corn ears as they come from the husking rolls. The shelling mechanism consists of a peg-studded cylinder that rotates inside a cylindrical screen. The shelled corn drops through the holes in the screen onto a set of sieves that agitate. The trash that comes through the cylindrical screen is blown away by a blast of air created by a fan located below the cylinder. The shelled corn falls through the sieves into the auger where it is augered into the wagon.

Suggested Teaching-Learning Activities

1. Bring a corn picker before the class disassembled to the point where all the movable parts can be seen, but yet, they are still functional. Demonstrate the operation of these parts before the class.

2. Have students disassemble completely a corn picker and learn its parts and their functions.

3. Demonstrate proper and improper corn picker operation under field conditions.

4. Bring to the class several combines of different makes that are in need of adjustment and repair. Follow the procedure below when making the needed adjustments and repairs.

   a. Operate the machine in the field noting any malfunctions in operation.

   b. Inspect the machine noting worn and broken parts and parts that are out of line or adjustment.

   c. Following the operator's and manufacturer's service manuals, make the necessary repairs and adjustments.

   d. Lubricate the machine for field operation.

   e. Test the machine in the field and make any adjustments necessary for proper operation.

Suggested Instructional Materials and References

Instructional materials

1. Corn pickers for complete disassembly

2. Machines for use in demonstrating proper and improper field operation

References

1. Machines for Power Learning, pp. 540-560.

2. Farm Machinery and Equipment, pp. 343-353.

3. Operator's manuals

4. Manufacturer's service manuals

VII. To prepare and paint crop harvesting machines after they have been repaired

Teacher Preparation

Subject Matter Content

If the persons being taught this module has not been taught the competency on preparing and painting crop harvesting machines included in the module on "Tractor Repair," they should be taught that competency at this time. The procedures outlines in that competency apply to painting crop harvesting machines as well as tractors.

Suggestions for Evaluating Educational Outcomes of the Module

The following criteria should be used to evaluate the educational outcome of this module.

1. Attentiveness in class and participation in laboratory activities

2. The ability of the student to use the operator's and manufacturer's service manuals

3. The ability of the student to perform the repair and adjustment activities on machines. As a final outcome, it is suggested that each student completely recondition a machine in need of repair and adjustment.

4. Employers evaluation of the ability of the student to adjust, repair, and service machines in his dealership

Source of Suggested Instructional Materials and References

1. Ridenour, H. E. Combines and Combining, Columbus, Ohio: The Ohio State University, Agricultural Administration Building, 2120 Fyffe Road, Department of Agricultural Education, 1965. Price: $.75.

2. Stone, A. A. and Gulvin, H. F. Machines for Power Farming, New York, New York: John Wiley and Sons, Inc., 1957. Price: $5.95.

3. Smith, N. P. Farm Machinery and Equipment, Fifth Edition, New York, New York: McGraw-Hill Book Company, 1964. Price: $10.50.

4. Operator's and manufacturer's service manuals from major line agricultural machinery manufacturers.

THE CENTER FOR RESEARCH AND LEADERSHIP DEVELOPMENT
IN VOCATIONAL AND TECHNICAL EDUCATION
THE OHIO STATE UNIVERSITY
980 KINNEAR ROAD
COLUMBUS, OHIO, 43212

INSTRUCTOR NOTE: As soon as you have completed teaching each module, please record your reaction on this form and return to the above address.

1. Instructor's Name _____

2. Name of school _____ State _____

3. Course outline used: _____Agriculture Supply--Sales and Service Occupations
_____Ornamental Horticulture--Service Occupations
_____Agricultural Machinery--Service Occupations

4. Name of module evaluated in this report _____

5. To what group (age and/or class description) was this material presented? ____
_____

6. How many students:
   a) Were enrolled in class (total) _____
   b) Participated in studying this module _____
   c) Participated in a related occupational work experience program while you taught this module _____

7. Actual time spent teaching module:

		Recommended time if you were to teach the module again:
_____hours	Classroom Instruction	_____hours
_____hours	Laboratory Experience	_____hours
_____hours	Occupational Experience (Average time for each student participating)	_____hours
_____hours	Total time	_____hours

(RESPOND TO THE FOLLOWING STATEMENTS WITH A CHECK (✓) ALONG THE LINE TO INDICATE YOUR BEST ESTIMATE.)

	VERY APPROPRIATE	NOT APPROPRIATE
8. The suggested time allotments given with this module were:	. . . .	
9. The suggestions for introducing this module were:	. . . .	
10. The suggested competencies to be developed were:	. . . .	
11. For your particular class situation, the level of subject matter content was:	. . . .	
12. The Suggested Teaching-Learning Activities were:	. . . .	
13. The Suggested Instructional Materials and References were:	. . . .	
14. The Suggested Occupational Experiences were:	. . . .	

(OVER)

15. Was the subject matter content sufficiently detailed to enable you to develop the desired degree of competency in the student? Yes_____No_____
Comments:

16. Was the subject matter content directly related to the type of occupational experience the student received? Yes_____No_____
Comments:

17. List any subject matter items which should be added or deleted:

18. List any additional instructional materials and references which you used or think appropriate:

19. List any additional Teaching-Learning Activities which you feel were particularly successful:

20. List any additional Occupational Work Experiences you used or feel appropriate:

21. What do you see as the major strength of this module?

22. What do you see as the major weakness of this module?

23. Other comments concerning this module:

_____ _____
(Date) (Instructor's Signature)

_____
(School Address)

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

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ADJUSTMENT, MAINTENANCE, AND REPAIR OF SMALL GASOLINE ENGINES

One of Sixteen Modules in the Course Preparing for Entry in

AGRICULTURAL MACHINERY - SERVICE OCCUPATIONS

Module No. 12

The Center for Research and Leadership Development
in Vocational and Technical Education

The Ohio State University
980 Kinnear Road
Columbus, Ohio, 43212

The development of these materials was supported by a grant
from the
Division of Adult and Vocational Research
United States Office of Education

August, 1965

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MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) James W. Hensel (Agency) The Center for Vocational and Technical Education

(Address) 980 Kinnear Road, Columbus, Ohio 43212

DATE: August 4, 1967

RE: (Author, Title, Publisher, Date) Module No. 12, "Adjustment, Maintenance, and Repair of Small Gasoline Engines," The Center for Vocational and Technical Education, August, 1965.

Supplementary Information on Instructional Material

Provide information below which is not included in the publication. Mark N/A in each blank for which information is not available or not applicable. Mark P when information is included in the publication. See reverse side for further instructions.

(1) Source of Available Copies:
Agency The Center for Vocational and Technical Education
Address 980 Kinnear Road, Columbus, Ohio 43212
Limitation on Available Copies No Limit Price/Unit $ 7.50/set
(quantity prices)

(2) Means Used to Develop Material:
Development Group National Task Force
Level of Group National
Method of Design, Testing, and Trial Part of a funded project of the USOE, OE-5-85-009; materials based on research from state studies; see preface material in the course outline.

(3) Utilization of Material:
Appropriate School Setting Post high school
Type of Program General post high school class in agricultural machinery
Occupational Focus Agricultural machinery service occupations
Geographic Adaptability Nationwide
Uses of Material Instructor course planning
Users of Material Teachers

(4) Requirements for Using Material:
Teacher Competency Background in agricultural machinery
Student Selection Criteria Post high school, mechanical aptitude, high school background, goal in agricultural machinery service occupation.
Time Allotment Estimated time listed in module. (P)

Supplemental Media --
Necessary x
Desirable ____ (Check Which)

Describe Suggested references given in module. (P)

Source (agency)
(address)

ADJUSTMENT, MAINTENANCE, AND REPAIR OF
SMALL GASOLINE ENGINES

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II. To understand combustion principles of internal combustion engines	5
III. To understand ignition principles of small gasoline engines	7
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Suggestions for Evaluating Educational Outcomes of the Module	22
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_____

6. How many students:
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7. Actual time spent teaching module:

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(RESPOND TO THE FOLLOWING STATEMENTS WITH A CHECK (✓) ALONG THE LINE TO INDICATE YOUR BEST ESTIMATE.)

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11. For your particular class situation, the level of subject matter content was:	___.___.___.___	
12. The Suggested Teaching-Learning Activities were:	___.___.___.___	
13. The Suggested Instructional Materials and References were:	___.___.___.___	
14. The Suggested Occupational Experiences were:	___.___.___.___	

(OVER)

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Comments:

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19. List any additional Teaching-Learning Activities which you feel were particularly successful:

20. List any additional Occupational Work Experiences you used or feel appropriate:

21. What do you see as the major strength of this module?

22. What do you see as the major weakness of this module?

23. Other comments concerning this module:

_____ (Date)

_____ (Instructor's Signature)

_____ (School Address)

ADJUSTMENT, MAINTENANCE, AND REPAIR OF SMALL GASOLINE ENGINES

Major Teaching Objective

To develop the ability to adjust, maintain, and repair small gasoline engines effectively.

Suggested Time Allotment

At school		
Class instruction	40 hours	
Laboratory experience	68 hours	
Total at school		108 hours
Occupational experience		0 hours
Total for Module		108 hours

Suggestions for Introducing the Module

The extensive use of small gasoline engines makes necessary the ability of many employees in agricultural machinery business to adjust, maintain, and repair small internal combustion engines. This is especially true for those employed as service supervisors, machinery mechanics, and machinery mechanics' helpers. The effective and efficient employee in this area has a thorough understanding of the nomenclature of small engines, an understanding of the relationship of the components to each other, a knowledge of tools common to this segment of mechanics, and the ability to apply these understandings and knowledge to practical situations.

The following may be used in creating interest in the module. Bring to class several different makes of small gasoline engines, selected on the basis of their operating efficiency. Before the class, start these engines to demonstrate their various operating speeds. Have the class attempt to determine why these engines run at different speeds. Point out that the differences in running speeds of the various engines are probably due to malfunctions that could probably be corrected with adjustment. As the students progress through the module, have them check these motors until they have identified the reasons they run at different speeds.

The teacher should impress upon the students that employers are expecting an increasingly higher degree of speed and efficiency from employees in the performance of their jobs. This demands the development of performance skills as well as understandings.

Competencies to be Developed

I. To understand small gasoline engine nomenclature

Teacher Preparation

Subject Matter Content

A knowledge of the nomenclature of small gasoline engines and the function of each part is essential. The components of small gasoline engines vary according to manufacturers, but the following are applicable in most cases.

1. Main engine components

   a. Crankcase and cylinder block
   b. Cylinder head
   c. Spark plug grounding switch
   d. Crankcase breather
   e. Bearing plate
   f. Valves, springs, and keepers
   g. Tappet cover plate
   h. Governor control lever
   i. Governor weight assembly and shaft
   j. Valve tappets
   k. Spark advance weight and spring
   l. Cam gear
   m. Engine base
   n. Cam shaft and plug
   o. Governor crank assembly
   p. Governor lever assembly
   q. Throttle link
   r. Governor control rod
   s. Main bearings
   t. Piston, ring and pin assembly
   u. Connecting rod and oil slinger
   v. Crank shaft
   w. Reduction gear assembly

2. Air, fuel, and exahust system components

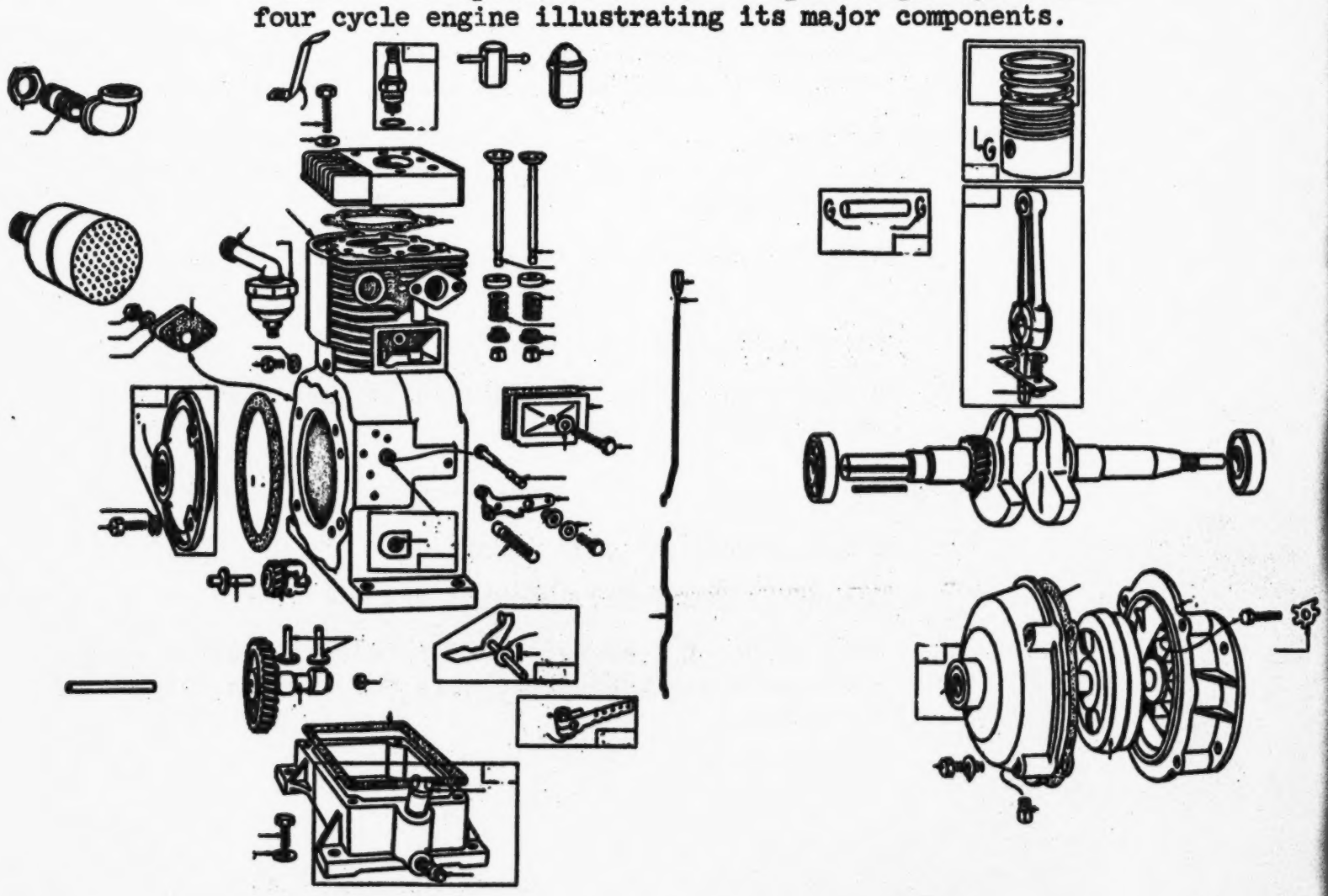
   a. Fuel tank
   b. Fuel tank outlet
   c. Exhaust outlet and muffler
   d. Carburetor lower body
   e. Carburetor upper body
   f. Throttle
   g. Butterfly (choke and/or throttle)
   h. Idle valve

i. Needle valve
j. Idle adjustor screw
k. Throttle lever
l. Choke lever
m. Float
n. Air cleaner

3. Ignition system components

a. Engine flywheel
b. Magneto (on magneto type)
c. Magneto armature (on magneto type)
d. Ignition coil (magneto and battery type)
e. Bearing plate
f. Breaker box cover and stop switch assembly
g. Breaker points
h. Point gap adjusting cam
i. Condenser
j. Breaker base
k. Breaker shaft
l. Spark plug
m. Flywheel housing
n. Distributor (on battery type)
o. Battery (on battery type)

Below is an exploded view of a sample single cylinder--four cycle engine illustrating its major components.



Suggested Teaching-Learning Activities

1. At the beginning of the class, place several small gas engine parts around the classroom and have each student attempt to identify them.

2. Demonstrate the terms work, torque, and horsepower to the class as they are being discussed. As these terms are being demonstrated, have the students compute work done, the amount of torque created, and the amount of horsepower created.

3. As the engine components are being discussed, have each student dismantle a small gasoline engine and identify on his engine the parts being discussed.

4. After all terms have been discussed by the teacher, tear a small gasoline engine down completely and have students identify the parts.

5. Supply students with a list of terms common to the language associated with small gasoline engines. Have students define the terms they know and find the definitions of those they do not know. Other terms may be added to the list in the content.

Suggested Instructional Materials and References

Instructional materials

1. Overhead transparencies, preferably overlays, of the illustrations presented in the content

2. A fulcrum, a 1" x 4" x 5' board, and four 2" x 4" x 8" bricks for demonstrating work, torque and horsepower

3. A small gasoline engine for each member of the class and the instructor

4. Several small gasoline engine parts

5. A set of tools for each student to use when tearing down his engine

References

S*1. Small Engines Service Manual, pp. 20-23, 55-63.

S*2. All About Small Gas Engines, pp. 277-301.

*The symbol T (teacher) or S (student) denotes those references designed especially for the teacher or the student.

II. To understand combustion principles of internal combustion engines

Teacher Preparation

Subject Matter Content

The information presented in General Theories of Operation, pp. 3-10 should be used as the main reference in teaching this competency and supplemented with the following materials. The information should be presented to the class in the order that it is presented in this module.

The principle upon which internal combustion engines operate is simple but understood by relatively few outside the field of engine mechanics.

The internal combustion engine is a machine for converting potential chemical energy into mechanical power.

The essentials for combustion are

1. Fuel
2. Air
3. Ignition
4. Compression

The process by which internal combustion engines convert chemical energy into mechanical power involves four events

1. Intake
2. Compression
3. Power
4. Exhaust

Small gasoline engines are designed as

1. Four-stroke cycle engines. Four strokes (up or down movement of the piston) are required to complete the four events (intake, compression, power, and exhaust) involved in converting potential chemical power into mechanical power. One event is conducted with the completion of each stroke of the piston. (Refer to reference General Theories of Operation pp. 4 and 5.)

2. Two-stroke cycle engines. Engines of this design require only two strokes of the piston to complete the four necessary events (intake, compression, power, and exhaust). On most small engines, the upward stroke of the piston draws a fuel-air mixture already in the cylinder above the piston. The downward stroke provides the power and exhausts the burned fuel-air mixture at the same time. (Refer to reference All About Small Gasoline Engines, p.14.)

Suggested Teaching-Learning Activities

1. Use cutaway models of four-cycle and two-cycle small engines to demonstrate the internal engine operating principles of each type.

2. After discussing the items in the subject matter content, show the movie, "The ABC of Internal Combustion".

Suggested Instructional Materials and References

Instructional materials

1. Overhead transparencies illustrating the principles of internal combustion engines.

2. A small engine with a cutaway view of the combustion chamber, piston, valves, etc.

3. "The ABC of Internal Combustion"

References

1. Small Engines Service Manual, pp. 2-4.

2. All About Small Gas Engines.

S*3. General Theories of Operations, pp. 3-10.

III. To understand ignition principles of small gasoline engines

Teacher Preparation

Subject Matter Content

The information present in General Theories of Operation pp. 19-24 should be used as the main reference in teaching the competency and supplemented with the following materials. The information presented in this reference should be presented to the class in the order that it is presented in these materials.

The two types of ignition systems used on small gasoline engines are magneto systems and battery systems.

1. Magneto ignition utilizes the principle of electro magnetic induction and produces electrical energy through the use of a dynamo or generator. The two main types are low tension and high tension magnetos. A typical magneto ignition system consists of the following major components:

   a. Impulse coupling

   b. Coil

   c. Magnetic rotor

   d. Frame laminations

   e. Breaker points

   f. Breaker arm

   g. Condenser

   h. Spark plug

   i. Flywheel

2. In engines with multiple cylinders, the magneto system may also include

   a. Distributor rotor

   b. Distributor gear

c. Distributor pinion

d. High-tension lead rod

3. A battery ignition system depends upon a storage battery as its source of electrical energy. A typical battery ignition system consists of

a. Ignition coil

b. Condenser

c. Distribution system

1) Cap
2) Rotor seal
3) Dust seal
4) Weight spring
5) Advance weight
6) Weight base and shaft
7) Bushing
8) Coupling
9) Grease cup
10) Switch
11) Wiring
12) Spark plugs

Suggested Teaching-Learning Activities

1. Using overhead transparencies, charts, diagrams and teacher-made mock-ups, discuss the principles involved in ignition systems of small engines.

2. Have students define

a. Vacuum advance

b. Armature

c. Spark advance

d. Normal spark plug

e. Cold spark plug

f. Hot spark plug

g. Spark plug fouling

h. Spark plug gaps

i. Primary winding

j. Secondary winding

k. SAE

3. Have each student carefully and completely disassemble both a magneto and a battery ignition system. Be sure the students mark each part to make certain it can be reassembled correctly.

4. Following the operator's manual to determine proper settings for plugs, points, etc., have students reassemble the torn down ignition systems.

5. Disassemble both a magneto- and battery-type ignition system and have the students identify each part.

6. Have students trouble shoot the ignition system of at least one engine that performs improperly.

7. Have students place a volt meter on the hot point of the engine magneto or battery to measure the voltage produced. Then place the volt meter on the plug to measure the amount of voltage going into the plug. Point out to the class that the coil is responsible for the increase in voltage.

Suggested Instructional Materials and References

Instructional materials

1. Overhead transparencies, charts, and diagrams of small gas engine electrical systems

2. Display boards showing ignition system parts

3. One small engine per student

4. A cross section of a coil

5. A magneto and battery of the type used in small gasoline engine ignition systems

6. Various types of spark plugs used in small gasoline engines

References

1. All About Small Gas Engines, pp. 182-220.
2. Briggs and Stratton Repair Instructions II, pp. 13-22.
3. General Theories of Operation, pp. 19-24.
4. Small Engines Service Manual, pp. 5-14, 24-29.

IV. To understand combustion principles of small gasoline engine systems

Teacher Preparation

Subject Matter Content

The information present in General Theories of Operation pp. 10-19 should be used as the main reference in teaching the competency and supplemented with the following materials. The information presented in this reference should be presented to the class in the order that it is presented in these materials.

Small engine fuel systems consist primarily of a fuel tank and carburetor.

The primary function of the fuel tank is storage for fuel which is supplied to the carburetor through a fuel line.

The primary function of the carburetor is to produce and supply to the engine a mixture of fuel and air on which the engine operates.

The primary function of the air cleaner is to remove foreign particles from the air so that the air entering the carburetor will be clean.

1. Operation of carburetors, involves several principles. Carburetor designs are complicated, but the principle of carburetion is relatively simple. Air and fuel flow into a cylinder of an engine because of the difference between the pressure within the cylinder and atmospheric pressure outside the cylinder.

Principles of operation involve the following:

a. Venturi is the basic principle used in modern carburetors. This principle depends on the fact that gas or liquid flowing through a constricted section in a passage undergoes an increase in speed and a reduction in pressure as compared to its speed and pressure prior to and after passing through the restricted section.

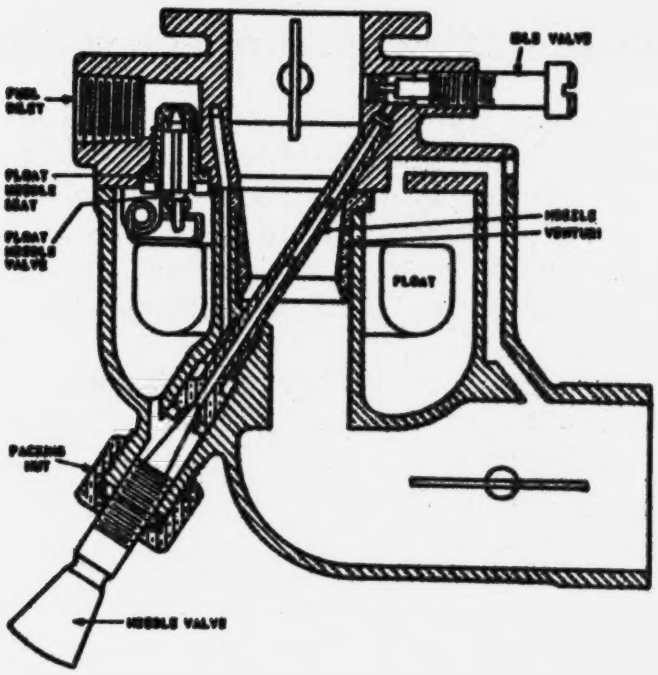
b. Air bleeding is the principle used in modern carburetors because it reduces the amount of fuel drawn from a carburetor jet, and it assists in atomization of fuels necessary for efficient combustion.

c. Fuel and air mixtures (the ratio of fuel and air) are determined by these factors:

   1) Weather (temperature)
   2) Speed of engine
   3) Load on engine

d. The level of fuel in the main discharge nozzle must be maintained at a fairly constant level to meet the varying demands of the engine. When the level becomes too low, the engine fails to operate, or to operate properly, because of an inadequate supply of fuel.

e. To assure dependability, many carburetor designs include a second or compensating nozzle. In combination with the main nozzle, the two give a substantially constant mixture.



An Elementary Carburetor With Major Components Identified

2. Carburetors are grouped according to design and type. Design, as used here, refers to air entrance into the carburetor.

   Basically, there are three carburetor designs.

   a. Updraft is the design by which air enters the bottom of the carburetor and must lift the fuel by air friction.

   b. Downdraft is the design by which the carburetor is placed above the engine; air enters the top, passes downward, mixes with the fuel, and then passes into the manifold and into the engine.

   c. Crossdraft or side outlet is the design by which air enters the side, mixes with the fuel in horizontal mixing tube, and passes into the manifold, which may be built into the engine block. This design is used on most lawn mowers.

3. Basically, there are three types of carburetors.

   a. Float type is used primarily with overhead fuel tanks. The level of fuel in the carburetor is controlled by a float which operates a valve that regulates the flow of fuel into the bowl of the carburetor.

b. Suction type is above the fuel tank and has a fuel pipe extending down into the fuel tank. Fuel is sucked into the carburetor when the movement of the piston in the cylinder creates a vacuum reducing the atmospheric pressure in the carburetor below that in the fuel tank.

c. Floatless (diaphragm) type serves a dual function by also serving as a fuel pump. This type maintains a constant level of fuel and operates satisfactorily when tilted to acute angles.

4. Air cleaners supply clean air to the carburetor. Unclean air is likely to reduce efficiency of the engine, and is also very detrimental to the life of the engine.

Air cleaners are simple, and are easily maintained. The three basic types are

a. Oil-bath cleaners

b. Oil-foam cleaners

c. Dry-element cleaners

5. Carburetor trouble shooting is necessary, since an efficient small engines mechanic must be aware that complete failure of an engine to operate seldom originates in the carburetor. Skill in recognizing carburetor malfunction should be developed through recognizing the following signs and following the proper procedures.

a. Engine fails to operate

Before examining the carburetor, check the ignition, compression and supply of fuel. If these prove satisfactory, examine the carburetor and make corrections through the following steps:

1) Examine choke to see that it is operating properly.
2) Check the flow of fuel to the carburetor. Fuel flow may be restricted by clogged lines or vapor lock.
3) Check for air leaks where the carburetor is fastened to the manifold.
4) Check for worn linkage
5) Check for dirt in the carburetor.

6) Check for incorrect fuel level.
7) Check for worn parts.
8) Check for maladjustment.

Adjustments should be made according to the manufacturer's recommendations provided in the operator's manual.

b. Engine operates, but performance is poor.

Poor performance often results from too lean a mixture and may be remedied by checking and correcting the following possible causes:

1) Air leakage at carburetor or manifold
2) Clogged fuel lines
3) Defective fuel pump
4) Incorrect fuel level
5) Clogged fuel screen
6) Dirt in carburetor jets and passage
7) Damaged or wrong-size main metering jet
8) Worn idle needle valve and seat
9) Loose jets
10) Defective gaskets
11) Worn throttle shaft
12) Leaking vacuum lines to accessory equipment

c. Engine operates but idles poorly.

This condition may be caused by defective ignition, leaking engine valves, uneven engine compression, or faulty carburetor condition. The carburetor should be checked for the following:

1) Incorrect adjustment of idle needle valve
2) Incorrect float level
3) Sticking float needle valve
4) Air leaks at carburetor and manifold
5) Defective gaskets
6) Clogged idle discharge holes
7) Loose jets in carburetor
8) Leaking vacuum lines to accessory equipment

<u>Suggested Teaching-Learning Activities</u>

1. Demonstrate to students the principles of carburetion by using a simple atomizer or hand sprayer and candle.

2. Tear down a carburetor. As the principles of operation are discussed, show the class the carburetor part involved in making the principle turn into a function.

3. Attach a fuel meter in the gas line between the gas tank and the carburetor. Demonstrate to the class the increase in gas flow to the carburetor as the speed of the engine increases or slows down as a result of pull on the engine.

4. As the types and designs of carburetors are discussed in class, show the class an actual carburetor of each type and design. Disassemble each carburetor and show the class how each differs.

5. Have students disassemble, examine, clean, and adjust several carburetors on several different types of small gasoline engines.

6. Have students disassemble, examine, clean, make necessary maintenance repairs, and reassemble each type of air cleaner.

7. Foul up the carburetor system on several small gasoline engines. Have students trouble shoot these systems using the procedures outlined.

Suggested Instructional Materials and References

Instructional materials

1. Overhead transparencies, preferably overlays in color, illustrating fuel systems, their function and operation

2. Charts illustrating carburetors, their major components and their functions

3. A disassembled carburetor mounted on a display board to present an exploded view

4. An atomizer or simple hand sprayer and candle

5. A carburetor of each type and design

6. A carburetor for each student

7. An air clearner for each student

References

1. All About Small Gas Engines, pp. 137-151.

2. Briggs and Stratton Repair Instructions II, pp. 23-40.

3. General Theroies of Operation, pp. 10-19.

4. Small Engines Service Manual, pp. 14-19, 29-31.

V. To understand the small gasoline engine running gear and its related parts

Teacher Preparation

Subject Matter Content

The heavy work load placed on the running gear necessitates its proper adjustment and maintenance to prevent excessive major repairs. The actual work produced by an engine is done by its running gear.

The main components of the running gear of a small engine are

1. Pistons, pins, and rings
2. Connecting rods
3. Crank shaft and cam gears
4. Lubricating system pump or splasher
5. Engine bearings
6. Engine valves and springs and retainers
   a. Intake
   b. Exhaust

(See Small Engine Service Manual, page 57, for a cutaway view of the running gear and its related parts.)

Related components are

1. Cylinders
2. Head

3. Frame

4. Base

5. Flywheel

A thorough knowledge of proper adjustment of running gear parts and of diagnostic procedures is necessary to overhaul a small engine effectively.

Conditions which result from improperly adjusted or defective running gear components and related parts are

1. High oil consumption

2. Loss of power

3. Engine overheating

4. Excessive engine noise

5. Engine failure to operate

A single defect can cause any one of the above conditions to exist, but in many cases the condition is caused by a combination of defects. Proper diagnostic procedures do not stop upon the location of one defect but demand close examination for all defects which may produce the condition. Careful study of materials related to the particular make of engine which are supplied by the manufacturers is essential for effective results.

Excessive friction causes rapid destruction of running gear parts. This cannot be eliminated, but it can be reduced to a minimum by the proper use of friction-reducing lubricants. Engine oil has five main functions.

1. It reduces friction which results in reduced wear.

2. It serves as a cushion between shafts and bearings.

3. It serves as a coolant.

4. It helps to keep the interior of the engine clean.

5. It seals power between piston rings and cylinder walls.

Engine oils are classified according to viscosity and the American Petroleum Institute (API) service classifications. Viscosity

refers to the weights or thickness of the oil and API service classifications refer to the quality of the oil. API service classifications are

1. Service ML (Motor Light)
2. Service MM (Motor Moderate)
3. Service MS (Motor Severe)
4. Service DG (Diesel General)
5. Service DM (Diesel Moderate)
6. Service DS (Diesel Severe)

An oil may meet the specifications for all grades and be labeled as such.

Additives, as detergents, are often used with engine oils to give them more cleaning ability.

Suggested Teaching-Learning Activities

1. Using overhead transparencies, charts, and diagrams, familiarize students with the running gear components and related parts, their functions, and the relationship of the various parts to each other.
2. Have students disassemble and reassemble the running gear of a small gasoline engine.
3. Have students accuartely perform the following activities:
   a. Grind valves
   b. Seat valves
   c. Replace all running gear bearings
   d. Replace piston rings
   e. Hone a cylinder
   f. Resize a cylinder and insert a sleeve
   g. Adjust or repair lubricating system

h. Replace gaskets

i. Reassemble and properly adjust each part

4. Have a lubricant specialist speak to the class to explain types and grades of engine oil.

Suggested Instructional Materials and References

Instructional materials

1. Overhead transparencies, charts, diagrams, and mockups of the running gear and its related parts

2. One small gasoline engine per student

3. A set of tools for each student

4. A clear plastic model of an engine

5. Samples of oils and other lubricants used in small engines

6. Operators' manuals

7. Special equipment needed to carry out the jobs listed under item 3 of the teaching-learning activities

References

1. All About Small Gas Engines, pp. 39-136.

2. Small Engines Service Manual, pp. 53-57.

3. Briggs and Stratton Repair Instructions II, pp. 41-59.

4. Gulf Farm Tractor Guide, pp. 12-18.

VI. To understand small gasoline governors and cooling systems

Teacher Preparation

Subject Matter Content

The purpose of the governor is to maintain, with certain limits, a desired engine speed under varying loads.

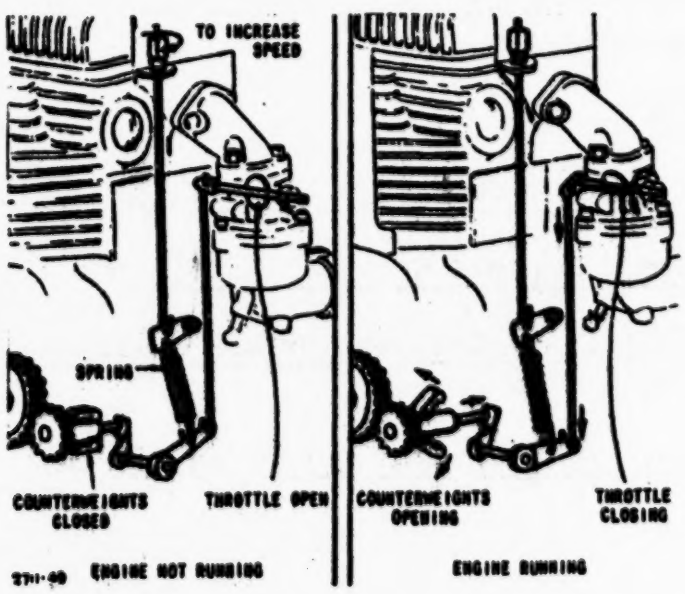
Governors may be either mechanical or velocity types. The three basic designes of governors are classified according to the force upon which they operate.

1. Engine speed governor operates by weights which tend to fly outward as the speed of the engine increases. The action involves the movement of a rod attached to the throttle to open or close the throttle.

2. Velocity governor operates by the velocity of the gas going through the manifold. This passage through the manifold acts on a spring-loaded floating obstruction in the shape of a ball or disk attached to the throttle.

3. Vacuum governor operates on the intake manifold vacuum. This vacuum decreases as the engine load increases and and increases as the engine load decreases.

The purpose of the governor is to maintain a desired engine speed under varying loads. It must serve as an automatic means of opening and closing the throttle. When the load is increased, the engine speed tends to decrease, so the throttle must be gradually opened in order to maintain the desired speed. The opposite is true when the load is decreased.



Exploded View of a Typical Governor Used on Many Small Engines.

The purpose of the cooling system is to regulate the temperature of the engine. Engines will not operate efficiently if they are too cool. Engines operate most efficiently at a temperature of

about 200 degrees F. If the temperature exceeds this, the engine may be damaged.

Basically, there are two types of cooling systems used on small engines.

1. Air

2. Water

Air-cooled engines are used almost exclusively for small machinery. Water-cooled engines may be used on small machinery but are used primarily on larger machinery. The typical water-cooled enigne is much more rugged in construction than the smaller air-cooled engines, which are usually lighter in weight.

The principles of operation of air-cooled and water-cooled engines are basically the same. Heat created by the burning fuel in the combustion chamber is transferred to the water or air as it flows around the cylinder walls. This constant transfer of heat helps maintain the desired engine temperature. Approximately one-third of the heat created by the burning fuel must be removed by the cooling system. A defective cooling system will cause much damage to the engine.

Periodic checking and servicing is essential to a properly-maintained cooling system. Servicing an air-cooled system involves two basic activities.

1. Keeping all air passages around the engine free of dirt and foreign matter

2. Checking to make certain the fins on the flywheel are in good condition

<u>Suggested Teaching-Learning Activities</u>

1. Using overhead transparencies, models, mockups, etc. show the parts of a governor, explain their functions, and identify the air flow in the engine cooling system.

2. Have students remove the governor from a small gasoline engine, disassemble it, reassemble it, properly adjust it, and replace it on the engine. Repeat this operation on a different type of governor.

3. Using a clear plastic model of a small gasoline engine, force chalk dust through the cooling system to show how the air enters, circulates through, and leaves the engine.

4. Have students clean and service the cooling systems on several types of small gasoline engines.

5. Have students bring several small gasoline engines to the shop that need repairing and have students overhaul them using the Small Engines Service Manual and Briggs and Stratton Repair Instructions II as guides.

Suggested Instructional Materials and References

Instructional materials

1. Overhead transparencies, charts, etc.

2. Disassembled governors mounted on a display board.

3. Small engines with both types cooling systems

4. A clear plastic model of a small gasoline engine

5. A small gasoline engine for each student

References

All About Small Gas Engines, pp. 97-100, 113-114.

Suggestions for Evaluating Educational Outcomes of the Module

Educational outcomes of this module should be evaluated by the abilities and attitudes developed by the students.

1. Ability of students to repair small engines should be evaluated by assigning each student to an engine that needs several adjustments and repairs. Observation of the procedure followed by the student, his ability to use the necessary tools for the job, and the thoroughness and effectiveness of the job done will indicate his level of proficiency.

2. Evaluate student attitudes according to

   a. Interest of students

   b. Extent of participation in class activities

Source of Suggested Instructional Materials and References

Instructional materials

"The ABC of Internal Combustion," 16mm film, 18 minutes, color, sound. General Motors Corporation, Detroit, Michigan.

References

1. Briggs and Stratton Repair Instructions II, Form MS 4750-54. Milwaukee, Wisconsin: Briggs and Stratton Corporation. No charge.

2. General Theories of Operation, Form MS 3553-31. Milwaukee, Wisconsin: Briggs and Stratton Corporation. No charge.

3. Gulf Farm Tractor Guide, Sp 10293-R63. Houston, Texas: Gulf Oil Corporation, Gulf Building. Free.

4. Long, Kenneth F. Small Engines Service Manual, Sixth Edition. Technical Publications, Inc., 1014 Wyandotte Street, Kansas City 5, Missouri. Price: $4.95.

5. Purvis, Jud. All About Small Gas Engines, Goodheart-Wilcox Company, 18050 Harwood Avenue, Homewood, Illinois. 1963. Price: $3.38.

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TRACTOR TUNE - UP AND MAINTENANCE

One of Sixteen Modules in the Course Preparing for Entry in

AGRICULTURAL MACHINERY - SERVICE OCCUPATIONS

Module No. 13

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

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The Center for Research and Leadership Development

in Vocational and Technical Education

The Ohio State University
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August, 1965

VI 00500

MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) James W. Hensel (Agency) The Center for Vocational and Technical Education

(Address) 980 Kinnear Road, Columbus, Ohio 43212

DATE: August 4, 1967

RE: (Author, Title, Publisher, Date) Module No. 13, "Tractor Tune-up and Maintenance," The Center for Vocational and Technical Education, August, 1965.

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Development Group National Task Force
Level of Group National
Method of Design, Testing, and Trial Part of a funded project of the USOE, OE-5-85-009; materials based on research from state studies; see preface material in the course outline.

(3) Utilization of Material:
Appropriate School Setting Post high school
Type of Program General post high school class in agricultural machinery
Occupational Focus Agricultural machinery service occupations
Geographic Adaptability Nationwide
Uses of Material Instructor course planning
Users of Material Teachers

(4) Requirements for Using Material:
Teacher Competency Background in agricultural machinery
Student Selection Criteria Post high school, mechanical aptitude, high school background, goal in agricultural machinery service occupation.
Time Allotment Estimated time listed in module. (P)

Supplemental Media --
Necessary x
Desirable ____ (Check Which)

Describe Suggested references given in module. (P)

Source (agency)
(address)

TRACTOR TUNE-UP AND MAINTENANCE

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TRACTOR TUNE-UP AND MAINTENANCE

Major Teaching Objective

To understand a systematic procedure to follow and be able to effectively tune and maintain a farm tractor.

Suggested Time Allotments

At school		
Class instruction	24 hours	
Laboratory experience	48 hours	
Total at school		72 hours
Occupational experience		0 hours
Total for module		72 hours

Suggestions for Introducing the Module

A person preparing for employment as a mechanic, mechanic's helper, or service supervisor in an agricultural machinery business must be able to effectively tune and maintain a farm tractor. An efficient employee in these occupations will have an understanding of the importance of a properly tuned tractor, will have an effective systematic procedure to follow in "checking out" a tractor, and will possess the technical knowledge and abilities necessary to make the needed adjustments.

Competition is keen in many areas of the farm machinery service business and the progressive employer will be interested in only the efficient employee.

The following technique should be used to create interest in the module.

Bring a small tractor before the class. Alter the electrical system so that the tractor won't start and set the idling jet on the carburetor to a very slow idle. Demonstrate to the class that the tractor won't start. Give the students an opportunity to find the trouble. Show them how a simple little malfunction of the electrical system can keep the engine from functioning. Once the tractor is running and the idling difficulty is identified, have the student attempt to correct it. Emphasize how simple it is to make tune-up adjustments and how important it is to have a thorough understanding of the engine, its parts, and their functions, in order to be able to perform proper tune-up and maintenance.

Competencies to be Developed

I. To understand the economic importance of a properly tuned tractor

Teacher Preparation

Subject Matter Content

Studies conducted by agricultural engineers have shown that most farm tractors are not operating at the power and efficiency of which they are capable. Often this is caused by tractors which have not been properly tuned being delivered to farmers. To eliminate this situation, it is necessary that many persons planning an occupation in an agricultural machinery dealership possess the competencies needed to properly adjust and tune a tractor.

Studies have shown that proper tuning of the average farm tractor increased its horsepower eleven per cent. Fuel use efficiency was increased fourteen per cent for a saving of about five gallons per day on a fifty horsepower tractor while being used for plowing.

Implement companies are well aware of the need for adequately trained employees. Often implement companies are blamed for tractor troubles that could have been prevented by properly tuning and adjusting the tractors before delivery.

Suggested Teaching-Learning Activities

1. Have students develop graphs showing performances of properly adjusted tractors as compared with tractors not properly adjusted.

2. By the use of a gasoline flow meter, demonstrate to students the difference in fuel consumption when the tractor engine is properly timed and not timed and when the carburetor is properly adjusted and not adjusted.

3. By use of a dynamometer, demonstrate the difference in horsepower in properly and improperly tuned engines.

4. Have a local farm machinery service manager bring to the class the past month's service records of customers to illustrate a comparison of the average cost of tune-up and maintenance and the total value of the equipment that was serviced. Have him point out the savings that could have

been made by more timely maintenance. Have him point out instances where a mechanic's inability to perform proper maintenance and tune-up has resulted in additional service calls and lack of confidence in the dealership.

5. The governor on the tractor motor must be properly adjusted before any adjustment can be made while under test by the dynamometer. Show the difference between improper speed of engine and horsepower compared to proper speed of engine and horsepower.

Suggested Instructional Materials and References

Instructional Materials

1. Charts and graphs depicting the increased cost in operating an improperly tuned tractor

2. A gasoline flow meter to be used in determining the rate of fuel consumption

3. Dynamometer

References

S*1. Tractor Maintenance: Principles and Procedures, pages 1-3.

S 2. Gulf Farm Tractor Guide, page 1.

T 3. "Nebraska State Test Chart for P.T.O. Speed, Fuel Compression and Horsepower."

S 4. Implement and Tractor Tune-up Specifications.

*The symbol T (teacher) or S (student) denotes those references designed especially for the teacher or for the student.

II. To understand the construction and major components of a farm tractor

Teacher Preparation

Subject Matter Content

The ability to adjust and tune a tractor without an understanding of its construction, major components and their relationships to each other is very unlikely. Persons performing this type of service must have this understanding to develop and follow a systematic method of checking the components to make proper adjustments.

Tractors are composed of hundreds of parts. The smaller parts are built into major systems or assemblies such as:

1. Engine and accessories
2. Power train
3. Brakes
4. Steering mechanism
5. Chassis and related parts
6. Cooling system
7. Ignition system
8. Fuel system
9. Lubrication system

All farm tractors, except some experimental models, have internal combustion engines as the source of power.

Major assemblies of engines and their components are:

1. Engine
    a. Cylinder block and cylinder head
    b. Pistons and rings
    c. Connecting rods
    d. Rocker arm assembly

e. Oil pan, oil pump, and oil filter

f. Valves and valve springs

g. Camshaft and camshaft gear

h. Crankshaft

i. Flywheel

j. Timing gear

k. Main bearings

2. Engine accessory systems

a. Electrical and ignition system

1) Battery
2) Generator and charging circuit
3) Ignition circuit (spark plugs and glow plugs, coil, distributor, magneto, cranking motor)

b. Fuel, air, and exhaust systems - gasoline

1) Air cleaner
2) Fuel tank
3) Fuel line, cutoff valve, strainer and filter
4) Fuel pump - only for tractors that do not have the fuel tank located above the engine
5) Carburetor
6) Manifold, muffler, and exhaust
7) Governor

c. Fuel, air, and exhaust systems - diesel

1) Air cleaner
2) Fuel tank
3) Fuel lines and filter
4) Fuel injectors
5) Fuel injection pump
6) Manifold, muffler and outlet pipe
7) Governor

d. Fuel, air, and exhaust systems - LP Gas

1) Air cleaner
2) Fuel tank, valve, and line
3) Fuel filter
4) Carburetor
5) Pressure regulators and vaporizer
6) Manifold, muffler, and exhaust pipe
7) Governor

e. Cooling systems

1) Radiator, hose, and pressure cap
2) Water pump

3) Thermostat
4) Fan

f. Power train

1) Clutch
2) Transmission
3) Differential
4) Final drive or driving axles

g. Brakes

1) Pedals or levers
2) Drums
3) Bands
4) Shoe assemblies
5) Disk assemblies
6) Rods
7) Hydraulics
8) Power brakes

h. Steering mechanisms

1) Steering shaft
2) Bolster
3) Axle
4) Radius rod
5) Spindles
6) Tie rods
7) Drag link
8) Gears
9) Hydraulic and power steering

i. Chassis, wheels, and lights

1) Chassis frame
2) Front and rear lights
3) Wheels and tires

Suggested Teaching-Learning Activities

1. Have students develop written reports on a general type tractor construction, naming assemblies and systems and stating functions of each system. Also have students list how systems vary according to types of tractors.

2. Have students identify major components on a diagram of a general type tractor

3. Disassemble the major systems of a tractor to the extent that the components as listed in the content may be seen and studied by the students. Reassemble the components explaining the function of all components in a system.

Suggested Instructional Materials and References

Instructional Materials

1. Overhead transparencies and chart diagrams of cross section view of a tractor showing its assemblies and systems

2. Overhead transparencies and chart diagrams of exploded view of tractor systems showing major components of each system

3. A tractor

References

T 1. Tractors and Crawlers

S 2. Ford Tractor: Shop Manual

III. To adjust valves in tractor engines

Teacher Preparation

Subject Matter Content

High speeds, high temperatures, and increased compression place severe demands on engine valves. Improperly adjusted valves reduce the efficiency of the engine and accelerate wear thereby causing the need for early overhaul. When properly adjusted:

1. Valves last longer.

2. The engine uses fuel more efficiently.

3. The engine starts more easily.

4. Maximum power is produced.

5. The engine is less likely to overheat.

6. Smooth engine operation is provided.

Terms such as "tappet adjustment," "valve clearance," "valve spacing," and "valve lash" - all refer to valve clearance adjustments.

A properly adjusted valve will usually have a clearance of .006 inch to .030 inch between the valve stem and the rocker arm when the valve is closed. This varies according to the manufacturer and whether the engine is hot or cold. When performing engine tune-up jobs, it is advisable to follow suggestions in the operator's manual provided by the manufacturer.

Steps in the procedure listed should be followed when making valve clearance adjustments for valve-in-head engines.

1. Check operator's manual to determine whether engine should be hot or cold to make valve adjustments.

2. Remove tractor parts that interfere with removal of valve cover.

3. Clean dirt from valve cover and from around spark plugs.

4. Remove nuts or cap screws that hold valve (rocker-arm) cover.

5. Carefully remove valve cover to protect gasket.

6. Disconnect the center terminal wire to the distributor on spark ignition engines and shut off the fuel supply on diesel engines. This is a safety precaution.

7. Check cylinder head for tightness.

8. Slowly turn crankshaft until piston in number 1 cylinder is at top dead center (TDC) of compression stroke.

9. Visually inspect all parts making sure that all parts getting oil are not sludged.

10. Select the feeler-guage thickness recommended by the manufacturer.

11. Check clearance by inserting guage between valve stem and rocker arm of intake and exhaust valves. If clearances are correct on both, proceed with step 14.

12. Loosen adjusting-screw lock nut on valve rocker arm.

13. Turn adjusting screw with screwdriver until feeler guage will just slip in and out of the gap.

14. Hold adjusting screw with screwdriver and tighten lock nut with wrench. Then re-check.

15. Determine which cylinder fires next.

16. Crank engine until next cylinder in firing order is on compression. (TDC)

17. Adjust valves following same procedures as on number 1 cylinder and proceed in same manner with remaining cylinders.

18. Start engine and check lubrication of rocker arm.

19. Reassemble gasket, cover, etc.

Suggested Teaching-Learning Activities

1. Have students become familiar with instructions in operator's manuals through reading assignments and question and answer periods.

2. Demonstrate to students a procedure for determining when a piston is at TDC on the compression stroke.

3. Demonstrate to the class how the firing order may be determined and have a class member repeat the demonstration to be critiqued by other class members.

4. Have students give reasons for proper valve adjustments and list step by step the procedure to follow in adjusting valves.

5. Have students list ways of determining whether valve adjustment or overhaul is needed.

6. After having one student attempt to adjust valves in a late model engine using an out-of-date service manual as a guide, follow through step-by-step with the possible consequences of such a procedure to impress upon all students the necessity for keeping up-to-date in maintenance procedures.

Suggested Instructional Materials and References

Instructional Materials

1. Tractor engines

2. Operator's manuals

3. Overhead transparencies and diagrams of piston and crankshaft positions of cylinders and valves

4. Tools necessary for the competency

References

1. Tractor Maintenance: Principles and Procedures, pages 34-42.

S 2. Farm Tractor Tune-Up and Service Guide.

S 3. Operator's manuals for tractors.

S 4. Tractor Maintenance and Tune-Up, pages 7-10.

Suggested Occupational Experiences

Have students follow the recommended procedure for adjusting valves on at least two engines.

IV. To adjust and tune tractor electrical and ignition systems

Teacher Preparation

Subject Matter Content

The electrical system of a gasoline tractor provides ignition which is one of the three essentials for combustion. Ignition in a diesel engine is provided by the high temperature generated during the compression stroke.

Properly tuned ignition systems add efficiency and life to the operation of the tractor. A systematic approach to adjusting and tuning the ignition system includes cleaning, "checking out," and adjusting each major component. (Refer to illustration 63, page 33 in the reference entitled "Electrical.")

The purpose of the battery is to convert chemical energy into electrical energy. An unclean and corroded battery becomes weak and dead much more quickly than one kept in proper condition.

Procedure for testing, cleaning, and servicing batteries:

1. Check battery with a voltmeter or hydrometer to determine the degree of charge of the battery.

BATTERY SPECIFIC GRAVITY CHARGE

State of Charge	Specific Gravity Temperate Climates
Fully Charged	1.275
75%	1.250
50%	1.225
25%	1.200
Discharged	1.175

2. Disconnect cable and ground strap from battery terminals if they are corroded.

3. Clean cable clamps and battery posts with wire brush and sandpaper.

4. Remove loose dirt and corrosion particles.

5. Brush a soda and water mixture on top of battery, on posts, and on clamps.

6. Wash away residue with clean water.

7. Repeat steps "5" and "6" until there is no further foaming.

8. Dry top of battery with a clean cloth or install corrosion inhibitor belt disks under clamps.

9. Apply a coating of light grease to posts and cable clamps.

10. Reconnect cable and ground strap.

The generator is the source of power in battery-type tractor electrical systems. It is usually belt driven and located at the front of the tractor.

The starter or "cranking motor" is used for starting the motor and is located on the side next to the flywheel housing.

Some tractor manufacturers are installing alternators in place of generators on their tractors. The difference between them is that the generator develops direct current which is suitable for direct use by the battery and electrical equipment on the tractor. The alternator develops alternating current which must be "rectified" -- changed to direct current -- before it can be used. Servicing an alternator is considered more technical than the term "tune-up" usually implies. The following procedure should be followed in maintaining and checking the starter and generator.

1. Wipe dirt from starter or generator housing.
2. Remove cover band.
3. Check brushes for wear and binding action.
4. Inspect for thrown solder.
5. Replace worn brushes.
6. Check brushes for binding action in holder.
7. Check electrical connections for tightness.
8. Inspect commutator for wear and roughness.
9. Remove dirt and glaze from commutator surface.
10. Set and seat new brushes on commutator.
11. Blow dust from commutator, brush holders and casing.
12. Replace band.
13. Polarize the generator before starting the engine.
14. If the generator needs reconditioning, proper methods should be used in the reconditioning process. Included in this process should be that of turning on a lathe, polishing and under-cutting the mica.
15. Check starter bendix drive and lubricate with light out.

Generator polarity refers to the direction of current flow from the generator to the extended circuits. Failure to polarize the generator in agreement with the battery may result in burned cut-out relay points, a discharged battery, or serious damage to the generator.

Gasoline engines used in tractors depend upon electricity to ignite the fuel and air mixture in the combustion chamber. Ignition takes place when a spark occurs in the combustion chamber. The spark takes place when electricity jumps across the gap between the electrodes of a spark plug. The spark must occur at the proper time in the combustion chamber so that the burning fuel can exert pressure on the piston to cause the crankshaft to rotate.

The electrical circuit which provides the spark at the spark plug is known as the ignition circuit. (Refer to Ford Tractor: Shop Manual for diagram of electrical system.)

Spark plugs provide the spark in the combustion chamber to ignite the fuel-air mixture.

Tests have shown that properly conditioned spark plugs may increase horse power of an engine by as much as 8.6 per cent. Tests have also shown that properly conditioned spark plugs may decrease fuel consumption by as much as 6.1 per cent.

In the same tests it was found that new spark plugs increased horsepower 21.5 per cent and decreased fuel consumption 14.2 per cent.

Spark plugs vary in type and size according to:

1. Engine design
2. Kind of fuel used
3. Engine operating conditions

(Refer to examples in Modern Farm Power, page 111 and Farm Tractors: Basic Principles, Operation, and Maintenance, pages 54-55.)

Conditioning spark plugs should be done according to the following procedure:

1. Disconnect spark plug wires from plugs.
2. Loosen plugs one or two turns, then remove dirt.

3. Remove each plug and arrange so each plug can be identified with its cylinder.

4. Check the condition of each plug. Plugs that are worn should be replaced with new ones.

5. Remove oily deposits from plugs.

6. Clean threads with a wire brush.

7. Remove deposits from plugs.

8. Blow loose material from plugs.

9. File electrodes on plugs until both have flat surfaces.

10. Determine proper spark gap spacing.

11. Regap plugs and check using the proper sized wire feeler guage.

12. Replace plugs with gasket and tighten with fingers.

13. Completely tighten plug with a spark plug socket wrench or torque wrench to specifications.

14. Check connections and insulation on spark plug wires when reattaching them to spark plugs.

15. Check polarity of spark at spark plug.

16. A dynamometer check should be made after each adjustment to observe what is happening to the horsepower output of the engine.

Glow plugs are used to aid starting and provide a fast "clean up" of the exhaust in diesel engines. It is important that all glow plugs function properly to eliminate misfiring during warm up.

Faulty plugs, when the tip is burned away or when the sheath is ruptured, should be replaced.

Coils are used in ignition systems to increase the voltage of the electrical current needed to provide the spark in the combustion chamber. Coils will increase current from 6 or 12 volts up to 25,000 volts. Relatively little adjustment is needed for proper maintenance of coils.

Maximum performance and efficiency of an engine can be attained only if the spark occurs in the right cylinder at the right time. This is the function of the distributor which includes a cam that opens and closes the points and a rotor and cap which distributed the spark to the correct cylinder. This function is performed only if the ignition timing is correct.

Servicing the distributor and timing the ignition system are usually considered as tune-up jobs. (Refer to the reference entitled Farm Tractors: Basic Principles, Operation, and Maintenance, pages 48 and 49 for an example of a distributor.)

1. Servicing the Distributor

   a. Checking the condition of the distributor
      To perform this operation follow this procedure:

      1) Remove dirt from outside surface of distributor cap.
      2) Remove cap and clean inner surfaces. Leave wires connected.
      3) Check distriburor capfor chips, cracks, and carbon paths which indicate cross arcing.
      4) Remove distributor arm (rotor) and clean.
      5) Remove dust cover, if one is used, and check condition of felt seal.
      6) Check the centrifugal-advance mechanism.
      7) Check condition of breaker points. If the contact points are rough but show only slight pitting and metal deposit, smooth with an ignition file. If points are badly pitted and worn, replace them with a new set.
      8) Check condenser to make sure it is working properly. An improperly working condenser will cause a cone shaped deposit of metal on one point and a cone shaped pit on the other.

         If this condition is existing, check tightness of the screw that holds the condenser. If the screw is tight, check the condenser with a condenser tester to determine whether it should be replaced.

   b. Replacing breaker points

      1) Remove breaker arm and spring.
      2) Remove stationary breaker point and bracket.

3) Clean, then lubricate cam with special cam lubricant or with petroleum jelly or multi-purpose grease.
4) Install new points in reverse order.

c. Adjusting breaker points

1) Turn engine until cam opens breaker points to widest position.
2) Check points for proper spacing. Check operator's manul for correct spacing. This may vary from .015 to .026 inch.
3) Loosen lock screw on bracket that provides adjustment.
4) Adjust points for proper spacing and alignment.
5) Lock breaker points in position with lock screw.
6) Recheck gap between points and wipe points clean.

d. Reassembling the distributor

1) Lubricate wick in center of cam shaft.
2) Reassemble distributor in reverse order from that outlined in "checking the condition of the distributor."
3) Check condition of wires leading to spark plugs and to ignition coil.

2. Timing the Ignition - Spark Ignition Engines

Timing the engine may be done by two methods:

a. The breaker point method

b. The timing light method

The timing light method is the most accurate. Proper timing means that the ignition is set so the distributor will supply a spark to each cylinder at a time when the fuel will burn with greatest efficiency.

a. Timing by the breaker point method

1) Locate timing marks on flywheel or fan pulley.
2) Loosen or remove spark plug from number one cylinder.
3) Remove distributor cap.
4) Crank the engine until number 1 cylinder starts compression stroke. Watch which way the distributor rotor is turning.

5) Continue to rotate slowly until proper marking appears on flywheel or fan shaft pulley. Check operator's manual for marking to indicate top dead center (TPC) for number on cylinder.
6) Remove rotor and dust cap.
7) Note if breaker points are just starting to open. If breaker points are just starting to open, the timing is satisfactory and the distributor may be reassembled. If points are closing, continue with remaining steps.
8) Loosen clamps that hold distributor to engine block.
9) Turn the distributor slowly in the direction the rotor normally turns. This step is to make sure the breaker points are completely together.
10) Turn distributor body slowly in opposite direction until points start to open.
11) Tighten clamps that hold distributor body and reassemble distributor.
12) Tighten number one spark plug and attach spark plug wire.
13) Start the engine to see that it operates satisfactorily.
14) If you removed a cover from over the timing hole, replace it.

b. Timing by the timing light method

1) Locate timing marks on flywheel or fan pulley.
2) Connect timing light as recommended by manufacturer.
3) Determine from the operator's manual what timing mark to use with light.
4) Chalk the timing mark so it is easy to see.
5) Start engine and run at speed recommended in operator's manual.
6) Direct timing light at markings on the flywheel or on fan pulley.
7) Loosen clamps that hold distributor.
8) Turn distributor body slightly until timing mark is opposite pointer.
9) Tighten distributor and remove timing light.
10) Replace cover over timing hole if one was removed.

Magnetos are self-contained assemblies which are driven by the engine and supply high voltage current to the spark plugs.

Magnetos contain a coil, condenser, points, distributor, cap, and rotor. Magnetos with a spring loaded drive turn quickly at slow speeds when a cylinder is to fire, thus generating more voltage and resulting in a better spark while starting the engine.

Maintenance procedures for magnetos are very similar to those for battery powered ignition systems.

Suggested Teaching-Learning Activities

1. Have students prepare an engine electrical system from spare parts using cutaway components and then explain and trace the operation of the electrical system.

2. Have students diagram an engine electrical system showing each major assembly and component.

3. Have students list conditions which may cause fouling or failure of the assemblies of the electrical system.

4. Demonstrate to students a procedure for tuning the electrical system.

5. Have students develop a check list of trouble shooting procedures for an electrical system.

6. Have students trouble shoot and service a tractor's electrical system that has been incorrectly serviced by the instructor.

7. Have students practice installing and timing magnetos where interchangeable with battery system.

Suggested Instructional Materials and References

Instructional Materials

1. An engine electrical system mounted on a display board

2. Overhead transparencies listing the steps to follow in maintaining and tuning the electrical system

3. Electrical systems for students to use

4. Charts and diagrams of exploded views of the components of an electrical system

5. "Electrical System," University of Nebraska Filmstrip

References

1. Tractor Maintenance: Principles and Procedures, Unit III, Part Three; Unit I-III, Part Four.

2. Tractors and Crawlers, Chapter 5.

3. Tractor Maintenance and Tune-Up, pages 14-19.

4. Electrical, International Harvester, pages 25-30 and 35-41.

5. Ford Tractor: Shop Manual, Chapters II and III.

6. Gulf Farm Tractor Guide, pages 27-30.

7. Farm Tractor Tune-Up and Service Guide.

8. Modern Farm Power, pages 102-130.

9. Farm Tractors: Basic Principles, Operation, and Maintenance, pages 46-55.

Suggested Occupational Experiences

Each student should service at least one complete electrical system following procedures listed in the content. Students should make note of problems encountered and present these to the class.

V. To maintain and adjust tractor air, fuel, and exhaust system

Teacher Preparation

Subject Matter Content

Studies have shown that properly maintained air cleaners may lower fuel consumption by as much as 22.5 per cent. Horsepower

has been increased by as much as 27 per cent as a result of a properly cleaned and adjusted air cleaner.

Two common types of air cleaners used on tractors are:

1. Dry type

2. Oil bath type

To clean and service the oil bath air cleaner the following procedure should be used:

1. Remove oil cup and screen tray.

2. Inspect center tube and lower filter element.

3. Remove dirt from center pipe.

4. Clean dirt from lower filter (Do not try to remove a permanently installed filter element,)

5. Clean shell and upper metal-wool filter.

6. Drain filter body and screen for several minutes. (Diesel engine air cleaner filter screens must be completely dry before reinstalling if washed in a volatile solvent to prevent the possibility of the engine "running away.")

7. Clean the screened air intake, cap, or precleaner.

8. Reassemble filter parts.

Dry type air cleaners are now being used on many new tractors. The efficiency of this type cleaner is outstanding. Also the expense and mess of cleaning and replacing the oil in the oil-bath type are eliminated.

Dry type air cleaners should be serviced by the following procedure:

1. Stop engine if it is running.

2. Squeeze dust unloader if one is on the air cleaner.

3. Remove hood or grill if necessary to provide access to air cleaner unit.

4. Wipe off dust accumulated around end of cleaner where element will be removed.

5. Loosen hand screw or clamp that holds the end cap on the end of the cleaner and remove cap.

6. Clean the area around the element and clean the dust cup and baffle on air cleaners having end cups.

7. Remove filter element from cleaner.

8. Check condition of rubber gasket on end of filter element.

9. Clean filter element by:

   a. Tapping to loosen dust so it can be shaken out, or

   b. Use compressed air and blow from inside to outside, or

   c. Rinse in warm water and a low sudsing detergent.

10. Allow element to dry if washed.

11. Inspect element for damage.

12. Replace element in the cleaner and complete job by following procedure in reverse order from that used in removing the filter element.

The purpose of tractor fuel systems is to supply fuel to the engine.

Properly adjusted fuel systems result in an increase in horsepower and may result in a reduction in fuel consumption.

Servicing and tuning the fuel system for gasoline engines include several activities, following the manufacturer's recommendations, namely:

1. Servicing the sediment bowl, fuel filter, and fuel line:

   a. Close valve(s) on fuel supply line.

   b. Loosen nut that holds sediment bowl in position.

   c. Remove sediment bowl.

d. Remove sediment bowl gasket.

e. Remove strainer.

f. Wash strainer unless it is a disposable type.

g. Clean sediment bowl.

h. Open fuel valve and allow fuel to flow through to clean line between sediment bowl and tank.

i. Reinstall gasket, strainer, and sediment bowl.

j. Tighten nut that holds sediment bowl in position.

k. Open fuel valves and check for leaks.

2. Preparing for carburetor adjustment:

a. Determine if carburetor is equipped with a screen.

b. Close valve on fuel line and disconnect line at carburetor.

c. Remove screen from carburetor (if applicable).

d. Clean the screen and reassemble.

e. Start engine and check for air leaks around manifold connections and carburetor gaskets.

3. Adjusting idling speed screw:

a. Start engine and warm to operating temperature.

b. Set speed control lever at closed position.

c. Locate idling speed adjustment.

d. Adjust screw to normal idling speed.

4. Adjusting the idling fuel-air mixture:

a. Set speed control lever at idling position.

b. Locate idle-mixture adjusting screw.

c. Turn idle-mixture screw clockwise slowly until engine begins to "roll" or slow down.

d. Turn adjusting screw back slowly until engine runs smoothly.

5. Adjusting the load fuel-air mixture:

a. Run engine at full throttle either with or without load.

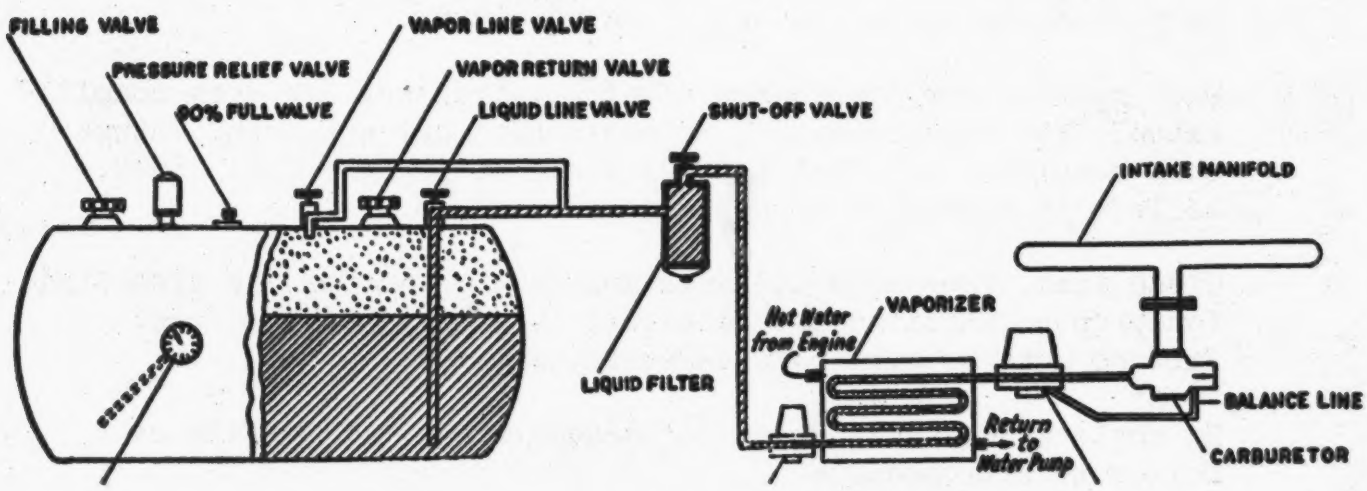
b. Turn load adjusting screw clockwise until engine begins to lose power.

c. Turn adjusting screw counter clockwise until engine gives off black smoke from exhaust.

d. Turn screw clockwise until engine runs smoothly and at full speed.

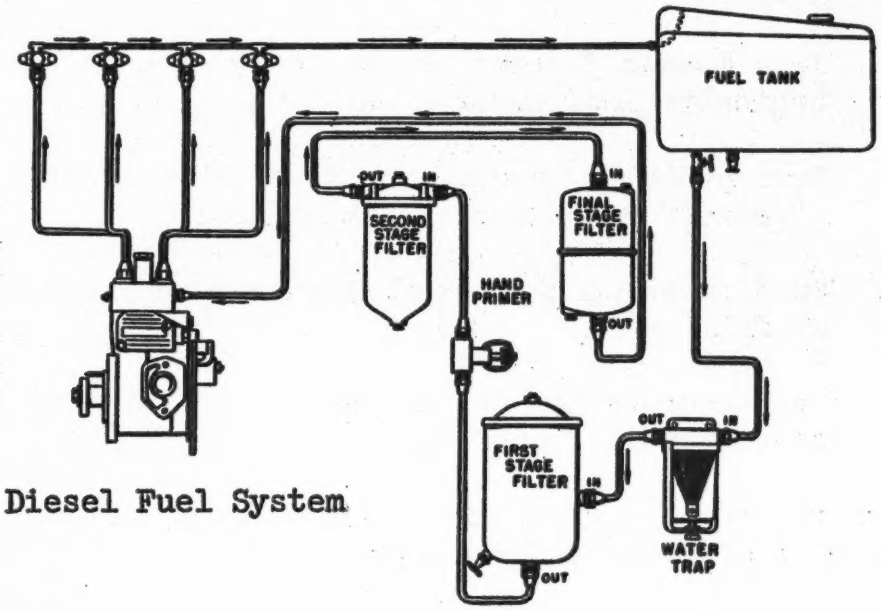
e. Check carburetor adjustment by accelerating engine quickly while under load.

Too lean a mixture will cause the engine to back fire and too rich a mixture will produce dark colored smoke.



LP Gas Fuel System

Fuel systems for LP Gas engines are basically the same as for gasoline engines with three or four exceptions. Main differences in a gasoline system and an LP Gas system are that the gas system has a different fuel filter, a vaporizer, and a regulator. The LP Gas carburetor does not have a float because the fuel enters the carburetor as a gas rather than as a liquid.



Diesel Fuel System

Servicing and adjusting LP Gas fuel systems should be according to procedures suggested by the manufacturer.

Fuel systems for some makes of diesel tractors are very complicated. For that reason it is advisable that servicing, other than servicing the fuel filters and bleeding the fuel lines, be left to mechanics highly skilled in this area.

Clean fuel, free from moisture and foreign matter, is essential for proper functioning of a diesel fuel system; therefore, filters must be carefully serviced regularly.

To replace fuel filters or to clean permanent type filters follow this procedure:

1. Turn off fuel supply at tank.

2. Clean outside of filter body and engine area around filter. Wipe dry.

3. Drain fuel from filter.

4. Remove old filter.

5. Wash filter as described under fuel systems for gasoline engines.

6. Clean inside of filter bowl (unless it is a self-contained type).

7. Reinstall cleaned filter or new disposal filter element.

8. Complete the filter assembly and tighten it.

9. Replace the drain plug or tighten the drain valve.

Servicing filters usually results in considerable air being left in the filter body and fuel line. Air in the filter and fuel line may cause an air lock when starting the engine. To prevent this condition, the fuel lines should be bled to remove the air.

The procedure that follows is about the same for bleeding first, second, and third stage filters.

1. Open the fuel tank, shut-off valve at the bottom of the tank.

2. Open the drain cock at the bottom of the fuel filter base. Close the drain cock when the fuel begins to flow.

3. Open the bleed screw at the top of the filter cover to release air that may be trapped. After a solid flow of fuel appears, tighten the bleed screw.

Servicing the manifold, muffler, and exhaust pipe usually is limited to checking for leaks and restrictions and cleaning drain holes on horizontal mufflers. Poor engine performance and burned valves will result from restrictions in the exhaust system.

Servicing the manifold includes removing the manifolds from the engine for thorough cleaning. Deposits of gum may be found inside the intake manifold as well as carbon deposits inside the exhaust manifold. They should be soaked in a good solvent to loosen gum and carbon deposits then dried thoroughly before being reinstalled.

The purpose of a governor on an engine is to automatically regulate the throttle so as to maintain a uniform rate of engine speed regardless of the load.

An improperly adjusted governor causes a loss of horsepower and may cause an increase in fuel consumption.

Governed engine speed, linkage, and other adjustments vary according to engine manufacturer; therefore, it is best to follow the recommendations of the manufacturer found in the service or operator's manual.

Suggested Teaching-Learning Activities

1. After demonstrating proper service techniques, have a student in the class redemonstrate proper technique to the entire class.

2. Have students trouble shoot and service an air, fuel, or exhaust system that has been deliberately "fouled up" by the teacher.

3. Have students report on principles and functions of air, fuel, and exhaust systems.

4. Have students identify major components of air, fuel, and exhaust systems.

5. Have students give reasons for steps suggested in procedures in content.

Suggested Instructional Materials and References

Instructional Materials

1. Charts and diagrams of air, fuel, and exhaust systems

2. Overhead transparencies, preferably overlays, of air, fuel, and exhaust systems. The overlays should be in colors to better illustrate the principles involved and the functions of the parts.

3. One of each type air cleaner

4. Tractors for demonstrations and laboratory experiences for students

5. A set of necessary tools for each student

6. "Fuel System & Fuel Storage," University of Nebraska Filmstrip.

References

1. Tractor Maintenance: Principles and Procedures, pages 53-66, 93-98, 115-117, 126-127.

2. Tractors and Crawlers, pages 144-146.

3. Farm Tractors: Basic Principles, Operation, and Maintenance, pages 31-34.

4. Ford Tractor: Shop Manual, pages 85-149.

Suggested Occupational Experiences

1. Have students completely service and adjust the air, fuel, and exhaust systems on at least two gasoline and two diesel tractors.

2. Have students report to the class on problems encountered.

VI. To maintain and adjust the tractor cooling system

Teacher Preparation

Subject Matter Content

The purpose of the cooling system is to help dispel the excess heat energy from the engine. Only about one-third of the potential heat energy in the tractor engine is turned into useful power and heat. The rest of the heat must be dispelled or the engine will be destroyed. This is accomplished through the exhaust system.

Overheating an engine is likely to caust sticking and burned valves, a cracked engine or block, or excessive engine knock.

There are two types of water cooling systems used on tractors, namely:

1. Thermo-siphon

2. Forced circulation

Three conditions which develop in cooling systems but which can be controlled through proper maintenance are:

1. Mineral deposits

2. Rust

3. Galvanic corrosion

FREEZING PROTECTION TABLE

Cooling System Capacity in Quarts	"PERMANENT" ANTIFREEZE REQUIRED												
	1	2	3	4	5	6	7	8	9	10	11	12	13
						(Quarts)							
5	16°	-12°	-62°										
6	19°	0°	-34°										
7	22°	7°	-17°	-54°									
8	23°	11°	- 7°	-34°	-69°					(Degrees F.)			
9	24°	14°	0°	-21°	-50°								
10	25°	16°	4°	-12°	-34°	-62°							
11	26°	18°	8°	- 6°	-23°	-47°							
12		19°	10°	0°	-15°	-34°	-57°						
13		21°	13°	3°	- 9°	-25°	-45°	-66°					
14			15°	6°	- 5°	-18°	-34°	-54°					
15			16°	8°	0°	-12°	-26°	-43°	-62°				
16			17°	10°	2°	- 8°	-19°	-34°	-52°				
17			18°	12°	5°	- 4°	-14°	-27°	-42°	-58°			
18			19°	14°	7°	0°	-10°	-21°	-34°	-50°	-65°		
19			20°	15°	9°	2°	- 7°	-16°	-28°	-42°	-56°		
20				16°	10°	4°	- 3°	-12°	-22°	-34°	-48°	-62°	
21				17°	12°	6°	0°	- 9°	-17°	-28°	-41°	-54°	-68°
22				18°	13°	8°	2°	- 6°	-14°	-23°	-34°	-47°	-59°
23				19°	14°	9°	4°	- 3°	-10°	-19°	-29°	-40°	-52°
24					15°	10°	5°	0°	- 8°	-15°	-24°	-34°	-46°

Adjust and maintain the cooling system through the following procedure:

1. Check radiator air passages to make sure they are free of foreign materials.

2. Check hose and hose clamps.

3. Check fan belt to make sure it is not broken or slipping. If the belt is slipping, it may be tightened by shifting the position of the generator, if it is driven by the fan belt, or by changing the position of an adjustable sheave on the fan pulley.

4. Check for external leaks other than those caused by loose hose clamps.

5. Flush cooling system if rust shows in the coolant. If a commercial flushing compound is to be used follow the instructions on the container.

6. Refill with coolant. Use clean soft water and add rust inhibitor or new antifreeze.

7. Change the antifreeze each year. Engine gases escape through the walls of the engine into the coolant changing the antifreeze into an acid.

Suggested Teaching-Learning Activities

1. Have students learn the components of cooling systems.

2. Have students list advantages and disadvantages of the two types of water cooling systems.

3. Have students report on causes of fouled cooling systems.

4. Demonstrate the difference in "boiling off" rates between alcohol and ethylene-glycol antifreeze with the resultant difference in protection levels.

5. Have students list several kinds of antifreezes and give good and bad points about each.

6. Attach a hose to the bottom of a five-gallon pail. Fill the pail half full with antifreeze and test for acidity with litmus paper. Attach the other end of the hose to the exhaust of a tractor engine. Start the engine forcing the exhaust fumes through the antifreeze.

Allow the engine to run about eight minutes. Then shut off the engine and let the antifreeze cool. After the antifreeze has colled to normal temperature, test it again with the litmus paper.

7. Demonstrate by placing clean iron in an old antifreeze solution that rust-inhibitive qualities are lost after prolonged usage.

8. Demonstrate how to check old thermostats for reliability.

9. Prepare a chart showing the amount of excessive cylinder wear, fuel consumption, and power loss caused by too low an engine operating temperature using the following data:

For a 60-hour gasoline engine test -

Operating temperature	40° F	100° F	140° F	160° F	180° F
Fuel consumption	3.8 gph	3.5 gph	3.2 gph	2.9 gph	2.8 gph
Cylinder wear	.008"	.002"	.001"	.0005"	.0003"
Power	26 hp	27.2 hp	28.5 hp	29 hp	29.5 hp

Suggested Instructional Materials and References

Instructional Materials

1. Charts on cooling system
2. Samples of flushing compounds and antifreezes
3. Tractors for demonstrations and experiences
4. Charts - The Engine Cooling System
5. "Cooling System," University of Nebraska Filmstrip.

References

1. Tractor Maintenance: Principles and Procedures, pages 105-111.

2. Farm Tractors: Basic Principles, Operation, and Maintenance, pages 58-65.

3. Tractors and Crawlers, pages 172-174.

4. Farm Tractor Tune-up and Service Guide.

Suggested Occupational Experiences

1. Have students completely service at least one cooling system.

2. Have students report unusual findings to the class.

VII. To maintain and adjust the power train

Teacher Preparation

Subject Matter Content

The power train of a tractor is considered to be the parts to the rear of the tractor engine that transmit engine power to the rear wheels or power take-off shafts.

Power trains vary in design according to manufacturers; therefore, it is advisable to follow procedures suggested by manufacturers when adjusting the power train. However, all manufacturers include basic components that are similar in design.

The clutch is a device for disconnecting the tractor engine from its lead while starting and idling. Clutches are either hand or foot operated. Regardless of the type used, the principle of operation is the same.

To adjust foot-operated clutches follow this procedure:

1. Determine from the operator's manual how much free travel is needed. This varies from $\frac{1}{2}$ inch to $1\frac{1}{2}$ inches.

2. Check clutch pedal for free travel.

3. Locate means provided for clutch adjustment.

4. Adjust linkage until clutch pedal has sufficient free travel.

5. Tighten locknut so that it holds adjustment securely.

To adjust hand-operated clutches follow these steps:

1. Check clutch-lever action to determine if adjustment is needed.

2. Disengage the clutch.

3. Place gear shift lever in neutral.

4. Remove hand hole cover on housing.

5. Turn clutch by hand until locking mechanism is on side next to hand hole.

6. Loosen lock and tighten collar one notch at a time or as recommended by operator's manual.

7. Check clutch lever for proper operation.

8. Replace lock pin and make certain it is properly seated.

9. Replace hand hole cover.

Servicing the remainder of the power train is limited primarily to the drive mechanism. Tests have shown that changing oil properly and at proper intervals in the transmission, final drive, and other parts of the drive train increases the life and efficiency of the tractor and reduces maintenance cost by as much as 5 per cent. Servicing the drive trains should be done in the following manner:

1. Drive the tractor until gear oil is thoroughly heated.

2. Place the tractor on a level surface.

3. Remove the drain plug(s) and clean, if of the magnetic type.

4. Replace the transmission oil filter, if the tractor has a filter.

5. Replace the drain plug(s).

6. Refill with the amount, type, and grade of lubricant recommended by the operator's manual.

7. Flush and drain gear case(s) with flushing oil on diesel fuel.

8. Clean filler plug and surrounding area.

9. Refill with proper type and grade of gear lubricant.

10. Replace filler plug(s).

11. Clean breather(s).

Suggested Teaching-Learning Activities

1. Have students list faulty mechanical or operational conditions which may develop due to an improperly serviced power train.

2. Have students diagram and label components of a power train.

3. Have students determine kinds of lubricants to be used in servicing the power train.

4. Have students list reasons for properly adjusting clutches.

5. Show students worn out clutch assemblies caused by improper adjustment or lack of attention.

6. Demonstrate proper clutch adjustment technique on cutaway clutch assemblies to more clearly present the necessity for proper clutch adjustment.

7. Demonstrate with a cutaway differential housing and one differential gear operated by an electric motor why the proper grade and type of lubricant is needed to furnish proper protection.

Suggested Instructional Materials and References

Instructional Materials

1. Charts and diagrams of power trains of different makes of tractors

2. Tools needed for this activity

3. Tractors

4. Cutaway models of power trains

References

1. Tractor Maintenance: Principles and Procedures, pages 71-75, 117-121.

2. Tractors and Crawlers, pages 178-245.

3. Farm Tractor Tune-Up and Service Guide.

Suggested Occupational Experiences

1. Have students adjust hand operated and foot operated clutches.

2. Have students service the power train components of a tractor.

VIII. To adjust tractor brakes

Teacher Preparation

Subject Matter Content

Brakes on tractors are used for stopping and for assistance in making short turns.

Three types of brakes used on tractors are:

1. External band brakes (external contracting)

2. Shoe brakes (internal expanding)

3. Disc brakes (mechanical, hydraulic and power)

To adjust mechanical brakes follow this procedure:

1. Check to see what provision is made for brake adjustment.

2. Jack up rear of tractor until both rear wheels clear the ground.

3. Release brake lock(s).

4. Complete the preliminary arrangements for adjustment of first brake.

5. Tighten adjusting screw, adjusting rod, or adjusting nut.

6. Complete reassembly, or tightening of locknuts, to maintain adjustments.

7. Adjust second brake in the same manner as the first one.

8. Check to make certain that the brakes are equalized.

9. Lower tractor from jack(s).

Hydraulic brakes do not require the same adjustments as mechanical brakes. Procedures listed in the operator's manual should be followed if air bleeding is necessary.

Suggested Teaching-Learning Activities

1. Show students examples of brake failures caused by different conditions.

2. Demonstrate the necessity for equalizing brake adjustments by driving a tractor with unequalized brakes on dry pavement. Show the difference in brake drum temperatures at the end of the demonstration.

3. Develop a clipping file of farm accidents caused by brake failures and present to the class.

4. Have students list types of brakes and give advantages of each.

5. Have students list reasons for keeping brakes properly adjusted.

Suggested Instructional Materials and References

Instructional Materials

1. Charts and diagrams of brake systems

2. Tractors for demonstration and practice

3. A set of tools for each student necessary for the activity

4. Overhead transparencies of brake systems

References

1. Tractor Maintenance: Principles and Procedures, pages 66-71.

2. Tractors and Crawlers, pages 248 - 261.

3. Farm Tractor Tune-Up and Service Guide

Suggested Occupational Experiences

Have students adjust at least two types of brakes.

IX. To maintain and adjust steering mechanisms and wheels

Teacher Preparation

Subject Matter Content

Steering mechanisms vary in design. Maintenance and adjustments on steering mechanisms should be according to the recommendations of the manufacturers. Maintenance and adjustments usually consist of lubricating properly and tightening connections.

Operator's manuals for the make of tractors used in the laboratory should be secured and followed in developing this competency.

Servicing tractor wheels includes several activities. These activities are:

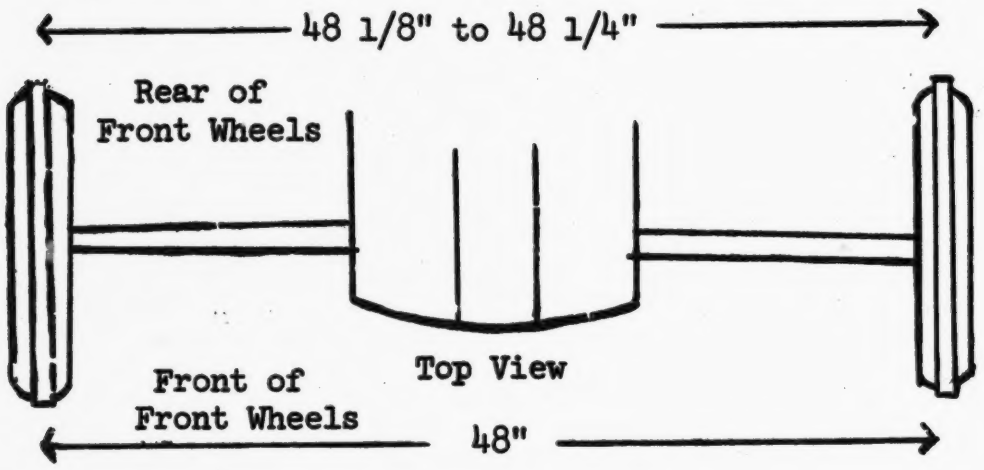
1. Checking wheel alignment (for standard type tractors)

2. Checking tires

3. Servicing front wheel bearings

Proper front wheel alignment reduces tire wear and makes steering easier. Proper toe-in is 1/8 inch to 1/4 inch. This means the total distance between the centerlines at the front of the tires should be 1/8 to 1/4 inch less than the total distance between the centerlines at the rear of the tires.

Example of Checking Toe-In



Toe-in adjustment is made by adjusting the clevis on the end of the tie rod.

Properly inflated tires last longer and help the tractor deliver satisfactory drawbar pull.

Tire inflation should be checked by the following procedure:

1. Remove valve cap and check pressure with guage. If pressure is checked with valve stem in the top position, add 1/2 pound per foot of liquid height.

2. Add air (or deflate) as needed to secure proper pressure.

3. Wash guage with clean water after using on tires containing calcium-chloride solution.

4. Replace valve cap.

Tires should also be checked for cuts, breaks, nails, stones, etc.

Much damage may result if grit and dirt particles are allowed to enter the bearings. Proper servicing helps prevent this condition.

Some tractors are equipped with grease fittings for gun lubrication. This type should be greased daily so the new grease

will work out around the dust seal and remove grit and dirt particles. These bearings should be thoroughly cleaned and repacked at least once a year.

Bearings on tractors without grease fittings must be serviced more frequently. To service this type bearing, follow this procedure:

1. Raise front wheels off the ground.
2. Clean dirt from wheel and hub cap and remove hup cap.
3. Remove cotter pin and adjusting nut.
4. Remove thrust washer and outer bearings.
5. Pull wheel off the spindle.
6. If the inner bearing remained in the hub, remove it.
7. Wash bearings thoroughly in a good grade solvent.
8. Remove all solvent from bearings and other washed parts, or else use gasoline and let parts air dry.
9. Examine bearings for wear.
10. Examine grease-retainer ring and seal. Replace if damaged.
11. Clean hub, hub cap, and spindle.
12. Pack each bearing with grease.
13. Replace inner bearing and grease-retainer seal if removed originally.
14. Coat spindle and inside of hub with grease.
15. Position wheel on spindle and install outer bearing.
16. Install thrust washer and slotted adjusting nut.
17. Turn wheel and tighten castellated nut until wheel just begins to drag, then back off the amount recommended by the operator's or service manual; or, tighten castellated nut to proper torque with torque wrench.

18. Lock nut with cotter pin.

19. Replace hub cap.

Suggested Teaching-Learning Activities

1. Have students develop a table of operating pressures for farm tractor tires.

2. Have students report on different types of tractor tires which should be installed for different soil or use.

3. Prepare a collection of sections of tire carcasses showing the following conditions:

   a. Weather checking caused by over-inflation or long exposure to sunlight

   b. Sidewall buckling and cord injury caused by under-inflation

   c. Diagonal or "x"-type breaks caused by over-inflation

   d. Tread-wiping caused by excessive operation on pavement

4. Develop a collection of wheel bearing assemblies ruined by:

   a. Lack of grease

   b. Excessive tightening of the castellated nut

   c. Dirt and grit accumulated because of worn out grease seals or because of lack of attention to cleanliness when packing the bearings

   d. Not removing solvent from bearings and races before repacking thereby preventing the grease from adhering to the metal surfaces

5. Make a toe-in calibration adjustment bar out of 1/2" pipe or hardwood and a chalk holder to demonstrate toe-in measurements.

6. Have students report on different types of front wheel assemblies and type of bearings used on tractors.

Suggested Instructional Materials and References

Instructional Materials

1. Charts and diagrams of steering mechanisms and wheel and bearing assemblies

2. Tractors

3. Tools for student use necessary for this competency

References

1. Tractors and Crawlers, pages 102-118.

2. Tractor Maintenance: Principles and Procedures, pages 28-32, 99-104.

Suggested Occupational Experiences

1. Have students align front wheels on a tractor.

2. Have students check and service tires on a tractor.

3. Have students clean and service front wheel bearings on at least one tractor.

X. To select and use proper lubricants for tractors

Teacher Preparation

Subject Matter Content

If the person being taught this module on "Tractor Tune-up and Maintenance" has not been taught the competency on understanding agricultural machinery lubrication included in the module on "Agricultural Machinery Assembly and Lubrication," he should be taught that competency at this time.

Suggestions for Evaluating Educational Outcomes of the Module

The educational outcomes of this module should be evaluated according to attitudinal changes and manipulative skills developed.

1. Manipulative skills

It is suggested that each student be required to perform a complete engine service tune-up, check and adjustment of those systems usually included in a tune-up and service operation. The teacher should observe the performance of each student to evaluate the student's accomplishments. Also, it is suggested that the student use a dynamometer in performing the tune-up operation. The use of the dynamometer should be demonstrated thoroughly to the student prior to this activity.

A suggested sequence for the servicing and tune-up of a gasoline tractor:

a. Remove spark plugs, inspect, then clean and regap or replace them as necessary.

b. Test engine compression.

c. Adjust valve clearance.

d. Remove distributor, disassemble, clean, recondition, and relubricate.

e. Regap breaker points or replace if necessary.

f. Inspect distributor rotor, cap, and ignition cables.

g. Clean fuel sediment bowl and screen.

h. Remove and clean crankcase oil pan and the oil pump screen.

i. Check carburetor fuel level.

j. Adjust carburetor fuel level, recondition or replace float valve assembly as necessary, and replace the bowl gasket.

k. Inspect the air cleaner and connections.

l. Remove and wash air filter screens and cup and replace hose if necessary

m. Install the spark plugs with new gaskets.

n. Check and correct ignition timing.

o. Cover the radiator and run the engine until it reaches normal operating temperature.

p. Adjust carburetor idle mixture and idle speed of the engine.

q. Check main fuel adjustment screw setting of the carburetor.

r. Adjust fast idle governed speed.

s. Check cooling system for pressure build-up at the radiator cap, coolant flow, and inspect the condition of the cap, upper and lower hoses, and the radiator core.

t. Flush the cooling system, clean the radiator fins, and replace hoses as necessary.

u. Inspect and adjust both fan and generator belts as necessary.

v. Inspect and adjust brakes.

w. Inspect and adjust clutches.

x. Inspect and service tires.

y. Check toe-in of front wheels.

z. Inspect and make necessary corrections in lights.

2. Attitudes

Attitudes should be evaluated according to:

a. Student participation in class discussions

b. Student response to assignments made

c. Carefulness and thoroughness of jobs performed

Sources of Suggested Instructional Materials and References

Instructional Materials

1. "Cooling System," Lincoln, Nebraska, University of Nebraska, College of Agriculture, Department of Agricultural Education.

2. "Electrical System," Lincoln, Nebraska, University of Nebraska, College of Agriculture, Department of Agricultural Education.

3. "Fuel System and Fuel Storage," Lincoln, Nebraska, University of Nebraska, College of Agriculture, Department of Agricultural Education.

References

1. Bedell, Earl and Frazee, Irving. Tractors and Crawlers, Chicago, Illinois: American Technical Society, 1963.

2. Henderson, G. E. and Turner, J. Howard. Farm Tractor Tune-Up and Service Guide, 1963, Southern Association Agricultural Engineers and Vocational Agriculture, Barrow Hall, Athens, Georgia. Price: $1.85.

3. Henderson, G. E. and Turner, J. Howard. Tractor Fuels and Lubricants, 1964. Southern Association Agricultural Engineers and Vocational Agriculture, Barrow Hall, Athens, Georgia. Price: $1.20.

4. Henderson, G. E. and Turner, J. Howard. Tractor Maintenance: Principles and Procedures, 1964. Southern Association Agricultural Engineers and Vocational Agriculture, Barrow Hall, Athens, Georgia. Price: $3.25.

5. Promersberger, W. J. and Bishop, F. E. Modern Farm Power, Englewood Cliffs, New Jersey: Prentice-Hall Inc., 1962.

6. Electrical, 1961. International Harvestor Company, 180 N. Michigan Avenue, Chicago, Illinois, Price: $1.50.

7. Farm Tractors: Basic Principles, Operation, and Maintenance, Engineering Bulletin No. FT-53, American Oil Company, New York City, New York. No Charge.

8. Gulf Farm Tractor Guide, Gulf Oil Corporation, Gulf Building, Houston, Texas. No. SP10293, No charge.

9. Implement and Tractor Shop Manual. Implement and Tractor Publications, Inc., 1014 Wyandotte Street, Kansas City, Missouri.

10. Implement and Tractor Tune-up Specifications. Implement and Tractor Publications, Inc., 1014 Wyandotte Street, Kansas City, Missouri.

11. "Nebraska State Test and Chart for P.T.O. Speed, Fuel Compression and Horsepower," Agricultural Engineering Department, College of Agriculture, Lincoln, Nebraska.

12. Tractor Maintenance and Tune-Up, 1962. International Harvestor Company, 180 North Michigan Avenue, Chicago 1, Illinois. Price: $1.50.

13. Ford Tractor: Shop Manual, 1955-60. Tractor and Implement Division, Ford Motor Company, Dearborn, Michigan.

THE CENTER FOR RESEARCH AND LEADERSHIP DEVELOPMENT
IN VOCATIONAL AND TECHNICAL EDUCATION
THE OHIO STATE UNIVERSITY
980 KINNEAR ROAD
COLUMBUS, OHIO, 43212

INSTRUCTOR NOTE: As soon as you have completed teaching each module, please record your reaction on this form and return to the above address.

1. Instructor's Name _____

2. Name of school _____ State _____

3. Course outline used: _____Agriculture Supply--Sales and Service Occupations
_____Ornamental Horticulture--Service Occupations
_____Agricultural Machinery--Service Occupations

4. Name of module evaluated in this report _____

5. To what group (age and/or class description) was this material presented? ____
_____

6. How many students:
   a) Were enrolled in class (total) _____
   b) Participated in studying this module _____
   c) Participated in a related occupational work experience program while you taught this module _____

7. Actual time spent teaching module:

		Recommended time if you were to teach the module again:
_____hours	Classroom Instruction	_____hours
_____hours	Laboratory Experience	_____hours
_____hours	Occupational Experience (Average time for each student participating)	_____hours
_____hours	Total time	_____hours

(RESPOND TO THE FOLLOWING STATEMENTS WITH A CHECK (✓) ALONG THE LINE TO INDICATE YOUR BEST ESTIMATE.)

	VERY APPROPRIATE	NOT APPROPRIATE
8. The suggested time allotments given with this module were:		
9. The suggestions for introducing this module were:		
10. The suggested competencies to be developed were:		
11. For your particular class situation, the level of subject matter content was:		
12. The Suggested Teaching-Learning Activities were:		
13. The Suggested Instructional Materials and References were:		
14. The Suggested Occupational Experiences were:		

(OVER)

15. Was the subject matter content sufficiently detailed to enable you to develop the desired degree of competency in the student? Yes_____No_____
Comments:

16. Was the subject matter content directly related to the type of occupational experience the student received? Yes_____No_____
Comments:

17. List any subject matter items which should be added or deleted:

18. List any additional instructional materials and references which you used or think appropriate:

19. List any additional Teaching-Learning Activities which you feel were particularly successful:

20. List any additional Occupational Work Experiences you used or feel appropriate:

21. What do you see as the major strength of this module?

22. What do you see as the major weakness of this module?

23. Other comments concerning this module:

_____ (Date)

_____ (Instructor's Signature)

_____ (School Address)

Complimentary

I. R. D. 501

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GASOLINE TRACTOR ENGINE SYSTEMS

One of Sixteen Modules in the Course Preparing for Entry in
AGRICULTURAL MACHINERY - SERVICE OCCUPATIONS

Module No. 14.

The Center for Research and Leadership Development
in Vocational and Technical Education

The Ohio State University
980 Kinnear Road
Columbus, Ohio, 43212

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

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August, 1965

VT000501

MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) James W. Hensel (Agency) The Center for Vocational and Technical Education

(Address) 980 Kinnear Road, Columbus, Ohio 43212

DATE: August 4, 1967

RE: (Author, Title, Publisher, Date) Module No. 14, "Gasoline Tractor Engine Systems," The Center for Vocational and Technical Education, August, 1965.

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Provide information below which is not included in the publication. Mark N/A in each blank for which information is not available or not applicable. Mark P when information is included in the publication. See reverse side for further instructions.

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Users of Material Teachers

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Teacher Competency Background in agricultural machinery
Student Selection Criteria Post high school, mechanical aptitude, high school background, goal in agricultural machinery service occupation.
Time Allotment Estimated time listed in module. (P)

Supplemental Media --
Necessary x
Desirable ____ (Check Which)

Describe Suggested references given in module. (P)

Source (agency)
(address)

GASOLINE TRACTOR ENGINE SYSTEMS

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THE CENTER FOR RESEARCH AND LEADERSHIP DEVELOPMENT
IN VOCATIONAL AND TECHNICAL EDUCATION
THE OHIO STATE UNIVERSITY
980 KINNEAR ROAD
COLUMBUS, OHIO, 43212

INSTRUCTOR NOTE: As soon as you have completed teaching each module, please record your reaction on this form and return to the above address.

1. Instructor's Name_____

2. Name of school_____State_____

3. Course outline used: _____Agriculture Supply--Sales and Service Occupations
_____Ornamental Horticulture--Service Occupations
_____Agricultural Machinery--Service Occupations

4. Name of module evaluated in this report_____

5. To what group (age and/or class description) was this material presented?____
_____

6. How many students:
   a) Were enrolled in class (total) _____
   b) Participated in studying this module _____
   c) Participated in a related occupational work experience program while you taught this module _____

7. Actual time spent teaching module:

		Recommended time if you were to teach the module again:
_____hours	Classroom Instruction	_____hours
_____hours	Laboratory Experience	_____hours
_____hours	Occupational Experience (Average time for each student participating)	_____hours
_____hours	Total time	_____hours

(RESPOND TO THE FOLLOWING STATEMENTS WITH A CHECK (✓) ALONG THE LINE TO INDICATE YOUR BEST ESTIMATE.)

	VERY APPROPRIATE	NOT APPROPRIATE
8. The suggested time allotments given with this module were:	. . . .	
9. The suggestions for introducing this module were:	. . . .	
10. The suggested competencies to be developed were:	. . . .	
11. For your particular class situation, the level of subject matter content was:	. . . .	
12. The Suggested Teaching-Learning Activities were:	. . . .	
13. The Suggested Instructional Materials and References were:	. . . .	
14. The Suggested Occupational Experiences were:	. . . .	

(OVER)

15. Was the subject matter content sufficiently detailed to enable you to develop the desired degree of competency in the student? Yes_____No_____
Comments:

16. Was the subject matter content directly related to the type of occupational experience the student received? Yes_____No_____
Comments:

17. List any subject matter items which should be added or deleted:

18. List any additional instructional materials and references which you used or think appropriate:

19. List any additional Teaching-Learning Activities which you feel were particularly successful:

20. List any additional Occupational Work Experiences you used or feel appropriate:

21. What do you see as the major strength of this module?

22. What do you see as the major weakness of this module?

23. Other comments concerning this module:

_____ (Date)

_____ (Instructor's Signature)

_____ (School Address)

GASOLINE TRACTOR ENGINE SYSTEMS

Major Teaching Objectives

To understand the principles of operation and the components and their functions of the various systems of a gasoline tractor engine

Suggested Time Allotments

At school		
Class instruction	18 hours	
Laboratory experience	24 hours	
Total at school		42 hours
Occupational experience		0 hours
Total for module		42 hours

Suggestions for Introducing the Module

It is highly important for those preparing for employment in an agricultural machinery service occupation to understand the construction and principles of operation of tractor gasoline engines.

Competition is keen in many areas of agricultural machinery service because buyers and users of agricultural machinery are demanding first-class service. Employers, therefore, are interested only in efficient employees.

The following techniques should be used to create interest in the module:

1. Bring a small tractor before the class. Remove the rotor button and ask a student why the engine will not run. Replace the rotor button and close the air intake (air cleaner) and ask another student to explain the reason the engine will not run. Involve students in a discussion of the principles of internal engine combustion. Also review the history of the development of internal combustion engines.

2. Place various parts of the gasoline engine system around the classroom and have students attempt to identify them. As the instruction in this module progresses, refer to the parts placed before the class for identification.

Competencies to be Developed

I. To understand the principles of operation of gasoline engines

Teacher Preparation

Subject Matter Content

The basic principles of internal combustion engines were first put forth by a Frenchman named DeRochas in 1862. Experimentation was carried out as early as 1678 by Hautefeuille, of France, to devise a heat engine that would utilize heat to produce continuous power. This particular engine used gun powder but did not prove practical. In 1680, a Dutchman named Huygens exhibited in Paris an engine with a cylinder and piston. This engine also operated on explosive powder.

Experiments on internal combustion engines continued, but it was 1876 before the first successful internal combustion engine on the four-stroke-cycle principle was patented by Dr. N. A. Otto, a German. In 1878, Dugald Clerk, an Englishman, patented a two-stroke-cycle engine.

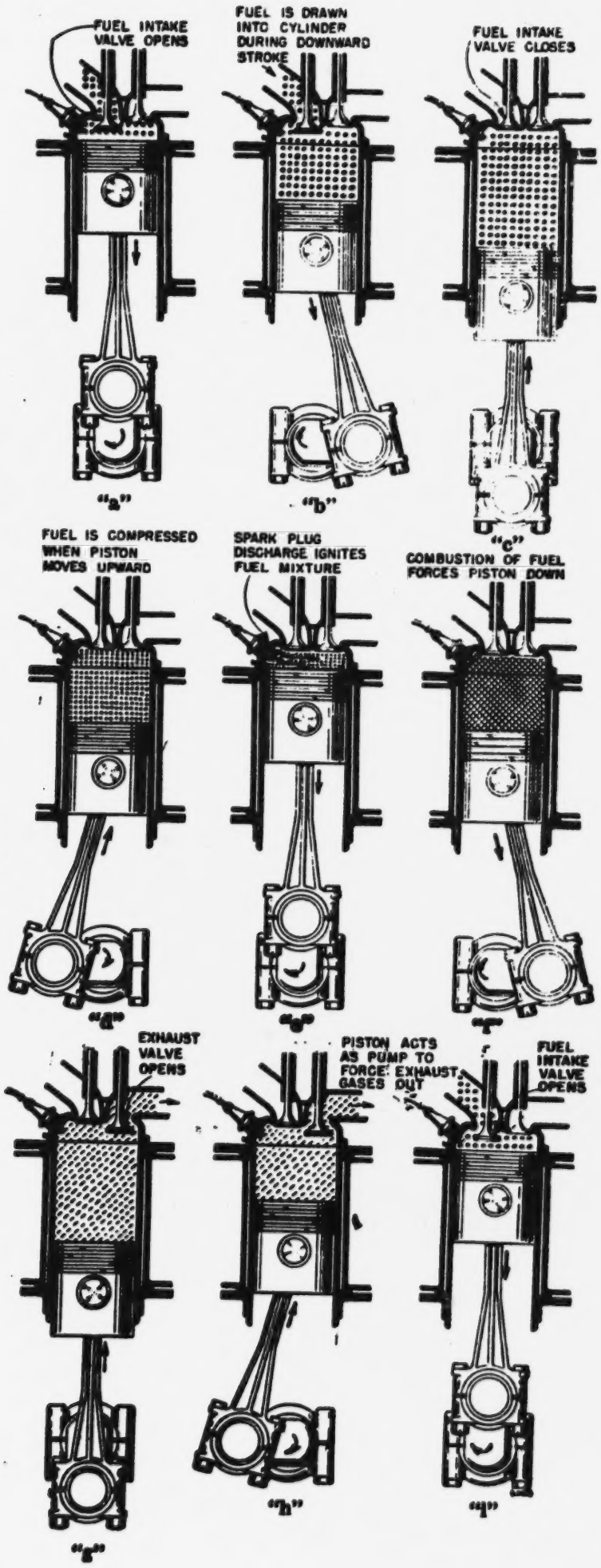
Internal combustion engines generate power by utilizing force created by the combustion of fuel and air. Combustion is the chemical action of oxidation. When this occurs in the internal combustion engine, the process is very rapid and produces great quantities of heat, expanding the gases which produce great pressures. It is the pressure of expansion that the engine converts to mechanical energy at the crankshaft.

Internal combustion engines may be four-stroke-cycle engines or two-stroke-cycle engines. The four-stroke-cycle engine is the most common type found in farm tractors. A stroke is the movement of the piston from Top Dead Center (TDC) or Head Dead Center (HDC) to Crank Dead Center (CDC). A stroke may also be defined as one half a revolution, or 180 degrees crankshaft travel, or the movement of the piston from its highest position in the cylinder to its lowest position in the cylinder.

The action which takes place in a complete cycle involves

1. Intake
2. Compression
3. Power
4. Exhaust

In a four-stroke-cycle engine, four up-and-down movements of the piston are required to complete the necessary actions. In a two-stroke-cycle engine only two up-and-down movements are needed to complete the necessary actions of intake, compression, power, and exhaust.



Sequence of Operations--
Four Cycle Spark-Ignition
Engine

Suggested Teaching Learning Activities

1. Use cutaway engines to demonstrate movement of pistons, valves, etc., in a four-stroke-cycle engine and a two-stroke-cycle engine.

2. Use transparencies and motion pictures to illustrate principles of internal combustion engines.

3. Have students make sketches illustrating the different strokes of the four- and two-stroke-cycle engines.

Suggested Instructional Materials and References

Instructional materials

1. Cutaway engines, four-stroke-cycle small engines and two-stroke-cycle small engines

2. Charts depicting the principles of internal combustion engines

3. Motion pictures and transparencies depicting principles of internal combustion engines

References

S*1. Tractors and Crawlers, pp. 140-144.

S 2. Modern Farm Power, pp. 9-19.

S 3. The ABC of Internal Combustion.

*The symbol T (teacher) or S (student) denotes those references designed especially for the teacher or for the student.

II. To understand the construction and major components of a tractor gasoline engine

Teacher Preparation

Subject Matter Content

Gasoline engines are composed of many small parts. Each part serves a specific function or, in some cases, several functions. The efficient tractor mechanic must have a thorough understanding

of the many parts of a gasoline engine and the functions they perform.

Because of the peculiar function of each part, each falls into a natural group, referred to as an assembly or a system.

Gasoline engine parts may be grouped into the following systems:

1. Stationary parts
    a. Cylinder block
    b. Cylinder head
    c. Crankcase
    d. Oil pan
    e. Cover
2. Moving parts
    a. Pistons and rings
    b. Connecting rods and wrist pins
    c. Crankshaft
    d. Main bearings
    e. Flywheel
    f. Camshaft and camshaft gear
    g. Valves
    h. Rocker arm assembly
    i. Oil pump and accessories
3. Electrical system
    a. Battery
    b. Generator and charging circuit
    c. Ignition circuit (distributor, coil, spark plugs, breaker points, condensor, and magneto)
    d. Cranking motor

4. Fuel, air, and exhaust systems

   a. Air cleaner

   b. Fuel tank

   c. Fuel line, cut-off valve, strainer, and filter

   d. Fuel pump (only in tractors that do not have the fuel tank located above the engine)

   e. Carburetor

   f. Manifold, muffler, and exhaust pipe

   g. Governors

5. Cooling system

   a. Radiator, hose, and pressure cap

   b. Water pump

   c. Thermostat

   d. Fan

Suggested Teaching-Learning Activities

1. Have students make reports on gasoline engines, naming assemblies and systems, the components of each, and the function of each component.

2. Disassemble a gasoline engine so that the components listed in the content may be seen and studied by the students. Reassemble the components, explain the function of each, and give the relationships of all components in a system.

Suggested Instructional Materials and References

Instructional materials

1. Overhead transparencies and charts of cross section veiws of gasoline engines

2. Overhead transparencies and diagrams of exploded view of each gasoline engine system

3. Tractor engines

References

1. Tractors and Crawlers, pp. 140-176.

2. Modern Farm Power, pp. 20-30.

III. To understand the stationary parts of a tractor gasoline engine

Teacher Preparation

Subject Matter Content

The stationary parts are those major parts of the engine which do not move.

The cylinder block is the basic frame of the engine. It supports all the components in relation to one another and maintains them in alignment. The most important requirement of the cylinder block is rigidity. In most cases, tractor engines are made of cast iron alloy.

Cylinder blocks may vary in design. They may be of the integral bore type; this is, the cylinder bore is machined directly into the material of the block. It may have separate and removable cylinder sleeves. The removable sleeve may be of the wet type (the coolant comes in direct contact with the outer surface of the sleeve), or it may be of the dry type (the sleeve or liner is inserted in the bore and is not in direct contact with the coolant).

Valve-in-block engines have the valve seats, ports, and guides in the block casting with their respective water jackets; whereas, the l-head engine block has only the cylinder bore water jackets.

If the block skirt extends only to the center line of the crankshaft main bearing, it is known as a "short skirt." If it extends below the center line of the crankshaft main bearing, it is known as a "deep skirt."

Many engine blocks may have oil galleries cored in. Others may have steel tubes inserted to act as galleries; whereas, others may have oil lines and fittings to carry oil to the various parts.

As a rule, the cylinder head is made of the same material as the cylinder block. It serves as a cap and is attached to the top of the engine block and covers the upper cylinder openings, thereby forming a combustion chamber.

The crankcase is the lower part of the cylinder block; it confines the lubricating oil near the engine's moving parts in the four-cycle engine. It also supports the crankshaft and camshaft bearings.

The oil pan serves as a reservoir to hold the crankcase lubricant and seals the lower part of the engine in the four-cycle engine.

Various types of covers are used on the timing train, the valve train, and sometimes on other components or inspection-holes. They are usually made of stamped steel.

Suggested Teaching-Learning Activities

1. Have students disassemble and examine several gasoline engines and the stationary parts to observe the various designs.

2. Have students label drawings of stationary engine parts.

3. Have students prepare and present written reports on function, designs, construction materials, etc., of stationary parts.

Suggested Instructional Materials and References

Instructional materials

1. Tractor engines

2. Overhead transparencies and diagrams of stationary engine parts

References

1. Modern Farm Power, pp. 21-22.

S 2. Ford Tractor Shop Manual.

IV. To understand the moving parts of a tractor gasoline engine

Teacher Preparation

Subject Matter Content

The moving parts of the engine that receive the gaseous energy produced in the combustion chamber and deliver it to the output end of the engine in the form of useful power are referred to in this module as the moving parts.

1. Pistons and rings

   Cylinders are sealed and the gaseous pressure transmitted to the connecting rod by the piston and its rings.

   The top section of the piston is the crown, and the lower section is the skirt.

   The upper set of rings, compression or power rings, are carried by the crown of the piston. The lower set of rings, oil control rings, are carried by the skirt of the piston.

2. Connecting rods and wrist pins

   A connecting rod is a bar or strut with a bearing at each end. The purpose of the connecting rod is to transmit the piston thrust to the crankshaft.

   The connecting link between the connecting rod and the piston is the wrist pin.

   There may be three arrangements of wrist pins.

   a. The wrist pin is secured in the piston, and the bearing is held in the connecting rod end.

   b. The wrist pin is fastened to the connecting rod, and the bearing is part of the piston.

   c. The wrist pin is free and bears against bearings in both the piston and the connecting rod.

3. Crankshafts

   Crankshafts deliver force to the transmission and power train as a result of the thrust from the connecting rod.

Some crankshafts are designed with counterweights opposite the crank pins. These relieve the load on the main bearing by offsetting the inertia forces.

4. Bearings

The purpose of bearings is to support rotating shafts and other moving parts that transmit power from one engine part to another.

Bearings reduce the friction between the moving surfaces by separating them with a film of lubricant and carry away the heat produced by unavoidable friction.

5. Flywheels

The flywheel is a heavy wheel or disk attached to the crankshaft. Through rotation, the flywheel acquires kinetic energy. It stores additional kinetic energy when it speeds up and gives back that energy when it slows down.

The main purpose of the flywheel is to reduce the speed fluctuations of the crankshaft, caused by the difference in the amount of energy exerted on the piston during the power stroke and during the compression stroke.

Single-cylinder engines require larger flywheels than multi-cylinder engines, because energy variations during a complete cycle are greater in single-cylinder engines.

6. Camshaft and gear

The camshaft is a lobed shaft which provides accentric action for opening the valves. It is driven from the crankshaft by a timing gear or through a timing chain.

7. Valves

The purpose of valves is to open and close ports in the combustion chamber. Since there are two ports for each cylinder, there must be two valves. The intake valve allows the fuel-air mixture to enter the chamber when the valve is open. Exhaust valves open to allow burned gases to escape from the combustion chamber into the exhaust system. Both valves are closed on the compression and power strokes.

8. Rocker arm assembly

The purpose of the rocker arm assembly is to actuate the valves at the proper time. The rocker arm assembly is actuated by the camshaft and consists of valve lifters, push rods, rocker arms, rocker arm shaft brackets, rocker arm shaft and accessory parts.

9. Oil pump and accessories

The oil pump is located in the oil pan. Its function is to provide engine lubrication. Pumps are of three types: vane, piston, and gear. Because of their long life and trouble-free operation, gear pumps are used in most engines.

In many engines, oil filters are located between the oil pump and the engine parts to remove abrasive particles.

Suggested Teaching-Learning Activities

1. Demonstrate the action of the running gear through the use of engine cutaways.

2. Have students disassemble an engine and study each part of the running gear and its function.

3. Have students label diagrams of running parts of an engine, giving the function of each part and its relationship to other parts.

Suggested Instructional Materials and References

Instructional materials

1. Tractor engines

2. Overhead transparencies and diagrams of running gear parts

3. Engine cutaway of running gear

References

1. Tractors and Crawlers, pp. 140-144.

2. Modern Farm Power, pp. 23-27.

V. To understand the electrical system

Teacher Preparation

Subject Matter Content

The electrical system of a gasoline tractor provides ignition, which is one of the three essentials for combustion. The electrical system also provides power for easy starting and for accessories, such as lights. Knowledge of the electrical system is essential in trouble shooting and in proper tune-up of the tractor engine.

The generator is the source of power in battery-type tractor electrical systems. Usually belt-driven, it is located at the front of the tractor.

The main components of the generator include pole shoes, armature, commutator, brushes, and housing.

Some tractor manufacturers are installing alternators in place of generators on their tractors. The generator develops direct current, which is suitable for direct use by the battery and electrical equipment on the tractor; and the alternator develops alternating current, which must be "rectified" (changed to direct current) before it can be used.

Generators may vary in design, according to electrical requirements. Types include

1. Third brush generator
2. Shunt generator
3. Interpole generator
4. Bucking field generator
5. Split field generator

All DC generator systems include a cut-out relay (automatic switch) to disconnect the generator output circuit when the voltage of the generator is lower than the voltage of the battery.

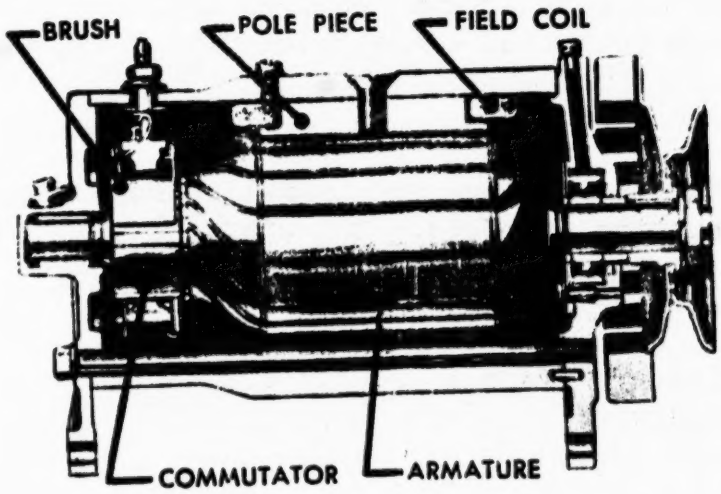
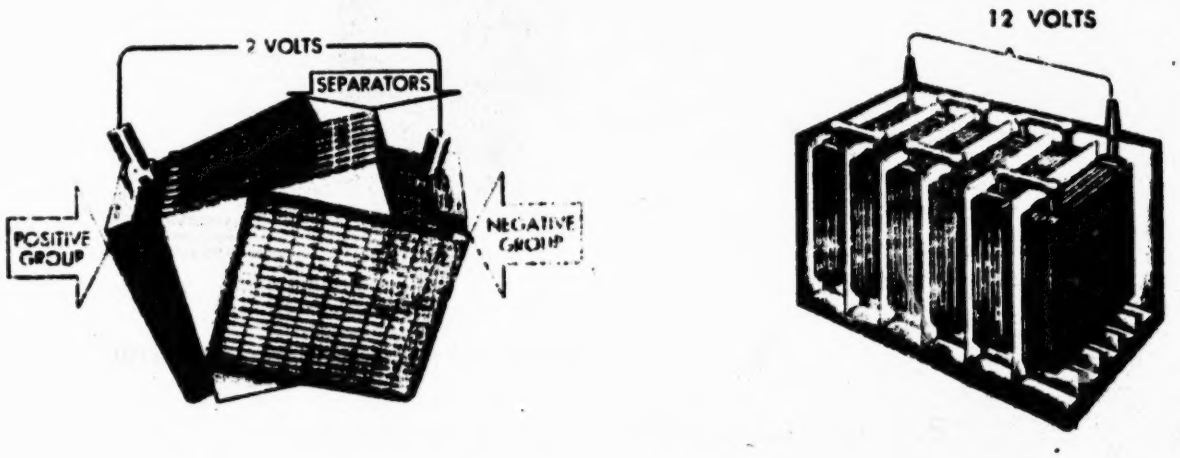


Diagram of Cross Section of a Generator

The purpose of the battery is to convert chemical energy into electrical energy. It stores electrical power when the engine is running, and provides power to start the engine and operate accessories.

A storage battery consists of positive plates, negative plates, an electrolyte, separators, and a container.



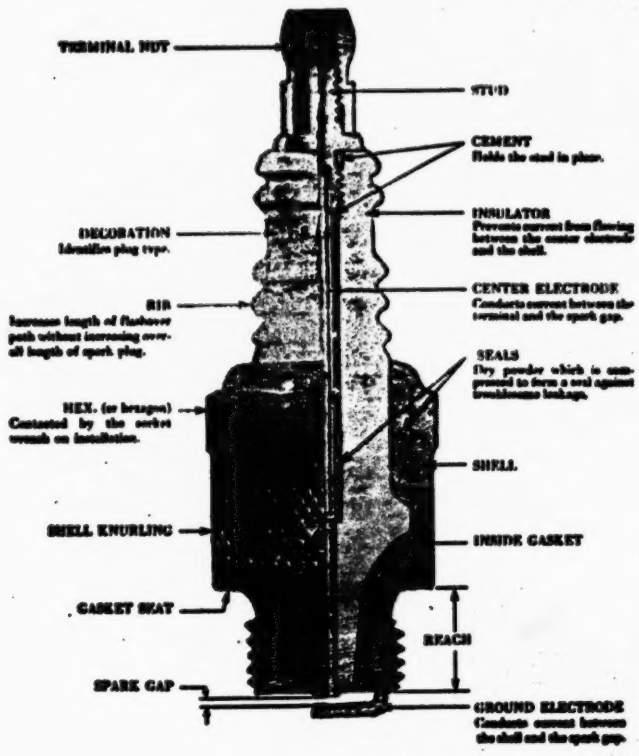
Drawing of a Cross Section View of a Typical Storage Battery

An ignition circuit provides the spark in the combustion chamber to ignite the fuel at the proper time. The major components on farm tractor engines include spark plugs, an ignition coil, and a distributor or a magneto.

1. Spark plugs

The spark plugs are installed in the engine combustion chambers. The spark which "jumps" between the terminal of the spark plug ignites the air-fuel mixture.

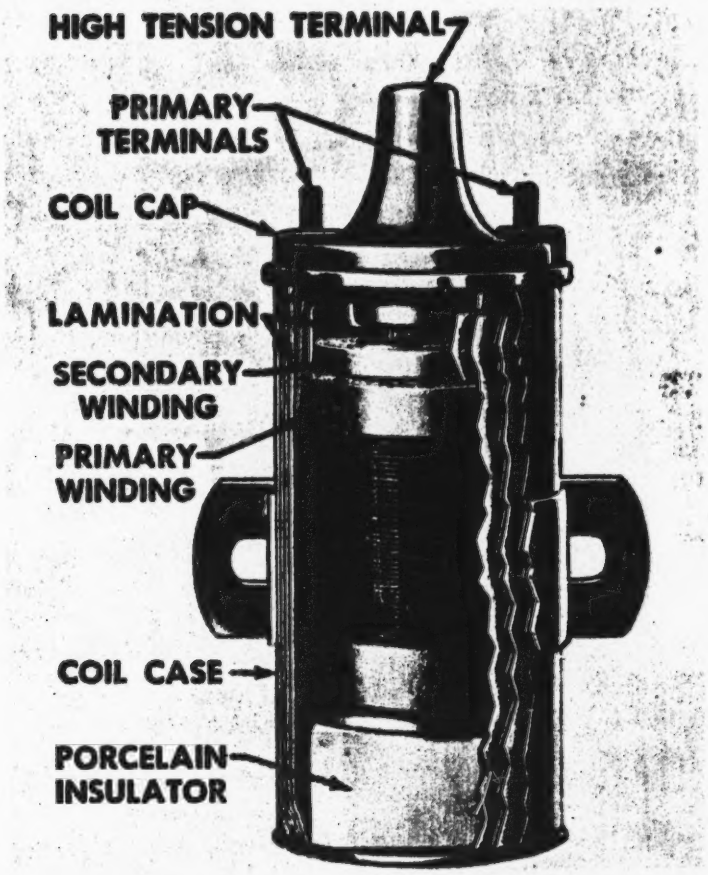
Spark plugs are usually classed as hot, cold, or standard.



Cutaway View of a Spark Plug

2. Ignition coil

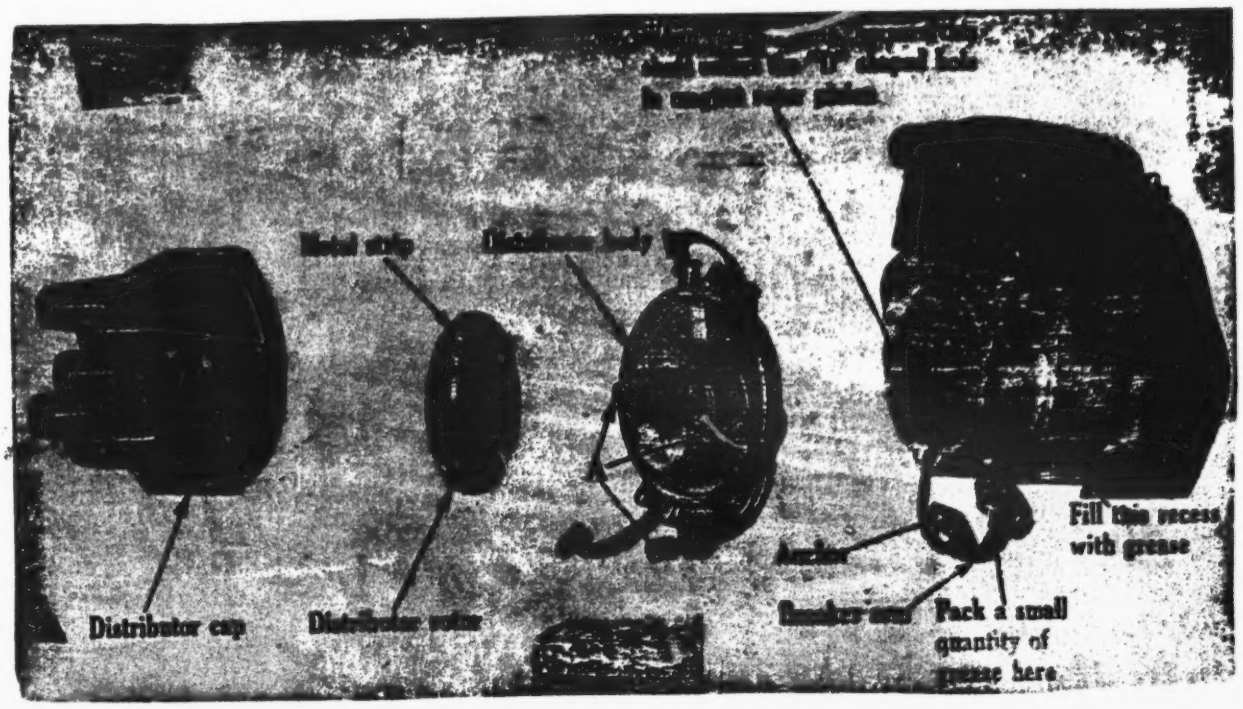
Coils are used in ignition systems to increase the voltage of the electrical current needed to provide the spark in the combustion chamber. Coils increase the current from 6 to 12 volts to as much as 25,000 volts.



Cutaway View of a Typical Ignition Coil

3. Distributor

A distributor has parts of two separate electrical circuits, a low-voltage circuit and a high-voltage circuit. The low-voltage, or primary system, consists of the source of current, a switch, a set of breaker points, a breaker cam, a condenser, a primary coil, and the wiring to make the circuit complete. The high-voltage, or secondary system, consists of the secondary, the spark distributor, the spark plugs, and the wiring to make the circuit complete. Also, most systems include a mechanism for advancing the timing of the spark.



Cutaway View of a Distributor

4. Magneto

Magnetos are self-contained assemblies which are driven by the engine and supply high voltage current to the spark plugs.

Magnetos contain a coil, a condenser, points, a distributor cap, and a rotor. Magnetos with a spring-loaded drive turn quickly when a cylinder is to fire, thus generating more voltage and resulting in a better spark while starting the engine.

5. Starting motor

The starting motor, or starter, which is found on most tractors, is a series-wound 6-, 12-, or 24-volt direct-current motor mounted near the flywheel of the tractor.

Suggested Teaching-Learning Activities

1. Have students disassemble and study an electrical system.

2. Have students diagram an engine electrical system, showing each major assembly and component.

3. Using electrical circuit parts, have students put together an ignition system typical of that used on a tractor engine. Have students measure the amount of voltage of the battery, and then of one of the plugs. Emphasize that the increase is due to the function of the coil.

Suggested Instructional Materials and References

Instructional materials

1. The electrical system of an engine mounted on a display board

2. Electrical systems for students to use

3. Overhead transparencies, charts, and diagrams showing exploded views of the components of an electrical system

References

1. Tractors and Crawlers, pp. 158-172.

2. Modern Farm Power, pp. 102-130.

S 3. Electrical Systems.

VI. To understand the fuel, air, and exhaust systems

Teacher Preparation

Subject Matter Content

The purpose of tractor fuel systems is to supply fuel to the engine. The fuel system on most tractors with a spark-ignited engine consists of fuel tank, fuel line, cut-off valve, strainers and filters, fuel pump (unless the fuel tank is located above the engine), carburetor, and intake manifold.

1. Fuel tank

The fuel tank serves as a reservoir for the storage of fuel. On most tractors the fuel tank is located above the engine, and the fuel flows to the carburetor by the force of gravity. Some tanks have built-in filters and strainers to prevent dirt from entering the tank with the fuel.

2. Cut-off valve, strainers, and filters

The cut-off valve closes the fuel line when repairs are made on the fuel system. The strainers remove the small particles of foreign matter before they pass into the carburetor. The sediment bowl collects the large particles of dirt and water.

3. Fuel pump

A fuel pump is necessary on tractors that do not have the fuel tanks located above the engine or that do not have gravity pressure sufficient to supply the engine requirements.

4. Carburetor

The purpose of a carburetor is to mix air and fuel in certain definite proportions so as to form an efficient combustible mixture.

There are three basic types of carburetors used at present.

a. Suction type

b. Float type

c. Diaphragm type

5. Intake manifold

The purpose of the intake manifold is to distribute the air-fuel mixture to the cylinders. It consists of passages from the carburetor to pairs of cylinders or, in some cases, to each cylinder.

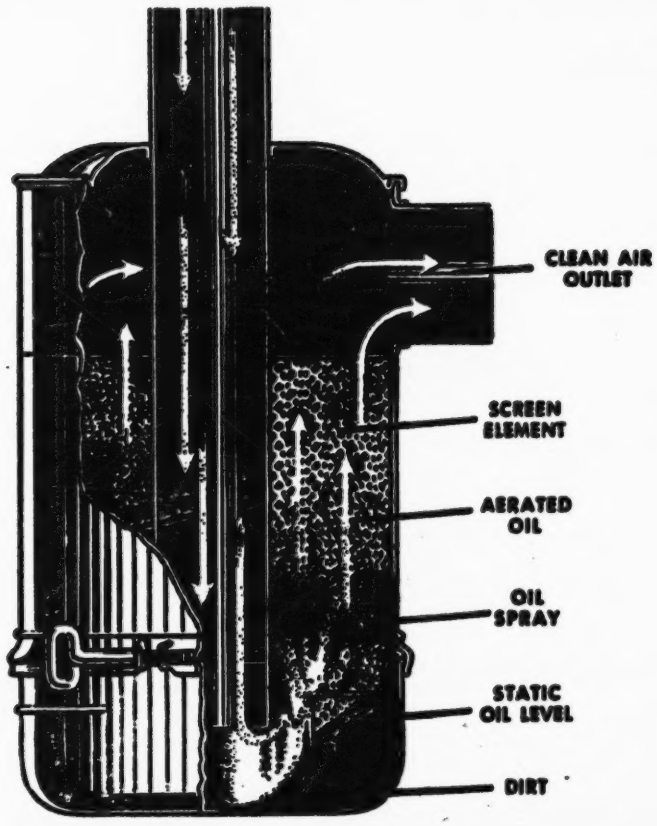
6. Air cleaners

The carburetor air-intake system is part of the fuel system. It consists of a pre-cleaner, a cleaner, and a passage or duct to the carburetor.

The two common types of air cleaners used on tractors are

a. Dry type

b. Oil bath type



Cutaway View of an Oil Bath Type Cleaner

7. Exhaust system

Exhaust systems pipe the exhaust gases away from the engine. Most systems consist of an exhaust manifold to receive the gases from the cylinders, a muffler to reduce the engine noises, and an exhaust pipe to conduct the exhaust gases out of the way of the cylinder.

8. Governors

The purpose of a governor on an engine is to regulate the throttle automatically so as to maintain a uniform rate of engine speed regardless of the load. The flyball or flyweight type of governor is the most common type found on tractors.

Suggested Teaching-Learning Activity

Have students thoroughly disassemble and examine a complete fuel, air, and exhaust system. In the process, they should learn each of the assemblies and the components of each assembly.

Suggested Instructional Materials and References

Instructional materials

1. Tractors for students to use in learning the fuel, air, and exhaust systems

2. Charts and diagrams of air, fuel, and exhaust systems

3. Overhead transparencies, preferably overlays of air, fuel, and exhaust systems

References

1. Tractors and Crawlers, pp. 144-158, 174-176.

2. Modern Farm Power, pp. 51-66, 83-91, 92-101.

S 3. Fuel Systems and Fuel Storage.

VII. To understand the cooling system

Teacher Preparation

Subject Matter Content

Only about one-third of the heat energy of fuel is converted into mechanical energy and leaves the engine in the form of brake horsepower. Thus, about two-thirds of the heat energy of fuel shows up in hot exhaust gases, friction heat, and heating of the walls of the combustion chamber.

The purpose of the cooling system is to remove the unwanted heat from the engine.

Almost all tractor engines are provided with a liquid cooling system. The two types used on tractors are

1. Forced-circulation system

2. Thermo-siphon system

a. Forced-circulation system

This system incorporates a pump to assist the circulation and a thermostat to control the temperature of the coolant by controlling the flow of the coolant.

b. Thermo-siphon system

This system differs from the forced-circulation system because a pump is not used to force the circulation of the coolant; but rather the circulation is caused by the difference in the temperature of the coolant in the radiator and in the engine.

Both systems consist of radiator and fan. The purpose of the radiator is to expose the coolant to the air in such a way that an effective heat exchange may take place. The fan increases the flow of air through the radiator so that the heat is removed more rapidly than would be the case if there were no fan.

Pressure caps are used to allow pressure in the radiator to equalize with outside pressure upon cooling and consequent contraction of the coolant. This eliminates the danger of the radiator tank collapsing.

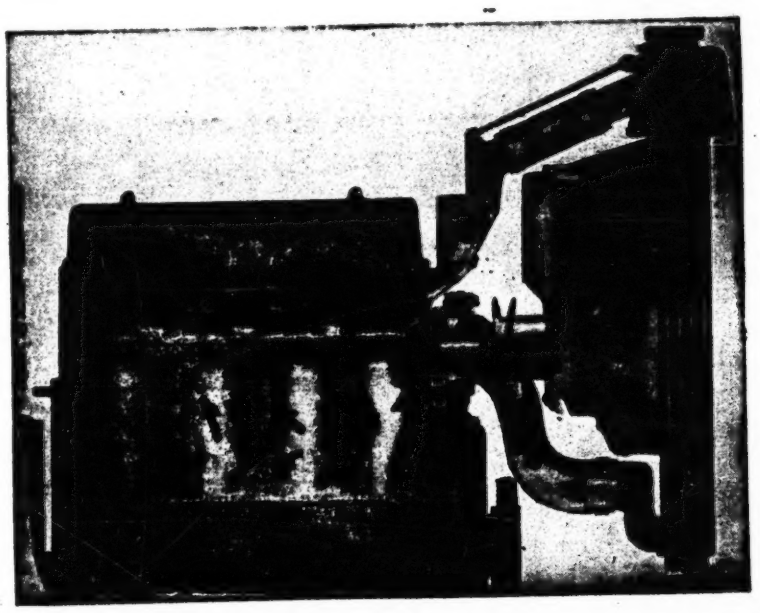


Diagram of Cross Section of a Forced-Circulation Cooling System

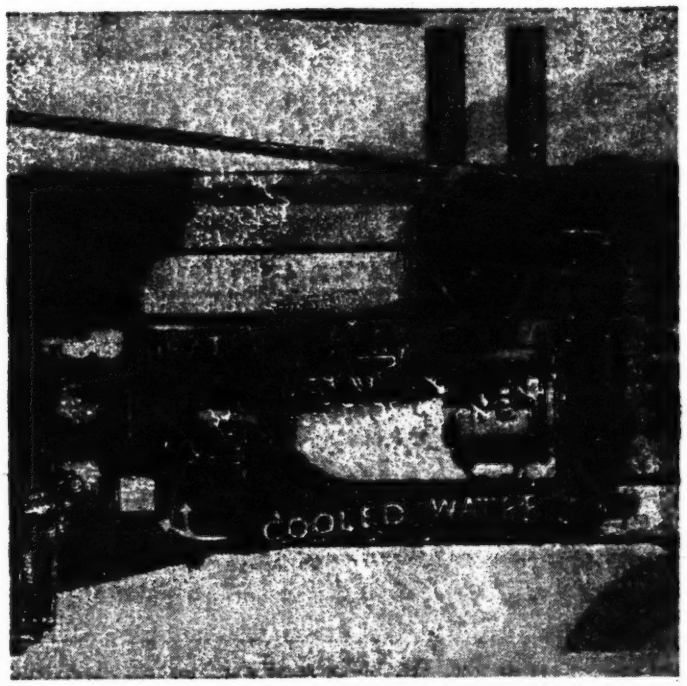


Diagram of Cross Section of a Thermo-Siphon Cooling System

Suggested Teaching-Learning Activities

1. Have students disassemble and examine a cooling system.

2. Have students learn the components of cooling systems.

3. Have students list advantages and disadvantages of the two types of liquid cooling systems.

Suggested Instructional Materials and References

Instructional materials

1. Tractor and other cooling systems for student use

2. Charts, diagrams, and overhead transparencies on cooling systems.

References

1. Tractors and Crawlers, pp. 172-174.

2. Modern Farm Power, pp. 131-142.

S 3. Cooling Systems.

Suggestions for Evaluating Educational Outcomes of the Module

The educational outcome of the module should be evaluated according to knowledge gained by each student and by attitudinal changes.

The following criteria should be used:

1. Student interest in the material covered in the module
2. Student participation in class and laboratory activities
3. Quality of reports presented by students
4. Student performance at the end of the module, compared with performance at the beginning

Sources of Suggested Instructional Materials and References

Instructional materials

"Farm Tractor Maintenance" filmstrip set. Lincoln, Nebraska: University of Nebraska, Agricultural Education Department, College of Agriculture. This filmstrip set includes the following filmstrips.

"Electrical Systems"
"Fuel Systems and Fuel Storage"
"The Engine Cooling System"
"Cooling Systems"

References

1. Ford Tractor Shop Manuel. Tractor and Implement Division, Dearborn, Michigan, Ford Motor Company, 1955-1960.

2. Frazee, Irving and Bedell, Earl L. Tractors and Crawlers. Chicago: American Technical Society, 1963.

3. Promersberger, William J. and Bishop, Frank E. Modern Farm Power. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1962. Price: $6.28.

4. "The ABC of Internal Combustion," 16 mm. movie, General Motors Corporation.

Complimentary

I. R. D.

THE CENTER FOR VOCATIONAL AND
TECHNICAL EDUCATION
THE OHIO STATE UNIVERSITY
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DIESEL ENGINE SYSTEMS

One of Sixteen Modules in the Course Preparing for Entry in

AGRICULTURAL MACHINERY - SERVICE OCCUPATIONS

Module No. 15

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

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MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
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FROM: (Person) James W. Hensel (Agency) The Center for Vocational and Technical Education

(Address) 980 Kinnear Road, Columbus, Ohio 43212

DATE: August 4, 1967

RE: (Author, Title, Publisher, Date) Module No. 15, "Diesel Engine System," The Center for Vocational and Technical Education, August, 1965.

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Provide information below which is not included in the publication. Mark N/A in each blank for which information is not available or not applicable. Mark P when information is included in the publication. See reverse side for further instructions.

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(3) Utilization of Material:
Appropriate School Setting Post high school
Type of Program General post high school class in agricultural machinery
Occupational Focus Agricultural machinery service occupations
Geographic Adaptability Nationwide
Uses of Material Instructor course planning
Users of Material Teachers

(4) Requirements for Using Material:
Teacher Competency Background in agricultural machinery
Student Selection Criteria Post high school, mechanical aptitude, high school background, goal in agricultural machinery service occupation.
Time Allotment Estimated time listed in module. (P)

Supplemental Media --
Necessary x
Desirable ____ (Check Which)

Describe Suggested references given in module. (P)

Source (agency)
(address)

DIESEL ENGINE SYSTEMS

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DIESEL ENGINE SYSTEMS

Major Teaching Objective

To understand the construction and principles of operation of diesel engines

Suggested Time Allotments

At School

Class instruction	30 hours	
Laboratory experience	24 hours	
Total at school		54 hours
Occupational experience		0 hours
Total for module		54 hours

Suggestions for Introducing the Module

Until recent years farm tractor power has been limited primarily to gasoline engines. With improvements in diesel engines and with farming requiring heavier power units, diesel engines are fast gaining in popularity for use on the farm.

For this reason, it is highly important for those planning careers in the agricultural machinery field to have an understanding of the construction and principles of operation of a diesel engine. Also, persons planning for employment in the field of agricultural machinery should have a knowledge of the economics involved in diesel engines as compared with gasoline engines.

The following technique should be used to create interest in the module:

> Bring before the class both a gasoline and a diesel tractor engine. Have students identify on each engine the fuel system, governing system, lubricating system, and the cooling system. Emphasize the difference in systems and construction of the two engines.

Competencies to be Developed

I. To understand what a diesel is and how it works

Teacher Preparation

Subject Matter Content

The essential feature of the diesel engine is the compression of a charge of air producing a temperature beyond the self-ignition point of the fuel, and the subsequent injection of fuel, and instantaneous ignition of the fuel in this highly compressed hot air.

A diesel engine is a machine which produces power by burning fuel in a body of air which has been compressed by a moving piston.

To understand what a diesel engine is, one must have a knowledge of the principles of operation of the engine. Actions that take place inside the engine are referred to as basic actions and occur in the following order:

1. Air is drawn into the cylinder.

2. Air is compressed to a high pressure, causing its temperature to rise.

3. The fuel is injected into the cylinder in the form of a fine spray. Fuel in the form of a spray produces a "homogeneous" mixture of fuel and air.

4. Combustion occurs immediately after fuel is injected into the cylinder because the temperature of the air is high enough, sometimes as high as 1,000 degrees F., to ignite the fuel. Combustion produces an expansion of the gaseous mixture, which pushes on the piston and causes the engine to produce mechanical power.

5. Having lost their pressure, the gases are exhausted.

The diesel engine introduces fuel into its combustion chamber by means of an injector after air alone has been squeezed to about one-sixteenth of its original volume by the piston (16 to 1 compression ratio).

The fuel charge is forced into the combustion chamber by the injector action through a number of tiny holes, each approximately .005 inches in diameter, and at pressures of 10,000-20,000 pounds per square inch. This produces a fine mist or spray, and the atomizing effect aids in vaporizing the fuel and mixing it more intimately with the air present.

At the 16 to 1 compression ratio, compression pressures in the diesel combustion chamber reach 500-800 pounds per square inch with accompanying high temperatures of approximately 1000° F.

This "heat of compression" spontaneously ignites the fuel injected. The diesel method of ignition simply utilizes a law of nature - when air is compressed, its temperature rises in proportion to the compression ratio. The same result may be noticed to a lesser degree when using a hand air pump to inflate a tire or a basketball.

Up and down movements of the piston in the cylinder are known as strokes. During a stroke one or more events or actions occur. The strokes described above are known as:

1. Intake
2. Compression
3. Power
4. Exhaust

In a four-stroke-cycle engine one event occurs during each stroke and four strokes are required to complete a cycle. In a two-stroke-cycle engine more than one event occurs during a stroke and only two strokes are required to complete a cycle.

Although the outward appearance of a diesel tractor may not be greatly different from that of a gasoline tractor, there are a number of differences in the engine.

1. Diesel engines do not have ignition systems.
2. Diesel engines draw only air into the cylinder on the intake stroke.
3. Diesel engines use much greater compression ratios.
4. Diesel engines use less volatile, heavier liquid fuels.
5. Diesel engines use fuel pumps and injectors instead of carburetors.
6. Diesel engines are heavier than gasoline engines of the same size.

<u>Suggested Teaching-Learning Activities</u>

1. Through the use of charts, diagrams, and teacher-made mockups, illustrate the up and down movements (strokes) in the cylinder of both a two-stroke-cycle and a four-stroke-cycle diesel engine.
2. Bring a cutaway model of a diesel engine before the class and demonstrate the four-stroke cycle.
3. Bring gasoline and diesel engines of comparable size before the class and point out the differences in the two engines.

4. Have students survey their local communities to determine the extent to which diesel engines are used on farms.

Suggested Instructional Materials and References

Instructional Materials

1. Charts, diagrams, and mockups of the stroke action in both types of diesel engines

2. A cutaway model of a diesel engine

3. A gasoline engine

4. A diesel engine

References

S*1. Diesel and High Compression Gas Engines, pp. 1-15.

S 2. Engineering Bulletin. No. AD-206, pp. 3-11.

*The symbol T (teacher) or S(student) denotes those references designed especially for the teacher or for the student.

II. To understand the structural parts of a diesel engine

Teacher Preparation

Subject Matter Content

In general, the engine structure includes those parts which are fixed and have as their main function holding the engine together. Its primary job is to support and keep in line the moving parts, which resist the forces set up by the operation of the engine. The engine structure also supports auxiliary systems and provides jackets and passages for cooling water, a pump for lubricating oil, and a protecting enclosure.

The two kinds of forces acting on the structure are:

1. Firing pressures, which act on the cylinder heads and crankshaft bearings

2. Inertia forces, which are caused by motion of the pistons, connecting rods, and crankshaft

Frame designs of diesel engines vary, since they may be of either vertical design or horizontal design. Vertical frames may be of the automotive design used for smaller, stationary engines or A-frame design used for large engines. Also the frame may be either two-piece or three-piece, depending upon its design, which may be determined by its size and use.

The two-piece vertical frame construction is the most widely used. The lower part, or bedplate, of the two-piece frame forms the base, supports the main bearings, encloses the lower part of the crankcase and cylinder block.

Most designs include all cylinders in a single block; however, some designs cast cylinders individually.

Frames for horizontal engines are constructed very much like those of vertical engines. They are usually in two parts.

Resistance to wear and cooling is the prime requirement of cylinders of diesel engines. To build up resistance, the cylinder is fitted with a sleeve or liner, which may be either the "dry" or the "wet" type. The main difference between "wet" liner and a "dry" liner is that the "dry" liner makes metal-to-metal contact with the cylinder casting which contains the water jacket. The "wet" liner does not make metal-to-metal contact with the cylinder casting and its outside surface is wetted by the cooling water. "Wet" cylinder liners are used most commonly in tractor engines.

Since cylinder heads of diesel engines must be stronger and more carefully cooled than gasoline engine cylinder heads, a more complicated structure is required. Thus, many large engines use individual cylinder heads.

<u>Suggested Teaching-Learning Activities</u>

1. Show students a dry and wet type sleeve.

2. Bring a cutaway model of a diesel engine before the class, identify the various parts of the engine structure, and explain the function of each part.

3. Bring before the class two diesel engines, one of the vertical design and the other of the horizontal design. Explain the differences in the construction of each type engine.

4. Have each student team draw a diesel engine, identifying the following:

   a. Engine design

   b. Type of cooling

   c. Type of cylinder sleeves

   d. Number of structural parts

Suggested Instructional Materials and References

Instructional Materials

1. Charts of the types of engine designs
2. A cutaway model of a diesel engine
3. A vertical design and a horizontal design diesel engine
4. Diesel engines for disassembly

References

Diesel and High-Compression Gas Engines. pp. 147-155.

III. To understand the function of the running gear and its parts

Teacher Preparation

Subject Matter Content

The moving parts of the engine that receive the gaseous energy produced in the combustion chamber and deliver it to the output end of the engine in the form of useful power are referred to as the running gear.

The piston and its rings seal the cylinders and transmit the gaseous pressure to the connecting rod.

The top section of the piston is referred to as the crown and the lower section as the skirt. The shape of the crown is determined by the design of the combustion chamber.

Piston connection to connecting rods may be according to two designs.

1. Trunk piston--This design is used in most engines. The connecting rod acts directly on the piston. The side thrust caused by this design causes the piston to press against the cylinder wall, first on one side and then on the other, causing considerable wear near the middle of the stroke.

2. Cross head piston--The connecting rod does not act directly on the piston in this design, since the crosshead and crosshead guides prevent this action. (Example: See Diesel and High Compression Gas Engines, page 160.)

The advantages of a crosshead are:

1. Easier lubrication

2. Uniformly distributed clearance around the piston

3. Simpler piston construction because the wrist pin and its bearings are eliminated

Even though crosshead designs offer advantages over trunk piston design, they are offset by disadvantages such as added weight and height and need for more careful adjustment.

Piston rings serve several important purposes and are classified according to the service they perform.

1. Compression rings--Usually numbering four to six, they are located in the crown of the piston. They serve two main purposes.

   a. They seal the space between the piston and the liner.

   b. They transmit heat from the piston to the water-cooled cylinder liner.

2. Seal rings--As the face of the compression ring or the cylinder bore wears, the gap at the joint of the ring becomes larger. To reduce compression loss from leakage through the gap, special seal rings are used. Seal rings are also located on the top portion of the piston, below the compression rings.

Usually one or two, occasionally three, oil control rings are located near the bottom of the piston skirt. These rings scrape off, on the downstroke, most of the lubricating oil splashed on the cylinder wall by the crankshaft and connecting rod, and rode over the remaining oil film on the up stroke.

Oil control rings prevent surplus oil from being carried into the combustion chamber. This surplus oil is only partially consumed, leaving a carbon deposit. Oil rings also allow sufficient oil to be carried to the upper part of the cylinder liner during the upstroke to lubricate the piston surface and the compression rings.

A connecting link between the connecting rod and the piston is known as the wrist pin. There may be three arrangements of wrist pins.

1. The wrist pin is secured in the piston and the bearing is held in the connecting rod end.

2. The wrist pin is fastened to the connecting rod and the bearing is part of the piston.

3. The wrist pin is free and bears against bearings in both the piston and the connecting rod.

Crankshafts deliver force to the transmission and power train as a result of the thrust from the connecting rod.

Some crankshafts are designed with counterweights opposite the crank pins. These relieve the load on the main bearing by offsetting the inertia forces.

The purpose of bearings is to support rotating shafts and other moving parts and aid in transmitting loads from one engine part to another.

Bearings reduce the friction between the moving surfaces by separating them with a film or lubricant and carry away the heat produced by unavoidable friction.

The flywheel is a heavy wheel or disk attached to the crankshaft. Through rotation, the flywheel acquires kinetic energy. It stores additional kinetic energy when it speeds up, and it gives back that energy when it slows down.

The main purpose of the flywheel is to reduce the speed fluctuations of the crankshaft that are caused by the difference in the amount of energy exerted on the piston during the power stroke and the compression stroke.

Single-cylinder engines require larger flywheels than multi-cylinder engines, because energy variations during a complete cycle are greater in single-cylinder engines.

Suggested Teaching-Learning Activities

1. Bring before the class several types of each kind of ring. Explain the advantages and disadvantages of each.

2. Bring a piston with rings to the class and point out the crown, skirt oil rings, compression rings, and seal rings.

3. Measure cylinder wear on new and old cylinders.

4. Using a cutaway model of an actual diesel tractor engine, demonstrate to the class the function of the connecting rods, the wrist pins, the crankshaft, and the flywheel.

5. Have the diesel engine running gear completely disassembled. Have students reassemble it and replace it in the engine.

6. At the end of the discussion of the running gear, lay out the parts of the running gear and have students identify them.

Suggested Instructional Materials and References

Instructional Materials

1. Various types and kinds of rings

2. A piston complete with rings for a diesel engine

3. Two diesel engines, one using cross head pistons and the other using truck pistons

4. A cutaway model of a diesel engine

5. Diesel engine running gear parts

References

Diesel and High Compression Gas Engines, pp. 156-177.

IV. To understand the diesel air intake and exhaust system

Teacher Preparation

Subject Matter Content

The main purpose of the air intake and valve systems is to charge the cylinder with air and remove the products of combustion (the burned gas).

In four-cycle engines, separate piston strokes fill and discharge the cylinders. The only additional parts needed are valves and actuating gear to control the flow of air and exhaust gas.

In two-cycle engines, fresh air must be forced in to push out the exhaust gas and charge the cylinder. This is the function of the scavenging system.

Components of the air intake and valve systems and their functions are:

1. Valves--Valves control the admission of the air charge in four-cycle engines, the discharge of exhaust gases in all four-cycle and many two-cycle engines, the admission of fuel in some engines, and the admission of compressed air for starting many large engines.

2. Valve actuating gear--The function of the valve actuating gear is to cause and control the opening and closing of the intake and exhaust valves. The actuating gear may also actuate the fuel injection valves, the fuel pumps, or the air starting valves.

   Valve actuating gear usually consist of:

   a. Camshaft drives

   b. Camshafts

   c. Pusher rods and rockers

3. Superchargers--The purpose of the supercharger is to force more air into the cylinder so that more fuel can be burned and the engine output boosted.

   Superchargers are usually either the positive displacement rotary blower type or the centrifugal blower type.

4. Scavenging systems--In two-cycle engines the pressure of the incoming air charge must be used to scavenge or push out the exhaust gases during a short period of time when the piston is near the bottom of its stroke.

   The three basic methods of supplying the incoming air charge at the low pressure needed to accomplish this are:

   a. Crankcase scavenging

   b. Power piston scavenging

   c. Pump or blower scavenging

Suggested Teaching-Learning Activities

1. Lay out various parts of the air intake system and have students attempt to identify them.

2. Through the use of pictorial diagrams in wall chart form and strip films, demonstrate the various parts of the air intake system.

3. Bring several types of superchargers to class to familiarize the students with them and their functions.

4. Have students disassemble an air system on a diesel engine. Have students identify the parts and observe how they function in the motor. Included in the system should be valves, valve actuating gear, superchargers, scavenging systems, camshaft, and drive.

Suggested Instructional Materials and References

Instructional Materials

1. Parts of a diesel air intake and exhaust system

2. Strip films and charts of the air system in diesel motors

3. Several diesel motors for students to disassemble

4. A supercharger of each type

References

Diesel and High-Compression Gas Engines, pp. 178-205.

V. To understand diesel fuel systems

Teacher Preparation

Subject Matter Content

The heart of the diesel engine is the fuel injection system. The function of the fuel injection system is to deliver fuel to the combustion chamber. In doing so it must:

1. Meter or measure the correct quantity of fuel to be injected

2. Time the fuel injection

3. Control the rate of fuel injection

4. Atomize, or break up, the fuel into fine particles

5. Properly distribute the fuel in the combustion chamber

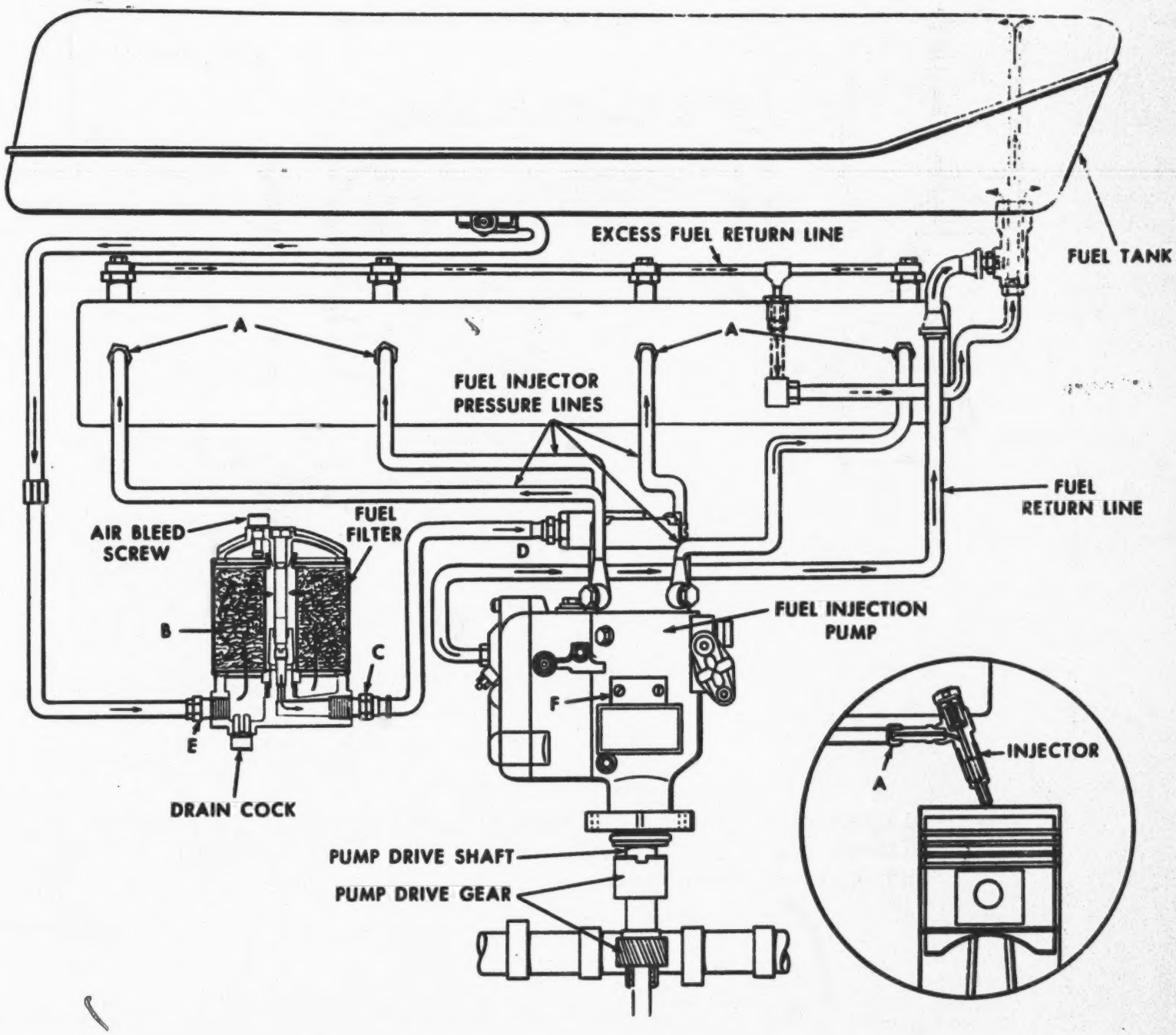
Most modern diesels use mechanical or solid injection instead of the original air injection method. Pumps and spray valves are the basic elements of solid injection systems. The three main classes of solid injection systems are:

1. Common rail

2. Individual-pump

3. Distributor systems

"Diesel Fuel Systems"



Diesel Fuel System

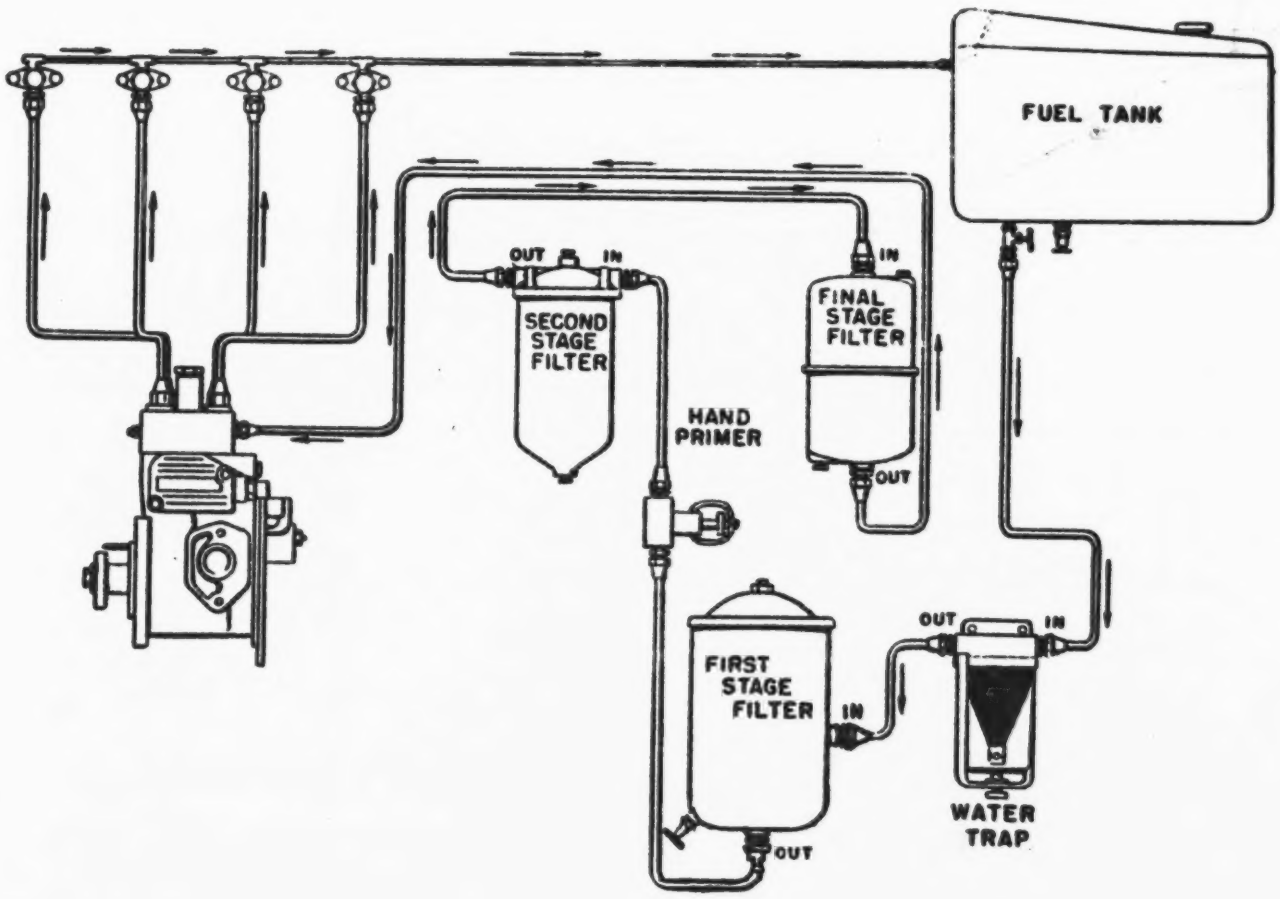


Diagram of a diesel fuel system showing several in-line filters and traps for the removal of foreign material and moisture from fuel.

There are two designs of the common rail or header systems.

1. Cam-operated spray valve design--This design uses a single pump which supplies high-pressure fuel to the "common rail" connected by tubing to spray valves (fuel nozzles). The spray valves are mechanically operated by cam action and control the metering and timing. (Example: See Diesel and High-Compression Gas Engines, p. 209.)

2. Self-actuated spray valve design--A cam-operated fuel injector and a spring-loaded nozzle perform the functions of the fuel-needle valve. This is the chief difference between the self-actuated spray valve design and the cam-operated spray valve design. (Example: See Diesel and High-Compression Gas Engines, p. 210.)

In the individual pump system of fuel injection the pump performs the major job. The functions of the pump are:

1. To raise the pressure of the fuel

2. To meter the charge

3. To time the injection

(Example: See Diesel and High Compression Gas Engines, diagram 3, p. 212.)

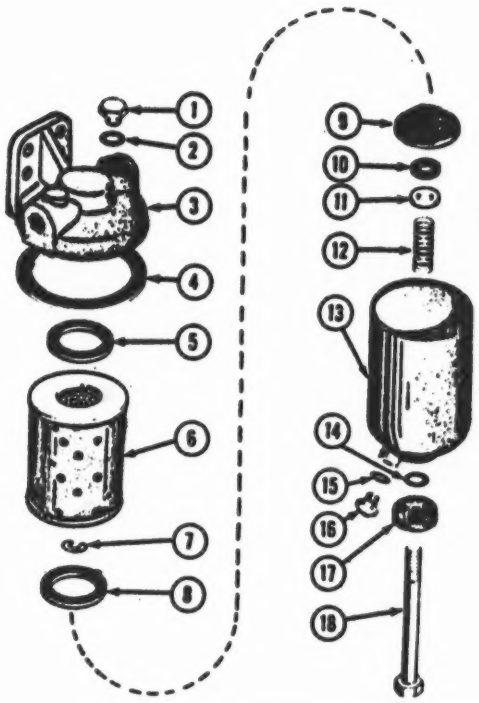
Distributor injection systems may be either high-pressure or low-pressure.

In this system the fuel is metered at a central point and then directed by the distributor to each cylinder in the proper firing order. (Example: See Diesel and High-Compression Gas Engines, diagram 4, p. 214, and diagram 5, p. 215.)

An important part of the fuel assembly of a diesel engine is the fuel filter system. The number of filters used ranges from one to three. Filters are usually referred to as:

1. First stage (primary or auxiliary), which removes most of the water and coarse material

"First Stage Fuel Filter Assembly"

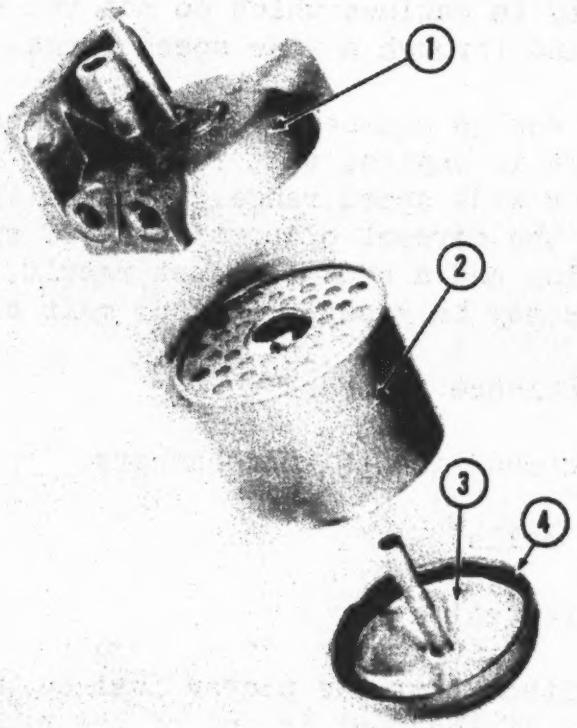


First Stage Fuel Filter Assembly

1. Vent Plug
2. Vent Plug Washer
3. Filter Head Assembly
4. Gasket - Body to Head
5. Gasket - Element End
6. Filter Element
7. Snap-Ring
8. Gasket - Element End
9. Element Lower Plate
10. Element Plate Oil Seal
11. Spring Washer
12. Element Tension Spring
13. Filter Body Assembly
14. Body Oil Seal
15. Drain Plug Washer
16. Drain Plug
17. Oil Seal Retainer
18. Center Bolt

2. Second stage (intermediate or final if only two are used), which removes the finer particles and a small amount of water

"Second Stage Fuel Filter Assembly"



Second Stage Fuel Filter Assembly
1. Filter Head
2. Filter Element
3. Filter Base Assembly
4. Element Seal

3. Third stage, which (if used) removes any remaining small particles

Although combustion chambers are not a part of the fuel system, they are closely related to it and must be understood to know a diesel engine fully.

The entire job of vaporizing, mixing, and igniting fuel takes place inside the cylinder in an extremely short time. In order for this job to be performed properly and efficiently, the combustion chamber must be designed for the most efficient performance possible.

Successful combustion depends upon:

1. Fine atomization
2. High temperature for prompt ignition
3. High relative velocity between fuel and air particles
4. Good mixing of fuel and air particles

Combustion chamber designs vary according to manufacturers but basically can be grouped as:

1. Open chambers--This design, because it is simple, is used primarily in engines which do not run at high maximum speeds and through a wide speed range.

2. Special design chambers--Special design chambers are necessary in engines that run at high maximum speeds and through a wide speed range. Because speed changes unbalance the correct proportioning of spray, incomplete combustion and a smoky exhaust result. Special design chambers may be grouped in four main classes.

   a. Turbulence chambers

   b. Precombustion or antechambers

   c. Air cells

   d. Energy cells

It is very important that the proper fuel be used in a diesel tractor engine. If the fuel is not of the proper specification, damage to the engine will result. Manufacturers of diesel engines list in the operator's manual, for each machine they make, the type of fuel to be used in their engines. The recommendations of the manufacturer should be followed when selecting diesel fuels.

Mechanics and mechanics' helpers should understand all the properties of diesel fuel in order to provide long, trouble-free operation of the engine. If a diesel engine doesn't operate satisfactorily, check the fuel properties. Two standard grades of diesel fuel are distilled by manufacturers.

1. Number One Diesel Fuel (No. 1-D)

2. Number Two Diesel Fuel (No. 2-D)

The following factors effect the burning of fuel and ultimately the efficiency of operation of the diesel engine.

1. Cetane rating--Cetane rating is a measure of the self-ignition and burning qualities of diesel fuel. If a fuel has the proper cetane rating for the engine it is to be used in it will:

   a. Cause easier starting

b. Produce less smoke

c. Reduce fuel knock

The most satisfactory cetane rating for diesel engines is between 40 and 60.

2. Volatility of fuel--The volatility of a fuel has reference to the ease at which the fuel will change into a vapor or gas.

3. Carbon residue--Carbon residue is the carbon deposit left after all the good qualities in the fuel have burned. This residue forms on all parts of the engine that come in contact with it.

4. Viscosity--The viscosity of the fuel has reference to the length of time it takes for a fuel to flow through the orifice in the injector nozzle tip.

   a. Most fuels have different viscosity rates because of the size of the injector orifice and the size of the engines.

   b. Diesel fuels must have more lubricating qualities than other fuels because the injector and injector pump are lubricated through the fuel.

   c. Proper viscosity provides a better spray pattern.

5. Sulphur content--The sulphur content has reference to the amount of non-combustible materials in the fuel, that, when burned, form gases that mix with water in the cylinder and form a corrosive liquid. This corrosion causes the engine parts to gum up and work improperly.

6. Ash content--When a fuel burns, a certain amount of non-combustible ashes are left in the cylinder. These ashes take on the form of an abrasive in the cylinders.

7. Water and sediment content--Water and sediment can cause serious damage to the fuel system of a diesel engine.

   a. It may cause the fuel system parts to rust.

   b. It may interfere with proper injector lubrication.

   c. It may cause plugging of nozzle tips.

8. Flash point--Fuel flash point refers to the lowest temperature at which the fuel vapor will ignite. The compression ratios of diesel engine systems are higher than those for spark ignition systems. This is necessary because the compressed air serves to ignite the fuel in the compression chamber. The average compression ratio for diesel tractors is approximately 16.3 to 1.

9. Pour point--Pour point is the point at which the fuel oil congeals or solidifies by cooling. If a fuel oil does not have the correct pour point in cold weather it will not move into or through the injector lines, injector, and the injector pump.

10. Cloud point--At some temperature slightly above the pour point diesel fuel becomes cloudy due to the formation of wax crystals. The temperature at which this begins to occur is called the cloud point. Since the wax crystals cause clogging of fuel filters and supply lines, and since this occurs at temperatures above the pour point, the cloud point may be an even more important consideration as a fuel specification than the pour point. The cloud point also depends on the hydrocarbon composition of the fuel. Cloud points usually occur from 8 to 10 degrees Fahrenheit above the pour points, but cloud points as high as 15 or even 20 degrees above the pour points are not uncommon.

Suggested Teaching-Learning Activities

1. Bring a diesel motor before the class. Call attention to the fuel system. Disassemble and discuss the fuel system part by part.

2. Have the class compare the following diesel engine fuel systems:

   a. Cam-operated valve design

   b. Self-activated spray valve design

   c. Individual pump system

   d. High-pressure distributor system

   e. Low-pressure distributor system

3. Have students replace the fuel filter in several diesel engines. Call to their attention the construction of the filter and parts associated with it.

4. Have students observe the types of combustion chambers mentioned in the content in diesel motors.

5. Have students disassemble and study the parts of the fuel pump.

6. Bring to the class several fuel injectors. Have students disassemble them and become familiar with the parts of each one.

7. Demonstrate pour and cloud points by heating and cooling diesel fuel samples in a test tube.

8. Visit a local agricultural machinery dealership and observe calibration testing of fuel pumps.

9. Have students check injector nozzles for proper spray pattern.

Suggested Instructional Materials and References

Instructional Materials

1. Diesel motors
2. Fuel filters
3. Fuel pumps
4. Fuel injectors

References

1. Diesel and High Compression Gas Engines, pp. 206-239.
S 2. Tractor Fuels and Lubricants, pp. 11-14.

VI. To understand the auxiliary systems of a diesel engine

Teacher Preparation

Subject Matter Content

An understanding of diesel engines is not complete without a knowledge of the auxiliary systems.

Auxiliary systems include:

1. Governing system
2. Lubricating system
3. Cooling system

The purpose of a governing system is to maintain a constant engine speed automatically even under varying loads.

The basic principle which makes a governing system work is that any change in load immediately causes a change in speed. To keep the engine running at a steady speed, the flow of fuel must be regulated in such a way that the power developed is just equal to that needed at the desired speed. The governor does this by noting a change in engine speed and then adjusting the rate of fuel flow to meet the needs of the engine to maintain a steady speed.

Governors may be either:

1. Mechanically operated
2. Hydraulically operated

Governors which are mechanical or hydraulic may vary in design and function and may be classed as:

1. Constant speed
2. Variable speed
3. Speed-limiting
4. Load-limiting
5. Pressure-regulating
6. Torque-converter
7. Overspeed trip
   (Example: See Diesel and High-Compression Gas Engines, diagram 7, p. 278.)

An essential system for the operation of an engine is the lubricating system.

The function of the lubricating system is to keep all moving parts properly lubricated. To do this, the lubricating system must:

1. Maintain an oil film between the shafts and bearing surfaces at the main, crankpin, and wrist pin bearings

2. Maintain an oil film for the camshaft, valve gear, and engine auxiliaries

3. Provide oil film between the piston and the cylinder wall

Most diesel engines have a pressure-circulating lubricating system. The design of the system varies according to the engine size and design.

The main components and their functions of a typical lubricating system are:

1. Sumps (wet or dry)--The purpose of the sump is oil storage. In many designs it is part of the crankcase. In other designs the oil storage is outside the engine itself and is known as a dry sump.

2. Main pump--Usually this is mechanically driven and forces oil under pressure to the lubricating piping of the engine.

The auxiliary pump is usually driven by an electric motor . It lubricates cylinder and bearing surfaces before the engine reaches necessary speed and after it is shut down.

The purpose of the oil strainer is to prevent dirt passing into the engine.

The function of the oil cooler is to maintain the temperature of the oil within desired limits.

Only about one third of the heat energy of the fuel is converted into mechanical energy and leaves the engine in the form of brake horsepower. Thus, about two-thirds of the heat energy of the fuel shows up in hot exhaust gases, friction heat, and heat in the walls of the combustion chamber.

The purpose of the cooling system is to remove the unwanted heat from the engine.

Heat Input and Disposal in a Diesel Engine
(Three-Quarters to Full Load)

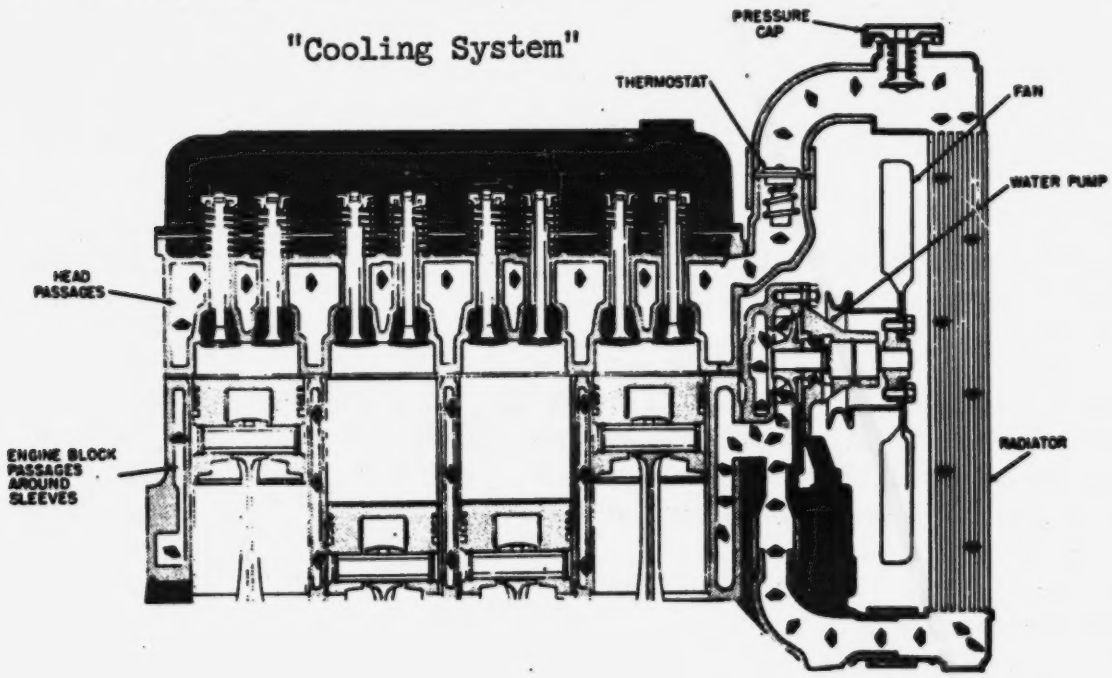
Thermal Transfer	BTU per BHP-Hr.	Per Cent
Heat input	7,367	100.0
Heat disposal:		
Useful work	2,544	34.6
To cooling water and lubricating oil	2,194	29.8
To exhaust gases	2,259	30.6
Lost by radiation	370	5.0
Total heat disposal	7,367	100.0

Cooling systems vary according to engine size and design. Classes of cooling systems are:

1. Open cooling system
2. Steam systems
3. By-pass systems
4. Closed cooling systems

The closed cooling system is used on diesel engines in the same way that it is used on other farm machinery. It uses a water to air (radiator) type heat exchanger.

"Cooling System"



Suggested Teaching-Learning Activities

1. Through the use of charts, pictorial diagrams, and cutaways, explain how the governing, lubricating, and cooling systems of a diesel engine function.

2. Have students disassemble and become acquainted with the types of governors mentioned in the content.

3. Have students trace the lubrication system of a diesel tractor.

4. Through the use of a cutaway model of a diesel engine, demonstrate how the lubrication, governing, and cooling systems function.

Suggested Instructional Materials and References

Instructional Materials

1. Charts, pictorial diagrams, and cutaways of governing, lubricating, and cooling systems

2. A governor for each student

3. A diesel motor

d. A cutaway model of a diesel engine

References

Diesel and High-Compression Gas Engines, pp. 251-375.

Suggestions for Evaluating Educational Outcomes of the Module

The educational outcomes of the module should be evaluated according to knowledge gained by and attitudinal changes in each student.

The following criteria should be used:

1. Student interest in the materials covered in the module

2. Student participation in class and laboratory activities

3. Student performance at the end of study of the module as compared with their performance at the beginning

Sources of Suggested Instructional Materials and References

1. Automotive Diesel Engines, Engineering Bulletin AD 206. Chicago: Standard Oil Company.

2. Kates, Edgar J. Diesel and High-Compression Gas Engines, Chicago: American Technical Society, 1964. Price: $8.

3. Moses, Ben D. and Frost, Kenneth. Farm Power, New York: John Wiley and Sons, Inc., 1952.

4. Tractor Fuels and Lubricants, Agricultural Engineering Building. Athens, Georgia: Southern Association of Agricultural Engineering and Vocational Agriculture, 1964. Price: $1.20.

THE CENTER FOR RESEARCH AND LEADERSHIP DEVELOPMENT
IN VOCATIONAL AND TECHNICAL EDUCATION
THE OHIO STATE UNIVERSITY
980 KINNEAR ROAD
COLUMBUS, OHIO, 43212

INSTRUCTOR NOTE: As soon as you have completed teaching each module, please record your reaction on this form and return to the above address.

1. Instructor's Name_____

2. Name of school_____State_____

3. Course outline used: _____Agriculture Supply--Sales and Service Occupations
_____Ornamental Horticulture--Service Occupations
_____Agricultural Machinery--Service Occupations

4. Name of module evaluated in this report_____

5. To what group (age and/or class description) was this material presented?____
_____

6. How many students:
   a) Were enrolled in class (total) _____
   b) Participated in studying this module _____
   c) Participated in a related occupational work experience program while you taught this module _____

7. Actual time spent teaching module:

		Recommended time if you were to teach the module again:
_____hours	Classroom Instruction	_____hours
_____hours	Laboratory Experience	_____hours
_____hours	Occupational Experience (Average time for each student participating)	_____hours
_____hours	Total time	_____hours

(RESPOND TO THE FOLLOWING STATEMENTS WITH A CHECK (✓) ALONG THE LINE TO INDICATE YOUR BEST ESTIMATE.)

	VERY APPROPRIATE	NOT APPROPRIATE
8. The suggested time allotments given with this module were:	___.___.___.___	
9. The suggestions for introducing this module were:	___.___.___.___	
10. The suggested competencies to be developed were:	___.___.___.___	
11. For your particular class situation, the level of subject matter content was:	___.___.___.___	
12. The Suggested Teaching-Learning Activities were:	___.___.___.___	
13. The Suggested Instructional Materials and References were:	___.___.___.___	
14. The Suggested Occupational Experiences were:	___.___.___.___	

(OVER)

15. Was the subject matter content sufficiently detailed to enable you to develop the desired degree of competency in the student? Yes_____No_____
Comments:

16. Was the subject matter content directly related to the type of occupational experience the student received? Yes_____No_____
Comments:

17. List any subject matter items which should be added or deleted:

18. List any additional instructional materials and references which you used or think appropriate:

19. List any additional Teaching-Learning Activities which you feel were particularly successful:

20. List any additional Occupational Work Experiences you used or feel appropriate:

21. What do you see as the major strength of this module?

22. What do you see as the major weakness of this module?

23. Other comments concerning this module:

_____ _____
(Date) (Instructor's Signature)

_____
(School Address)

Complimentary

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TRACTOR REPAIR

One of Sixteen Modules in the Course Preparing for Entry in

AGRICULTURAL MACHINERY - SERVICE OCCUPATIONS

Module No. 16

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

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The Center for Research and Leadership Development

in Vocational and Technical Education

The Ohio State University
980 Kinnear Road
Columbus, Ohio, 43212

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United States Office of Education

August, 1965

VT000503

MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) James W. Hensel (Agency) The Center for Vocational and Technical Education

(Address) 980 Kinnear Road, Columbus, Ohio 43212

DATE: August 4, 1967

RE: (Author, Title, Publisher, Date) Module No. 16, "Tractor Repair." The Center for Vocational and Technical Education, August, 1965.

Supplementary Information on Instructional Material

Provide information below which is not included in the publication. Mark N/A in each blank for which information is not available or not applicable. Mark P when information is included in the publication. See reverse side for further instructions.

(1) Source of Available Copies:
Agency The Center for Vocational and Technical Education
Address 980 Kinnear Road, Columbus, Ohio 43212
Limitation on Available Copies No Limit Price/Unit $ 7.50/set
(quantity prices)

(2) Means Used to Develop Material:
Development Group National Task Force
Level of Group National
Method of Design, Testing, and Trial Part of a funded project of the USOE, OE-5-85-009; materials based on research from state studies; see preface material in the course outline.

(3) Utilization of Material:
Appropriate School Setting Post high school
Type of Program General post high school class in agricultural machinery
Occupational Focus Agricultural machinery service occupations
Geographic Adaptability Nationwide
Uses of Material Instructor course planning
Users of Material Teachers

(4) Requirements for Using Material:
Teacher Competency Background in agricultural machinery
Student Selection Criteria Post high school, mechanical aptitude, high school background, goal in agricultural machinery service occupation.
Time Allotment Estimated time listed in module. (P)

Supplemental Media --
Necessary x
Desirable ____ (Check Which)

Describe Suggested references given in module. (P)

Source (agency)
(address)

TRACTOR REPAIR

Major Teaching Objective

To develop (1) an understanding of the procedures to follow in overhauling a tractor and (2) the ability to disassemble, repair, reassemble, and tune the tractor for field operating conditions

Suggested Time Allotments

At school

Class instruction	168 hours	
Laboratory experience	336 hours	
Total at school		504 hours
Occupational experience		250 hours
Total for module		754 hours

Suggestions for Introducing the Module

The most important job responsibility of the agricultural machinery mechanic is repairing the tractor. To do this, he must understand the function of each part in the tractor and follow a systematic procedure. He must understand the various units on a tractor, their purpose, and the operation. Above all, he must be able to disassemble, diagnose troubles, make repairs, reassemble the unit, and get the tractor to function properly under field conditions.

Outlined in this module are the general steps or procedures to follow when making repairs common to all makes and models of tractors. For specific adjustments the manufacturer's specifications should be consulted and the adjustments made accordingly. If the repair procedure outlined in this module is not applicable to a tractor, follow the manufacturer's repair procedure.

Some classroom time should be devoted to discussion and study of each step in repair procedures, but the greatest part of the time should be allotted to student repair of tractors in the shop.

After each student has completely overhauled his first tractor, have him overhaul another tractor of the other kind (diesel or gasoline). With the second overhaul, he should develop sufficient understandings and abilities for a marketable skill in tractor repair.

Competencies to be Developed

I. To determine the extent of repair needed by a tractor

Teacher Preparation

Subject Matter Content

A tractor should be thoroughly tested to determine the extent of overhaul needed before any disassembly of the engine is begun. Tests provide valuable clues to possible internal malfunctions of the engine or other parts. As these tests are made record all observations.

1. Field tests. When operating the tractor under load observe the following:

   a. Oil pressure activity. A low pressure reading may indicate any of the following:

      1) Loose rod or main bearings
      2) Bad oil pump
      3) Loose camshaft bearing

   b. Blow-by through breather. Excessive blow-by means that the engine may have any of the following malfunctions:

      1) Worn rings
      2) Hole in piston
      3) No ring tension on cylinder wall
      4) Excessively high water temperature

   c. Operating water temperature. High operating water temperature suggests:

      1) Bad thermostat
      2) Plugged radiator fins or internal tubes
      3) Blown head gasket allowing compression vapors to escape into the engine coolant
      4) Internal crack in engine block or head

   d. Excessive noise or knock. Excessive noise in an operating engine suggests:

      1) Loose rod bearings, which knock when the engine is free running.
      2) Loose main bearings, which knock under load.
      3) Poor detination timing

e. Excessive blue or black smoke coming from the exhaust pipe. A black smoke indicates that the fuel mixture is too rich with fuel. This problem can be eliminated by tuning up the fuel system. A blue smoke indicates that oil is getting by the rings into the cylinder and burning with the fuel. Excessive blue smoke coming from the exhaust pipe suggest:

1) Worn or plugged oil rings
2) Fouled valve guide, which causes the engine to smoke after long periods of idling

2. Laboratory test. The best method of testing a tractor engine and clutch in the laboratory is by using a dynomometer. All findings should be recorded on the dynomometer test sheet.

3. Compression test. A compression test reveals malfunctions in the compression chambers of the engine and their associated parts. The following procedures should be followed when making a compression test on a gasoline or a diesel engine.

Gasoline engine compression test

a. Remove all spark plugs.

b. Insert compression gauge in the spark plug openings.

c. Crank engine, turning it over five times.

d. Read the compression gauge, noting the compression developed in each cylinder. All cylinders develop a compression within 10 pounds per square inch of each other and within the manufacturer's specifications.

e. Put oil in cylinders to determine whether the low compression is caused by valves or rings.

1) The oil seals up bad rings and compression readings increase.
2) If two adjacent cylinders have low compression, insert spark plug in one and check the other cylinders with the compression gauge. An increase in compression indicates a blown head gasket between cylinders.

Diesel engine compression test

a. Remove fuel line from the number die injector.

b. Remove attachment nuts on injector and then the injector.

1) When removing the injector, use a crowfoot bar to pry injector out of the head. Be extremely cautious not to damage the nozzle end of the injector. If the nozzle end is bumped, the small orfices in the tip will close.
2) Wrap the injector in a soft cloth to protect it while it is out of the engine.

c. Insert compression gauge of suitable capacity for a maximum compression of 1000 p.s.i. The reading should be about 500 p.s.i.

d. Start engine and let idle at the speed recommended by the manufacturer and read the gauge. Compare reading with the specifications set up by the manufacturer.

e. Install the injector, reversing the order outlined in the procedure above.

f. Using the procedure outlined above, test the compression in all cylinders.

g. Check the running heat efficiency of the engine under load.

This check is made by placing heat chalk on the exhaust opening on each cylinder. The chalk turns color if the cylinder is operating with proper heat efficiency. The injector and valves must function properly and proper compression must develop in the cylinder in order to get a proper color reading. Color reading guides are available in most diesel repair shops.

4. Visual inspection. The following observations should be made and noted when testing the tractor in the field and in the laboratory:

a. External oil leaks

b. Broken parts

c. Loose bolts

<u>Suggested Teaching-Learning Activities</u>

1. Have students observe several diesel and gasoline tractors needing overhauling, in operation in the field.

Vary the amount of load that these tractors operate under, and have the class observe what happened and record their observations. At this time discuss with them the possible repairs needed.

2. Bring these tractors into the school laboratory and have students run a compression test on them and test them with a dynamometer. Have students record their findings.

Note. For best results, have enough tractors so that only two students are working on a tractor. Assign students to tractors to be tested, and require them to stay with these tractors until they are completely overhauled.

Suggested Instructional Materials and References

Instructional materials

1. Dynamometer
2. Compression gauge
3. Spark plug wrench
4. Crowfoot bar
5. Heat chalk

References

1. Manufacturer's service manuals

Suggested Occupational Experience

Have students run field, laboratory, and compression tests on machines considered for overhaul at a local agricultural machinery dealership. Have them diagnose the malfunctions in the tractors and suggest repairs.

II. To prepare a tractor engine for repair

Teacher Preparation

Subject Matter Content

Thorough cleaning is the first step in preparing an engine for overhaul. The best method is steam cleaning; but if this is

not possible, clean the engine with a mixture of one part "Gunk" concentrate (a cleaning compound made for dirty engines) with four parts kerosene. Paint the engine with this mixture and allow it to soak for 20 minutes; then wash it off with a spray of water.

After the engine has been thoroughly cleaned, follow these steps to prepare it for overhaul:

1. Remove engine accessories. These include the hood, shrouds, radiator shell and grill.

2. Drain the coolant from radiator and block into a clean container and inspect it for rust particles and other foreign particles.

3. Remove all radiator clamps and hoses, noting those that need to be replaced. Record this information on the reconditioning sheet.

4. Remove the radiator holding bolts and the radiator.

   a. Check the radiator for bent fins, external leakage, and corrosion build up inside the radiator.

   b. If the radiator needs repair, send it to a radiator shop.

5. Remove external engine parts.

   a. Battery clamp and battery

      1) Remove battery cables removing the ground cable first.
      2) Inspect cables and note condition.
      3) Using a hygnometer and voltmeter, test the battery and recharge it, if necessary.

   b. Starter

   c. Water mainfold and thermostat

      1) Check thermostat and note its condition

   d. Carburetor (gasoline engine only)

      1) Remove linkage.
      2) Turn valve on gas tank off and remove gas line.
      3) Remove air cleaner base and note its condition.

e. Governor.

Diesel engines do not have the same type of governor as gasoline engines. Omit this step on the diesel engine.

1) Disconnect linkage and oil line.
2) Remove bolts around the housing.
3) Slip governor unit from housing.
4) Check spring for tension.

f. Intake and exhaust mainfold

g. Air cleaner

1) Check condition of air cleaner. An excessively dirty cleaner may suggest possible clues to causes of internal malfunctions.

h. Spark wires, spark plugs, and distributor

A diesel engine has a different type of fuel and ignition system. The following procedures should be followed when removing the injector and injector pump:

1. Injector

a. Turn fuel valve off at tank.

b. Remove fuel lines from injectors.

1) All fuel lines from pump to injectors must be removed at each end.
2) Remove line bracket.
3) Be careful not to bend lines.

c. Remove injector.

1) Remove hold-down nuts.
2) Use crowfoot bar to pry injector out.
3) Remove injector, being careful not to bump the nozzle tips.
4) Wrap injector in a soft cloth to avoid damage to the nozzle tips while they are out of the engine. Always remove the injector before removing the head.

2. Injection pump

a. Locate marks used in timing pump.

b. Rotate engine until marks are in proper position and the number one cylinder is on the compression stroke.

c. Remove throttle and stop linkage attached to pump.

d. Remove fuel lines.

e. Remove primary fuel line from pump.

f. Remove bolts holding the pump to the block.

g. Remove oil line that runs from the pump to block.

h. Remove pump.

i. Any calibration of the pump must be made on a test stand. Most dealers do not do this job but send pumps to special diesel repair shops. Some pumps, however, may be calibrated on the engine, operating at maximum load and using a ball fuel meter or dynamometer to measure fuel consumption.

j. Three types of injection pumps have been developed for use on diesel engines.

   1) Roasa master
   2) Boash
   3) Simms

   Manufacturer's specifications should be followed when overhauling these pumps.

k. Clean injection pump screen which is located on head of pump.

   1) Remove plug.
   2) Remove screen and "o" ring.
   3) Wash in solvent and blow dry with compression.
   4) Install screen on plug and ring.
   5) Install injection pump in head.

<u>Suggested Teaching-Learning Activities</u>

1. Demonstrate the cleaning and disassembly procedures outlined in the subject matter content. Emphasize proper procedures and tool usage.

2. Have students thoroughly clean their assigned tractors and remove all accessories.

3. Have students remove the external engine parts on their tractors according to the procedures outlined in the subject matter content above.

Suggested Instructional Materials and References

Instructional materials

1. Tractor for student use
2. Complete tool kits
3. Demonstration tractor
4. Steam cleaner

References

1. Manufacturer's service manuals
2. Steam cleaner instructions

Suggested Occupational Experiences

1. Have students do the following at a local agricultural machinery dealership:
   a. Steam clean a tractor.
   b. Remove all tractor accessories.
   c. Remove all tractor external parts.

III. To repair a tractor engine

Teacher Preparation

Subject Matter Content

After thorough testing and removal of all accessories and external parts, the engine is ready to be overhauled. A mechanic should learn well the following procedure, which outlines a complete engine overhaul, before he accepts employment and proceeds to overhaul a tractor engine in an agricultural machinery dealership.

Disassemble the engine in the following manner, and make observations of worn parts, and other faults.

1. Valve cover

   a. Remove valve cover by taking out four attachment bolts. Make sure that the area around the cover is clean and dirt free before the cover is removed.

2. Rocker arm assembly

   a. Oil must flow to the rocker arm assembly through an oil line or stud which retains this assembly. Locate the flow openings and check to see if they are plugged.

   b. Remove the oil line.

3. Push rods

4. Head nuts or capscrews.

   These are special nuts or capscrews of high strength steel. Under no circumstances should nuts or capscrews of any other material be used for this purpose.

5. Remove head

   a. Visually inspect the head, noting the following:

      1) Condition of valves
      2) Condition of headgasket
      3) Condition of top of piston

         a) Excessive carbon indicates bad rings.
         b) Piston loose in cylinder

      4) Pitting in the piston top and cylinder wall

         Pitting is caused by water entering the combustion chamber through the head gasket or a crack in the head or sleeve.

5) Taper of the cylinder wall

The taper of the cylinder is checked by a dial indicator or inside micrometer. Measure the diameter of the cylinder where the top ring travels and above the piston when at bottom dead center. By subtracting the latter measurement from the former the amount of taper can be determined. Compare the taper with maximum taper given in the manufacturer's specifications for the tractor.

6) Check cylinder for being out of round.

To check a cylinder for being "out of round," use the same tools as those used to check taper.

6. Remove valves from head and determine condition.

a. Place head on work lead.

b. Using suitable valve compressor, compress spring and cap and remove the two locks located on the end of the valve stem.

c. Release valve compressor.

d. Remove spring and valve cap. Some engines may have rotating valve caps on the exhaust valves. These caps allow valves to rotate, thus keeping the seat clean and free of carbon. Also, some engines may be equipped with two valve springs on each valve, allowing more positive valve seating.

e. Remove valves.

1) Visually inspect each valve for excessive burning.
2) Check valve stem for sticking in the guide, which is caused by carbon in the guide. The guide should be cleaned or replaced.
3) Check the valve seat for burning or cracks.

At this point in the overhaul procedure, study all observations made to determine whether a complete overhaul is necessary or whether reconditioning of the valves would bring the compression back to within manufacturer's recommendations. If the tractor needs a complete overhaul, follow these procedures:

1. Remove the engine block from the tractor mounting.

   a. Drain oil from the oil pan by removing the plug in the bottom of the pan.

   b. If necessary, remove the front axle and axle support, which is bolted to the engine block.

      1) Disconnect the front axle wishbone supports and steering linkage.
      2) Place safety jack under the transmission to support the engine while removing the front axle and wheels.
      3) Remove bolts around the rear engine bell housing. Usually there are one or two line-up pins in the rear bell housing which often stick and need to be freed by prying the engine away from the transmission.

   c. Attach engine lifting straps to the block so that when the engine is lifted from the mountings it will be balanced. Use short cap screws to replace the head studs or capscrews.

   d. Hook sound chain falls on hydraulic lifting crane to engine strap and remove the engine block from its mountings.

2. Place engine on an engine stand and fasten it down tightly. If an engine stand is not available, lay the engine block on its side on a workbench.

3. Remove oil pan.

   Take off capscrews around the oil pan, and check it for sludge deposits in the bottom.

4. Remove oil pump.

   a. Remove oil pump screen and pick-up tube. In some cases this tube may be a part of the pump.

   b. Remove locks on safety wire from the capscrews or nuts which hold the oil pump in place.

   c. Turn the pump housing back and forth until it comes free.

5. Remove fly wheel.

   a. Remove pressure plate.

      1) Remove capscrews on the pressure plate evenly.
      2) Be prepared to catch the pressure plate and clutch disk, as they drop when the last capscrew is removed.

   b. Remove flywheel nut locks and nuts.

      1) It may be necessary to lay a 2" x 4" block of wood, 12" long, beside the crankshaft to keep the crankshaft from turning during removal of flywheel nuts.
      2) Tap flywheel off with a soft mallet hammer.
      3) Because of the weight of the flywheel, be careful not to drop it while removing from the engine.

6. Check the flywheel starter ring gear for missing teeth and slippage on the flywheel, and record findings.

   a. Remove ring gear from the flywheel, cutting halfway through the ring gear with a cutting torch and splitting the remainder with a chisel, or cutting halfway through with a 1/4" drill and splitting the remainder with a chisel.

      Be extremely cautious to avoid cutting with the torch or drilling into the flywheel.

   b. Install new ring gear.

      1) Lay ring gear on flat fire bricks that completely support it.
      2) Use a torch to heat ring gear to 360° or until it turns a dark straw color.
      3) Quickly place ring gear on flywheel and let cool into place.

7. Remove pistons.

   a. On engines with sleeves, install a short capscrew and large washer at the top of each sleeve to hold sleeve while removing piston.

b. Cut ridge frame cylinder with a suitable ridge removing tool. Follow manufacturer's instructions for using the tool to remove the cylinder ridge.

c. Rotate crankshaft until the number one piston is at the bottom of its stroke.

d. Remove lock nuts on cotter pins from connecting rod.

e. Mark rod cap with a center punch on both halves to make certain it is reinstalled in the same position it was before disassembly. Also, notice whether mark is on the crankshaft side, and record observation.

f. Remove connecting rod nuts.

g. Remove rod cap.

1) Inspect insert for excessive wear, pitting, and corrosion.
2) Remove upper insert bearing.

h. Push piston out of cylinder.

i. Throw inserts away and reinstall cap on rod.

j. Repeat steps a through i to remove the remaining pistons.

8. Inspect pistons, pins, and connecting rods.

a. Clean piston.

1) Remove old rings.
2) Remove carbon from the piston top with a scraper.
3) Remove carbon from ring bands with a broken ring.
4) Do not use a wire brush for cleaning these parts.
5) Clean oil groove and oil return holes. The oil return holes should be cleaned with a drill bit of the same size as the oil return holes so as not to enlarge the holes.
6) Using a micrometer, check the size of the pistons against manufacturer's specifications, and determine whether they are within limits. A micrometer check also reveals whether the pistons are standard or oversized.

7) Compare ring band of piston with that of a new ring and check it with a feeler gauge. Insert ring in groove. Check the distance between the ring edge and groove wall. Check size of gap with manufacturer's specifications for maximum allowance clearance. These measurements, along with visual inspection and piston size, indicate whether the piston should be replaced.

b. Inspect connecting rod.

Put the connecting rod cap in place on the rod with punch marks lined up and rod nuts torqued to manufacturer's specifications. Using an inside micrometer, check whether the inside of the rod is out-of-round and the connecting rod opening is within manufacturer's specifications. If the measurements are not within specifications, install a new rod or recondition the old rod at a machine shop.

c. Check wrist pin.

1) Remove wrist pin from rod.

a) Mark piston and rod with a center punch to make sure they are reinstalled in the same position they were before dissassembley.
b) Remove snap rings on lock bolts that retain pin in the piston.
c) Using a brass punch, drive the pin out of the rod. Some pistons require that the wrist pin be pressed out. This is a job for a machinist who has a special piston holder and press.

2) Using a micrometer, check pin to see whether it is within manufacturer's specifications.
3) Check inside of the rod bushing with a telescopic gauge and outside micrometer to determine whether the opening is within manufacturer's specifications.
4) Record all measurements in order to determine what parts should be replaced or reconditioned.

9. Check cylinder for taper and being out-of-round.

   These checks are made with an inside micrometer or dial indicator. If the taper is not within specifications or the cylinder is out-of-round, install new sleeves or rebore the cylinders.

10. Remove crankshaft.

    a. Before removing crankshaft, check end play. One bearing, usually the center or rear bearing, controls the end play with a thrust ring built on the insert or a spearate ring. Locate the thrust bearing, and pry crankshaft forward. Insert feeler gauge in the opposite side and measure the gap. Record the gap and check it against manufacturer's specifications. If a new bearing is needed, it may be obtained in oversize thrust to take up for wear on the crankshaft flange.

    b. Remove front crankshaft pulley.

       1) Remove set screw, nut, or retaining bolt from the pulley.
       2) Using a suitable puller, remove crankshaft pulley.
       3) Be careful to fit puller jaws on the solid part of the pulley.
       4) Check pulley for cracks and excessive wear on the sealed surface.

    c. Remove timing cover.

       1) Remove all cap screws and nuts on the retaining cover.
       2) Pry cover off.
       3) Notice if the crankshaft end-play adjusting setscrew is built into the retaining cover.

    d. Check backlash between camshaft and crankshaft gear with dial indicator.

       1) Mount dial indicator on front of engine with needle resting on camshaft gear teeth.
       2) Rotate camshaft back and forth without moving the crankshaft. Take dial reading and compare with manufacturer's specifications listed as camshaft gear backlash. If backlash is excessive, new gears are needed.

e. Check timing marks on the camshaft and crankshaft gears. The marks must line up before disassembly and at reinstallation.

f. Mark main bearing cap in relation to block. Be careful to put caps back in the same position and place when reinstalling them.

g. Remove main bearing capscrew or nuts. Some nuts or capscrews have locks, and others are self-locking.

h. Remove main bearing cap by tapping it with a soft mallet hammer. Inspect the insert bearing for pitting, grooving, and excessive wear. At this point it may be necessary to remove the rear main oil seal retainer and seal.

i. Remove crankshaft. Try to keep it standing on end to avoid possible warping.

j. Reinstall main caps on block and tighten them to prevent damage to the caps.

11. Check the crankshaft.

a. Using a micrometer, check each journal for the following:

1) Out-of-round condition
2) Excessive wear
3) Taper of journal

Micrometer readings should be recorded and compared with manufacturer's specifications.

b. Check rear oil seal surface.

c. Check straightness of crankshaft.

1) Using two "V" blocks, rest the number one journal on one block and the rear main journal on the other block.
2) Set dial indicator needle to ride against the center main bearing and rotate shaft. Record the dial reading. If the reading is excessively high, a new crankshaft or regrinding of the old one, is needed. Compare the dial readings with the manufacturer's specifications to determine whether to replace, regrind, or reuse the crankshaft.

12. Remove cylinder sleeves.

    a. Use a suitable puller to pull sleeves out of the block. Sometimes wet sleeves may be driven out of the block with a hard wood block.

    b. Remove the capscrews that hold the sleeve in place. If the engine does not have sleeves, have the cylinder rebored at a local machine shop.

13. Remove camshaft.

    a. Remove retaining bolts behind cam gear.

    b. Slip camshaft out of the block . It is not necessary to remove the gear from the camshaft unless the gear needs replacing, in which case it must be done in a press.

    c. Be careful not to let the camshaft lobes scrape on the cam bushing when slipping it out of the block.

    d. Check camshaft with a micrometer to determine the bearing journal and lobe sizes, and compare these measurements with the manufacturer's specifications.

14. Remove valve lifters and check them for excessive wear and pits in the flat surfaces.

15. Remove camshaft bushing.

    a. Use a suitable driver plug fitted to the cam bushing and drive out all bushings.

    b. Camshaft bushings, the heart of good oil pressure, should be replaced on all overhauls.

16. Clean engine block.

    a. Soak block in cleaner tank and wash with hot water.

       Blow out all oil passages with air. If steam cleaner is available, steam the block and force steam through the oil passages.

    b. The block should be cleaned after the cylinders have been rebored.

c. Using 80 grit sandpaper, sand the top of the block and the base where the sleeves are installed. Caution: the cylinder must be clean around the top flange and at the bottom where the "O" rings seal.

d. Check block for cracks.

Up to this point in the overhaul procedure, disassembly of the engine and inspection of its parts, has been emphasized. The emphasis now turns to the installation of new parts and reassembly of the engine. The following procedure should be followed in reassembling the engine and installing parts:

1. Install camshaft bushings.

   a. Coat the surface of the bushings with light number 10 oil and install them in the block with a driving plug.

   b. Make sure that the oil holes in the bushing align with the oil holes in the block.

2. Install cylinder sleeves.

   a. Before installing "O" rings on the sleeve or in the block, try each sleeve in the block to make sure it falls into place without having to be forced.

   b. Install "O" rings on sleeve or in the block, using the lubricant recommended by the manufacturer.

   c. Push sleeve into place with hand or a light tap of a soft mallet hammer.

   d. Check protrusion of sleeve above block to make sure that it comes within the manufacturer's specifications. Shims may be added under sleeve flange to increase the protrusion.

3. Coat valve lifters with number 30-weight oil and install them in the block.

4. Install camshaft.

   a. Coat bearings with number 30-weight oil.

   b. Slide the camshaft through each bearing. Do not let lobes slide on the bushings.

c. Check for free rotation of the camshaft. If it does not rotate freely, the bushings have been improperly installed.

d. Install camshaft retaining bolts, and check end play of shaft with dial indicator to compare with manufacturer's specifications.

5. Install crankshaft.

a. Remove main cap.

b. Install new bearing inserts in the block and cap. Make certain that the two bearing halves are installed opposite each other.

c. Coat bearing with 30-weight oil.

d. It may be necessary to install one-half of the rear main oil seal.

1) Coat back of seal with aviation sealer.
2) Soak inside with 30-weight oil.
3) Push into channel.

e. Place crankshaft in the block. Make certain that the camshaft and crankshaft gear timing marks are in line.

f. Install main bearing caps.

1) Place plastic gauge strip on the bearing and install the cap.
2) Align marks on caps with marks on the block.
3) Install main bearing bolts and locks.
4) Torque bolts down, 20 pounds at a time, to manufacturer's specifications.
5) Remove cap and read plastic gauge on the bearing. This indicates the bearing clearance. If too much clearance is read, oversized bearings are needed.

g. Check crankshaft end-play.

6. Install front timing cover.

a. Install front crankshaft seal in cover.

1) Coat outside of seal with aviation sealer.
2) Coat inside with number 30-weight oil.
3) Tighten all bolts uniformly.

7. Install crankshaft pulley.

   a. Coat pulley seal surface with 30-weight oil.

   b. Make sure inside of pulley is clean. If it is not, use sandpaper to clean and clear it.

   c. Use a block of wood and hammer to tap the pulley into the crankshaft and install retainer.

8. Install pistons on connecting rod.

   a. Read manufacturer's instructions for installing rings.

   b. Check rings for size.

      1) Insert rings in cylinder and measure end gap with feeler gauge. All rings except the oil rings, must be checked.
      2) Check manufacturer's specifications to be within clearance limits. If ring end clearance is inadequate, it should be filed.

   c. Check piston cylinder clearance.

      Insert piston into cylinder and check side clearance to be within manufacturer's specifications.

   d. Assemble connecting rod and piston.

      1) Have the pin and bushing fitted at a machine shop that has honing and aligning equipment.
      2) Install piston and rod together, making sure the mark on top of the piston is toward the front of the engine and the mark on the rod is in proper relation to the camshaft.
      3) Install locks on pins.
      4) Caution: follow manufacturer's guide for locating piston to rod alignment.

9. Install piston and connecting rod in the sleeve.

   a. Install rings on the piston with a recommended ring expander.

      1) Carefully place each ring on the piston with the top marking up.
      2) Make sure rings are in the right grooves.
      3) Follow ring manufacturer's specifications for installing rings on piston.

         Example: a) Oil ring should be installed in the bottom groove with the bevel toward the top.
         b) The scrapper ring must be installed in the second groove with the outside notch down.
         c) The compression ring must be installed in the top piston groove with the inside notch up.

   b. Remove rod cap.

   c. Cover piston and rings with number 30-weight oil.

   d. Place ring compressor around piston and compress rings. Note: Follow the manufacturer's specifications for the type of compressing tool to use.

   e. Slide skirt of piston into sleeve, making sure the notch or arrow is toward the front of the block.

   f. Tap piston into sleeve with hammer handle. Only light pressure is needed to force the piston out of the ring compressor. Make sure the connecting rod aligns with the crankshaft as the piston is tapped into the cylinder. Be careful not to scratch the crankshaft journals.

   g. Install rod bearing and check.

      1) Coat the upper half of the bearing insert with 30-weight oil and insert in the connecting rod.
      2) Push connecting rod with piston attached down onto crankshaft.
      3) Install lower half of bearing insert into the cap and cover with oil.
      4) Place a strip of plastic gauze on the insert in the cap.

5) Install cap on connecting rod.
6) Tighten rod bolts or nuts according to manufacturer's specifications.
7) Remove rod bolts or nuts and read the plastic gauge. Compare these clearance readings with the manufacturer's specifications. If the clearance is greater than those prescribed by the manufacturer, use oversized bearings and repeat steps five and six.
8) Install lock nuts and bend metal locks around nuts.
9) This procedure should be used when installing all rod bearings.

10. Overhaul and install the oil pump.

a. Disassemble oil pump.

1) Remove gear from pump, using suitable puller.
2) Remove all parts from pump and clean them thoroughly.
3) One should install an oil pump overhaul kit, which includes new gears, shaft, gasket, and pressure regulating valve, when overhauling an oil pump.
4) Install new pump parts.

a) Check backlash between gears.
b) Check gear-to-housing clearance.
c) Check gear end clearance.
d) Compare these findings with manufacturer's specifications. If the readings are higher than those set down in the manufacturer's specifications, replace the housing.

5) Install pump into the block, torque bolts to manufacturer's specifications, and lock with wire or metal locks.
6) Fill oil pump inlet tube with number 30-weight oil to aid in priming the pump.

11. Install oil pan.

a. Coat block with aviation sealer and stick gasket to it.

b. Install pan and tighten bolts. Do not tighten bolts too tight, as they will break the gasket.

12. Recondition cylinder head.

a. Clean head.

1) Using a 1/4 hp. drill with a wire brush, remove carbon from the head.
2) Use a carbon scraper to remove excess carbon that cannot be removed with a wire buffer.
3) Clean around valve seats.
4) Wash the head in a cleaning solution and then hot water.

b. Remove and replace valve guides.

1) Drive guides out of head with a suitable guide driver and hammer.
2) Using emery paper, clean hole in head where guides are inserted.
3) Wipe guides and blow area around guide holes clean with compressed air.
4) Coat guide with number 10-weight oil and drive in place with driver and hammer.
5) Follow manufacturer's specifications for length of guide protrusion.

c. Grind valve seats.

1) Select valve guide pilot to fit guide.
2) Select a stone to fit the valve seat outside diameter and the degree of angle on the seat.
3) Set grinder on the seat and reface the seat.

a) Make sure the seat is within allowable limits for width of seat.
b) If the seat is too wide, use a 15° and 75° stone to narrow the seat.

d. Using a straight edge, check the head for warp.

e. Reface valves.

1) Clean valves with wire brush.
2) Using a micrometer, measure the valve stem for comparison with the manufacturer's specifications.
3) Set valve grinding machine for proper valve face angle.

4) Reface all valves.

Check valve head thickness after grinding to be certain is is within manufacturer's specifications.

5) Resurface valve stems on grinding machine.
6) Place valve in the head and check margin of seat on valve face with bluing. Grind seat to bring it within manufacturer's specifications, and allow proper valve seating.
7) Check valve springs.

a) Using a valve spring tester, check spring length and the tension at a given length.
b) Compare these measurements with the manufacturer's specifications and replace valve springs not within manufacturer's limits.

8) Coat valves and stems with number 30-weight oil and place in the head.
9) Install valve spring and keeper.

a) Check valve spring to see if there is any difference in the top and bottom by checking for coils being close together.
b) Install valve seals on stem of valve if recommended by the manufacturer.

f. Clean and check energy cells.

Note: Some diesel engines use what is called an "energy cell" or "precombustion chamber" to increase combustion efficiency.

1) Remove cell from head.

a) Remove bolts from cell.
b) Remove bolts from cell hold-down bars.
c) Remove bars and caps.
d) Remove cell with the necessary special puller and slide hammer, and check for burnt tips and enlarged hole. Keep all cells and caps together.
e) Soak cell in carbon remover, wash, and blow dry with compressed air.
f) Lab the cap and cell on a special lapping tool.

g) Clean hole in head and check for burnt places where cell may leak. If the cell has been leaking, replace the compression.
h) Replace any burnt cell.
i) Assemble and install in reverse order, following the procedure outlined by the manufacturer.
j) Torque nuts and hold-down bar to manufacturer's specifications.

13. Install head on block.

a. Install a new head gasket.

b. Coat gasket with a recommended gasket sealer.

c. Install all head bolts and snug them down.

d. Use torque wrench to finish tightening head bolts. Follow manufacturer's sequence for torquing head bolts.

14. Install push rods.

Make certain that each rod is set in the valve-lifter socket.

15. Recondition rocker arm assembly.

a. Remove all arms from shaft.

1) Remove cotter pin and washer.
2) Note where oil holes are in respect to the shaft.

b. Resurface all rocker arms on valve refacing machine.

c. Check rocker arm shaft with micrometer for excessive wear and compare with manufacturer's specifications.

d. Clean shaft internally to keep sludge from plugging oil holes.

e. Assemble rocker arms and shaft.

16. Install rocker arm assembly on head.

    a. Fit all rocker arm balls into socket of push rod.

    b. Make sure oil feed stud on line is in the proper place.

    c. Back up adjusting screws.

    d. Tighten rocker arm assembly to head.

17. Adjust valves.

    They should always be adjusted cold before starting engine.

18. Install valve cover.

    Coat valve cover with sealer and stick gasket to it. Do not coat the other side of the cover gasket.

19. Overhaul and install distributor (gasoline tractor only).

    a. Remove distributor cap.

        1) Check for cracks, corrosion on points, and other signs of wear.
        2) Remove rotor and inspect.

    b. Remove points.

        Check conditions of points.

    c. Remove condensor.

        Test condensor on tester.

    d. Remove point plate.

    e. Check spark advance weights for sticking.

    f. Check spark advance spring tension.

    g. Check distributor shaft and bushing for excessive wear.

    h. Assemble in reverse order.

i. Lubricate advance weights with number 10-weight oil.

j. Install new points and condensor.

k. Adjust the distributor to the manufacturer's specifications on high cam and lubricate cam with distributor cam grease.

l. Install rotor and cap.

20. Install and time distributor. See "Tractor Tune-Up and Maintenance" module for procedure.

21. Install spark plug wires.

a. Check spark plug wires for cracks and bad insulation.

b. Check terminals, making certain that they fit tight in the distributor cap and on the spark plug.

c. Check the spark plug firing order.

1) Remove the spark plug in the number one cylinder.
2) Rotate crankshaft until the number one piston is almost at the top of the compression stroke.
3) Insert spark plug.
4) Install the wire on the spark plug and in the distributor cap wire plug opening which the rotor in the distributor points to.
5) Install the remaining wires in rotation, running them to the plugs according to the firing order.
6) The cylinders are numbered starting with the first cylinder, which is the closest to the radiator, and counting back.

22. Install injector pump (diesel tractor only).

a. Rotate engine to bring the number one cylinder to the top of its compression stroke.

b. Line up crankshaft pulley on flywheel timing marks.

c. Turn the injector pump to proper timing mark and slide it into the block, meshing the gear on the pump with the gears on the crankshaft.

d. Recheck alignment of all markings.

e. Reassemble all parts in the reverse order.

23. Overhaul and install water pump.

a. Remove fan from the pump.

b. Remove fan hub and pulley with a pulley puller and mark the position of the hub on the shaft.

c. Remove rear pump cover.

d. Remove pump impeller from shaft.

e. Remove seal assembly.

f. Remove snap ring and then shaft and bearing from the pump housing.

g. Clean housing with a scraper and sand paper and blow clean with compressed air.

h. Install new water pump kit.

1) Using soft hammer, tap shaft and bearing into housing, and install snap ring.
2) Install new seal in the pump impeller.
3) Press impeller into place on the shaft. Do not tap on the shaft or seal, as it will break the seal.
4) Press fan nub onto shaft in its original position.
5) Install gasket and rear pump cover.
6) Install a new pump gasket.
7) Install pump on engine.

24. Overhaul and install generator.

a. Overhaul generator.

1) Remove and inspect generator cover.
2) Remove terminal wire from armature brush holder.
3) Remove wire from field to armature brush.
4) Remove long bolts from the commutator end-frame, and remove frame and generator brushes.

5) Remove field housing from pulley end-frame. Remove the pulley by removing the attachment nut and pressing the shaft from the pulley.
6) Remove pulley key and top armature shaft from the bearing.
7) Remove bearing from frame and check, clean, and repack it with grease. Clean generator parts in cleaning solution, wash with water, and blow dry with air under low pressure.
8) Check commutator end-frame bushing and armature shaft for excessive wear. Replace bushing, if necessary.
9) Check armature.

   a) Grawler test
   b) Induction test
   c) Light short test

10) Check field coil.

   a) Light continuity test
   b) Light short test

11) Turn commutator on metal turning lathe and undercut mica. Smooth commutator with fine sandpaper.
12) Install new brushes and make certain they fit properly against the commutator.
13) Assemble the generator, reversing the disassembly order outlined above.

b. Install generator on engine.

   1) Install new fan belt and tighten. (Refer to "Tractor Tune-up and Maintenance" module, p.10.)
   2) Polarize generator. (Refer to "Tractor Tune-up and Maintenance" module, p.10.)

25. Overhaul and install starter.

a. Remove starter and inspect its parts.

b. Remove screws holding field wires to brush holders.

c. Remove end-frame bolts and frame. Center punch housing for use in aligning the frame and housing.

d. Remove bolts from drive-end frame and remove the frame.

e. Remove armature from field housing.

f. Remove and inspect drive mechanism.

1) Check for broken spring.
2) Check for sheared drive bolt.
3) Check for untrue gear teeth.
4) Check for sticking screw mechanism caused by heavy grease, oil, or rust.
5) Clean parts, install new parts, as needed, and lubricate with 10-weight or a lighter oil.

g. Check field coils.

1) Use light test for continuity.
2) Use light test for detecting a short.

h. Check armature.

1) Use grawler test.
2) Use light test for shorts.
3) Use grawler test for induction.
4) Turn commutator on metal lathe. Do not undercut the mica on a starter commutator.

i. Check end-frame bushing for excessive wear, and replace if necessary.

j. Check armature lamintation for wear, which would suggest worn bushings.

k. Seat new bushings on commutator.

l. Reassemble starter, and install on the engine.

26. Install water manifold.

a. Check thermostat.

1) Place the thermostat in a pan of water.
2) Heat the water with a torch.
3) Note the temperature of the water when the thermostat opens.
4) Check this temperature reading with the manufacturer's specifications for temperature at which the thermostat should open. If the thermostat does not open within manufacturer's specifications, replace it with a new one.

b. Install thermostat in the head, with coil toward the block.

c. Install water manifold gasket and water manifold on the head.

27. Install intake and exhaust manifold.

a. Scrape and sand head and manifold gasket surfaces.

b. Install gasket on head.

c. Install manifold.

d. Torque bolts uniformly to meet manufacturer's specifications.

27A. On diesel engines the manifold heater must be cleaned and adjusted at this stage in the overhaul procedure.

a. Remove heater from manifold.

b. Check for burnt insulator material that may be shorting heater element.

c. Check insulated bolts.

d. Check element for burnt spots.

e. Check element for proper ground.

f. Reassemble element and install in the manifold.

g. Test the heater element.

1) Connect manifold to the positive post of a 1250 battery.
2) Connect insulated terminal to negative post. Wait 60 seconds and check the element. It should be red hot.

28. Overhaul and install fuel injectors (diesel only) .

a. Remove injectors and attach to pump injector tester.

1) Note pressure build-up until the injector injects fuel.
2) Keep hands away from the injector nozzle, as the fuel is under high enough pressure to penetrate the skin.

3) Watch spray pattern.
4) Check injector to see if it will hold pressure to within 300 lbs. of pop-off without leaking at tip.

b. Clean injector.

1) The injector should be cleaned and reset according to the procedures outlined by the manufacturer.
2) Cleanliness is of utmost importance here because all parts are built with close tolerance.

c. Install injector after overhauling the engine.

d. Using a piece of dowl stick wrapped in a soft cloth, wipe the injector hole clean.

e. Place a new copper gasket on the injector and install the injector in the head.

f. Tighten the injector hold-down nuts uniformly, according to manufacturer's specifications.

g. Install fuel lines.

Note: The following procedure should be carried out after the fuel filters are cleaned.

h. Bleed injector.

1) Loosen all injector lines at the injector and set the throttle to start.
2) Crank engine until fuel leaks from lines.
3) Close all lines and start engine.
4) Loosening one line at a time, let all air out of the line.

29. Overhaul and install governor (gasoline tractor only).

a. Clean governor.

b. Disassemble unit and check for the following:

1) Worn linkage
2) Worn weight pins
3) Worn and flat spots on weight balls
4) Worn bearing, bushing, and shaft
5) Worn and broken thrust bearing
6) Tension on governor spring

c. Reassemble entire unit.

d. Install new gasket, using aviation sealer to seal gasket to housing, and install the governor on the engine.

30. Overhaul and install carburetor.

a. Disassemble entire carburetor.

1) Remove screw around the float, and split carburetor.
2) Remove float by slipping pin out of bracket.

a) Check float for dents.
b) Shake float to see if there is fuel inside it.

3) Remove float needle valve assembly, seat, and seat gasket.

a) When installing the seat, make sure the new seat gasket is in place.
b) Needle, seat, and gasket should always be replaced for good fuel regulation.

4) Remove all jets.
5) Soak all parts in a carburetor cleaning solution for one hour.
6) Wash with hot water, and blow dry with compressed air.

b. Assemble carburetor.

1) Install carburetor overhaul kit.
2) Install jets in the lower and upper carburetor housing.
3) Install float seat in upper carburetor housing.
4) Install float and pin. Adjust float according to manufacturer's specifications.
5) Reassemble remaining parts.
6) Check choke butterfly to see that the anti-flooding valve is operating properly.
7) Preset all outside adjustments to manufacturer's specifications.

c. Install new carburetor flange gasket.

d. Install carburetor on the engine.

e. Start engine and set the carburetor for maximum R. P. M.'s by adjusting the governor spring according to the manufacturer's specifications.

31. Set spark plug gap and install spark plugs.

a. Measure the spark gap with a feeler gauge. Compare this gap with the manufacturer's specifications and adjust with a bending tool.

b. Attach spark plug wires.

32. Install oil filter.

a. Install gasket on oil filter bracket, using aviation sealer and bolt filter to block.

b. Soak oil filter element in either number 10- or number 20-weight oil and install filter in bracket.

33. Remove, clean, and install fuel filters (Diesel tractors only).

a. Remove primary fuel filter element. This is the filter closest to the tank.

1) Turn fuel off at tank.
2) Remove cap screw from top of bracket.
3) Remove fuel filter cup.
4) Remove element from filter cup.
5) Wash filter cup in diesel fuel.
6) Install new elements in filter cup.
7) Fill filter cup with clean diesel fuel.
8) Install filter cup in bracket, and install on the engine.

b. Bleed filter.

1) Loosen bleed screw on the top of the filter. Turn fuel on and open bleed screw until air bubbles cease.
2) Tighten bleed screw.

c. Clean secondary filter.

1) Turn fuel valve off.
2) Disconnect fuel lines.
3) Remove filter from bracket.
4) Remove fuel line fittings from old filter.
5) Discard old filter.
6) Reinstall fuel line fittings in new filter, using aviation sealer on fittings.
7) Reassemble secondary filter.
8) Turn fuel valve on.
9) Loosen bleed screw in the top of the filter and let the air out of the filter cup.

Suggested Teaching-Learning Activities

1. Identify and demonstrate special tool usage before the class.

2. Using charts, overhead transparencies, and other instructional materials, discuss with the class each step in the overhaul procedure.

3. Following the engine repair procedure outlined in this module, have students repair the engines on their respective tractors.

Suggested Instructional Materials and References

Instructional materials

1. Special tools used in repairing tractor engines

2. Charts, overhead transparencies, and other instructional materials pertaining to the content

3. A tractor for each two students

References

1. Farm Tractor Guide.

2. For Better Diesel Engine Overhaul.

3. For Better Gasoline Engine Overhaul

4. Implement and Tractor Service Manual

5. Manufacturer's service manuals.

6. Perfect Circle Service Manual.

7. Piston Rings, Pistons, and Cylinders.

Suggested Occupational Experience

Have students overhaul a tractor engine at a local agricultural machinery dealership under the supervision of the head mechanic. Have them parallel their work on the engine at the agricultural machinery dealership with their classroom study and repair procedures.

IV. To repair a tractor clutch

Teacher Preparation

Subject Matter Content

1. Check the clutch plate.

   a. Inspect lining for wear.

   b. Check plate and hub for cracks.

   c. Inspect shock springs for breakage.

   d. Inspect spline in hub for wear.

2. Check pressure plate.

   a. Check plate for cracks.

   b. Inspect for burnt spots.

   c. Check for broken springs.

   d. Check fingers for wear.

   e. Disassemble pressure plate and check the tension on all springs. Following the manufacturer's specifications, make the above checks and repairs, and reassemble.

   f. Install new pilot bearing on bushing on crankshaft. Grease inside of bushing with a small amount of wheel bearing grease after installing in the crankshaft.

3. Install flywheel on the crankshaft and torque bolts to manufacturer's specifications.

4. Install clutch.

   a. Place clutch disk against the flywheel.

   b. Insert clutch aligning tool in clutch and pilot bearing.

   c. Place pressure plate against the flywheel and install special shoulder capscrew.

   d. Torque capscrews to manufacturer's specifications.

   e. Remove aligning tool.

   f. Check fingers to be certain that they are the right distance from the clutch hub. Follow the manufacturer's specifications to adjust the clutch fingers.

5. Install new throw-out bearing on transmission main shaft tube.

   a. Lubricate tube with small amount of grease.

   b. Check throw-out bearing return spring for breaks and twists.

Suggested Teaching-Learning Activities

1. Identify and demonstrate special clutch tool usage before the class.

2. Using charts, overhead transparencies, and other instructional materials, discuss with the class each step in the repair procedure outlined in the content.

3. Following the clutch repair procedure in this module, have students repair the clutches of their assigned tractors.

Suggested Instructional Materials and References

Instructional materials

1. Special tools used in repairing clutch

2. Charts, overhead transparencies, and other instructional materials pertaining to the content

3. A tractor for each two students

References

1. Implement and Tractor Service Manual.

2. Manufacturer's service manuals.

Suggested Occupational Experience

Have students overhaul a tractor clutch at a local agricultural machinery dealership under the supervision of the head mechanic. Have them parallel their work on the clutch there with their classroom study and repair procedures.

V. To repair a tractor transmission

Teacher Preparation

Subject Matter Content

Before beginning any major overhaul of the transmission, study the manufacturer's trouble shooting service guide and attempt to diagnose trouble in the transmission.

Common transmission troubles include:

1. Locking into gear

2. Slipping out of gear

3. Oil transfer from one compartment to another

4. Missing gear teeth

5. Excessive noise caused by loose bearings or excessive end play

For repair, follow these procedures:

1. Remove transmission from the differential.

2. Remove external parts from transmission.

   a. Battery and box

   b. Brake and clutch pedals

c. Steering mechanism

d. Platform

3. Drain out transmission oil.

4. Remove PTO shaft.

a. Remove bolt from PTO bearing cover.

b. Use bar to pry PTO shaft and bearing out of the transmission housing.

c. Inspect PTO bearing and shaft.

1) Remove snap ring from shaft.
2) Using press or puller, remove bearing from shaft.
3) Check PTO seal located in the cover, and replace if necessary.

a) Use punch and hammer to remove seal.
b) Coat inside of new seal with aviation sealer. Using a flat plate, press seal into cover. Coat inside of seal with grease.

4) Check PTO bearing.

a) Wash bearing in cleaning solution and blow dry with compressed air.
b) Lubricate bearing with number 10-weight oil and rotate with hand. If bearing does not have a smooth, quiet roll, replace it.

5) Check PTO shaft.

a) Shaft must be straight.
b) Spline should be in good condition.
c) Seal surface should be smooth.
d) Reassemble PTO.

5. Remove transmission shifting cover.

a. Remove bolts around cover and lift cover off.

b. Check and repair cover.

1) Follow manufacturer's recommended procedure for repairing the transmission cover.

2) Check for excessive wear on shifting forks, rails, and lever, shifter pins, cup and snap ring.

c. Loosen set screws holding rail to fork.

d. Check for worn or weak detent pins and springs, and bent or sprung shifting fork.

6. Remove bolts around rear transmission housing, separating transmission from differential. At this point it may be necessary to remove brakes if they are mounted on the transmission.

7. Remove internal parts of the transmission, following the manufacturer's recommendations found in the index under "Transmission Overhaul."

a. Remove transmission input shaft.

1) Check gear teeth for chips, excessive wear, and pitting.
2) Check ball bearing.

a) Wash the bearing and blow dry with compressed air.
b) Lubricate it with clean oil.
c) Rotate bearing, checking for smoothness of roll and noise.
d) Check bearing for excessive end play.
e) Check all other ball bearings in the transmission in the same manner.

b. Remove and check the output shaft.

1) Inspect the third and fourth shifting collar for excessive teeth radius.
2) Check the sliding gear for excessive teeth wear and radius, chipped or broken teeth, and pits in the teeth.

c. Remove and check the idler gear and shaft.

1) Check idler gear and shaft.

a) Using a micrometer, measure the shaft for excessive wear. Compare findings with the manufacturer's specifications for shaft size.

b) Using the outside micrometer and telescopic gauge, check the wear on the internal bushing of the reverse idler gear.
c) Check the teeth on the idler gear for pitting, chipping or cracking, and excessive radius.

d. Remove countershaft gear assembly..

1) Remove shaft that runs through the housing and countershaft gear assembly.

a) Drive shaft out with a brass rod or punch.
b) Lift assembly out of housing.
c) Check countershaft assembly.

-- Check gears for pitting, chipping, and excessive radius on the teeth.
-- Check countershaft bearing.
-- Check countershaft for excessive wear.

d) Using a micrometer, measure all thrust washers for thickness, and compare these thicknesses with the manufacturer's specifications.

e. Replace all seals.

f. Reassemble transmission. Follow the manufacturer's procedure for assembling the transmission and adjusting all bearings and end play.

g. Install transmission cover.

1) Make sure all forks fit over their respective gears.
2) Tighten bolts.

h. Install all other transmission parts.

i. Fill the transmission with the oil recommended by the manufacturer.

Suggested Teaching-Learning Activities

1. Identify and demonstrate special transmission tool usage before the class.

2. Using charts, overhead transparencies, and other instructional materials, discuss with the class each step in the repair procedure outlined in the content.

3. Following the transmission repair procedure in this module, have students repair the transmissions of their assigned tractors.

Suggested Instructional Materials and References

Instructional materials

1. Special tools used in repairing transmission

2. Charts, overhead transparencies, and other instructional materials pertaining to the content

3. A tractor for every two students

References

1. Implement and Tractor Service Manual.

2. Mechanics Study Guide No. 5 -- Transmission Theory.

3. Manufacturer's service manuals.

Suggested Occupational Experience

Have students overhaul a tractor transmission at a local agricultural machinery dealership under the supervision of the head mechanic. Have them parallel their work there with their classroom study and repair procedures.

VI. To repair tractor brakes

Teacher Preparation

Subject Matter Content

1. Jack the tractor up and remove the rear wheels.

2. Place safety jack under the differential housing.

3. Remove brake drum.

   a. Remove screws holding the drum to the axle hub and remove drum.

   b. Remove the large nut that holds the wheel hub to the axle. Use a wheel puller to remove the hub from the axle.

4. Inspect the brake assembly.

   a. Check brake linings for wear.

   b. Check for oil leakage into brakes.

   c. Check to see if linkage is worn or frozen.

   d. Check the brake drum for scarring. If scarred, it may have to be turned on a metal lathe to be renewed.

   e. Check brake return springs for rusting and breakage.

5. Remove brake shoes and replace linings.

   a. Use a small punch to remove rivets.

   b. Clean shoes and rivet new linings to the shoe with a rivet set or rivet machine.

6. Install a new oil seal if the old seal is leaking oil into the brake assembly.

7. Reassemble brake parts and reinstall the tractor wheels.

8. Adjust the brakes.

9. Follow the manufacturer's recommended procedure for overhauling brakes that are located on the transmission. Use the procedure outlined above for inspecting these brakes.

Suggested Teaching-Learning Activities

1. Identify and demonstrate special brake tool usage before the class.

2. Using charts, overhead transparencies, and other instructional materials, discuss with the class each step in the repair procedure outlined in the content.

3. Following the brake repair procedure in this module, have students repair the brakes on their assigned tractors.

Suggested Instructional Materials and References

Instructional materials

1. Special tools used in repairing brakes

2. Charts, overhead transparencies, and other instructional materials, discuss with the class each step in the repair procedure outlined in the content.

3. A tractor for every two students.

References

1. Implement and Tractor Service Manual .

2. Manufacturer's service manuals.

Suggested Occupational Experience

Have students overhaul a set of tractor brakes at a local agricultural machinery dealership under the supervision of the head mechanic. Have them parallel their work there with their classroom study and repair procedures.

VII. To repair and adjust the final drive

Teacher Preparation

Subject Matter Content

1. Jack up the tractor and remove the rear wheels.

2. Place safety jacks under the differential housing.

3. Remove the housing and gears.

   a. Drain the oil from the final drive pans.

   b. Remove final drive pan.

   c. Remove the cap on the inner stub axle.

      1) Remove the bolts holding the cap. Knock the cap out by driving on the stub axle.
      2) Note the number of shims on the cap used to adjust the bearings. Keep these with the cap.
      3) Inspect bearing cup in the cap for wear and pitting.

4. Remove the stub axle.

   a. Remove the snap ring along the side of the gear that holds the gear in position on the stub axle.

   b. Drive axle out of the housing.

   c. Remove roller bearing from the axle with a bearing puller. Pull only on the inner race of the bearing.

5. Remove bowl gear.

6. Remove outside upper axle cap.

   a) Note the number of shims on the cap for adjusting bearings. Keep these with cap.
   b) Pull axle away from the differential.

7. Remove housing.

   a. Remove bolts holding the final drive housing to the differential housing.

   b. Pull the final drive housing away from the differential housing.

8. Check housing, bearings, axle, and gears.

   a. Check housing for cracks.

   b. Check bearings.

      1) Remove bearings.
      2) Wash the bearings and blow dry with compressed air.
      3) Inspect all bearing rollers, noting any pits or burnt spots.
      4) Inspect the inner race on roller bearings by holding bearing up to the light and observing the race as the bearing rotates. Note any pits, chips, or cracks on the rollers.
      5) Check all bearing cups for pits, chipping, color, or excessive groove wear in cups.

   c. Check stub axle.

      1) Check spline or keyway for excessive wear.
      2) Check bearing surface for bearing scars.

   d. Check bowl gear and axle gear for teeth worn to a sharp edge, internal spline wear, and chipped teeth.

9. Install housing on differential.

   a. Install a new gasket.

   b. Install new axle seal in housing and coat the inside of the housing with grease.

10. Install stub axle.

   a. Drive stub axle through bowl gear with new seals installed.

   b. Install snap rings.

   c. Install inside axle cap with shims and coat bearing with grease.

   d. Tighten bolts.

   e. Rotate gear. If bearings are too tight, add more shims. If bearings are too loose, remove shim. There should be a slight drag on the gear rotation.

f. If stub axle has adjustable nut under the cap, adjust in the same manner as the front wheel bearing is adjusted.

11. Install upper axle in housing.

    a. Coat bearing with grease.

    b. Install upper outside axle cap with shims. Shift transmission into neutral position and rotate bowl gear. Remove shims under cap until the drag slightly increases on bowl gear rotation.

12. Install new oil pan gasket.

13. Install oil pan.

14. Fill final drive pan with the kind of oil recommended by the manufacturer.

Suggested Teaching-Learning Activities

1. Identify and demonstrate special final drive repair tool usage before the class.

2. Using charts, overhead transparencies, and other instructional materials, discuss with the class each step in the repair procedure outlined in the content.

3. Following the final drive repair procedure in this module, have students repair the brakes on their assigned tractors.

Suggested Instructional Materials and References

Instructional materials

1. Special tools used in repairing final drives

2. Charts, overhead transparencies, and other instructional materials pertaining to the content

3. A tractor for every two students

References

1. Implement and Tractor Service Manual.

2. Manufacturer's service manuals.

Suggested Occupational Experience

Have students overhaul the final drive on a tractor at a local agricultural machinery dealership under the supervision of the head mechanic. Have them parallel their work there with their classroom study and repair procedures.

VIII. To repair and adjust the differential

Teacher Preparation

Subject Matter Content

1. Remove external parts.

   a. Jack tractor up and remove rear wheels.

   b. Place safety jacks under the transmission housing.

   c. Drain oil from the differential.

   d. Remove rear fenders.

   e. Remove tractor seat.

2. Split differential.

   a. Remove axle.

      1) Remove brake drums.
      2) Remove bolts around the back plate.
      3) Remove axle by tapping on the axle flange.

   b. Remove axle.

      1) Remove upper outside axle bearing cap.

         a) Remove bolts around cap.
         b) Pry cap out of housing.
         c) Pull axle out of differential.

   c. Remove bolts around housing of differential and split differential into halves.

3. Remove ring gear carrier.

   a. Remove cover on rear of differential housing.

   b. Mark caps that hold the ring gear carrier in the housing and remove bolts.

   c. Tap caps off with a soft mallet hammer and remove the ring gear carrier. Keep matching bearing cups and cones together.

4. Check axle and pinion gears.

   a. Mark carrier halves for alignment.

   b. Remove bolts holding carrier together and split the carrier into halves.

   c. Remove pinion and axle gears from shaft.

   d. Inspect thrust washers for excessive wear, splitting, and breaks.

   e. Inspect gear and shaft for excessive wear on teeth, chipped teeth, pitted teeth, inside gear wear, and crosshaft wear.

   f. Install new thrust washer and assemble carrier.

   g. Torque carrier bolts to the manufacturer's specifications.

5. Remove ring gear from carrier.

   a. If the ring gear is bolted to the carrier, remove nut locks and bolts.

   b. Remove gear from carrier.

   c. If ring gear is riveted to carrier

      1) Use cutting torch to cut off rivet beads.
      2) Cut rivet beads at the ring gear if ring gear is to be discarded, or cut rivets at the carrier if carrier is to be discarded.
      3) Use punch and hammer or press to push rivets out of the carrier.

4) Remove ring gear.
5) When assembling carrier and ring gear, replace rivets with special bolts and nuts and torque to manufacturer's specifications. Be sure to install locks on nuts.

6. Remove tapered roller bearings from carrier.

   a. Use puller or press to remove bearings.

   b. Inspect bearings. Follow the procedure outlined under step 8 in competency VII.

   c. Press bearing on carrier.

7. Remove pinion gear from differential housing.

   a. Remove bolts from pinion retainer cap.

   b. Using a hard wood block 2" x 2" x 2' and a hammer, drive pinion out of housing.

8. Inspect pinion gear and bearing.

   a. Remove large nuts from pinion shaft.

   b. Press double tapered roller bearing from the pinion shaft.

   c. Inspect bearing. Follow procedure outlined in step 7, competency VII.

   d. Inspect pinion gear for chipped or pitted teeth and excessive wear on the teeth.

9. Press bearings on pinion shaft and lubricate with gear oil.

10. Adjust bearings with large nut on pinion shaft.

    a. Adjust to a slight drag.

    b. Install second nut to lock first nut into position.

11. Install pinion in housing.

12. Install ring gear in housing.

    a. Adjust ring carrier bearings.

        1) Tighten bearing adjuster. Push against bearing cups and tighten to get slight drag on bearings.
        2) Adjust ring gear to pinion back lash.

            a) Tighten adjuster on one side and loosen the other side to move the ring gear closer to the pinion. Reversing this procedure moves the ring gear away from the pinion.
            b) Place dial indicator needly on the ring gear teeth and rotate ring gear back and forth without turning pinion. Note the dial reading and compare it with the manufacturer's specifications. Change reading by moving ring gears closer to or farther away from the pinion.
            c) Lock cap.

13. Install new gasket.

14. Reassemble differential, sealing all parts as they are assembled.

Suggested Teaching-Learning Activities

1. Identify and demonstrate special differential repair tool usage before the class.

2. Using charts, overhead transparencies, and other instructional materials, discuss with the class each step in the repair procedure outlined in the content.

3. Following the differential repair procedure in this module, have students repair the differential on their assigned tractors.

Suggested Instructional Materials and References

Instructional materials

1. Special tools for repairing differentials

2. Charts, overhead transparencies, and other instructional materials pertaining to the content

3. A tractor for every two students

References

1. Implement and Tractor Service Manual.

2. Manufacturer's service manuals.

Suggested Occupational Experience

Have students overhaul the differential on a tractor at a local agricultural machinery dealership under the supervision of the head mechanic. Have them parallel their work there with their classroom study and repair procedures.

IX. To repair the power steering units

Teacher Preparation

Subject Matter Content

1. Check and repair power steering unit. Check for the following minor items that hinder proper unit operation:

   a. Oil in reservoir

   b. Bad filter

   c. Loose drive belt

   d. Plugged air vent in resevoir

   e. Collapsed intake hose

   f. Plugged intake hose

2. Check hydraulic pump for maximum pressure.

   a. Remove pressure line from the hydraulic cylinder.

   b. Connect pressure gauge to line.

   c. Start engine and run at a fast idling speed. Turn steering wheel and note the gauge reading. Check manufacturer's specifications for maximum pump pressure. If satisfactory, connect the line to the cylinder again.

d. Remove the line from the opposite end of the cylinder and repeat the test in step c. A low pressure indicates a worn pump or faulty check valve.

3. Install a pump kit. This kit includes gears, bearings, seals, and "O" rings.

4. Check pump if pressure is low.

   a. Remove lines to pump.

   b. Remove bolts holding pump to block and remove pump.

   c. Disassemble pump. If it is a gear pump, check for worn gears, drive gear slippage and shaft due to sheared key or broken gears, worn housing, and too much clearance between gear teeth.

5. If the pump is the vane type, check for:

   a. Vanes for shortness

   b. Scarred and sticking vanes

   c. Worn housing

   d. Worn bearings

6. Remove and inspect check valve.

   a. Remove large plug.

   b. Remove spring and valve.

   c. Check spring tension on spring tester and compare with manufacturer's specifications.

   d. Check valve for groove in the seat.

   e. Check valve for sticking in housing.

7. Reassemble parts.

8. Remove and check hydraulic cylinder.

   a. Disassemble hydraulic cylinder according to the manufacturer's specifications.

      1) Check piston cups for breaks or splits.

2) Check the "O" ring.
3) Check for split piston packing.
4) Check inside of cylinder for scores that cut piston cup or packings.
5) Reassemble parts, installing complete new gaskets and "O" rings.

9. Check control valve.

a. Remove control valve from the tractor.

b. Disassemble valve control.

1) Look for flat or broken "O" rings.
2) Check for scored valve piston and housing.
3) Check for sticking valve.

c. Reassemble and install new "O" rings.

Suggested Teaching-Learning Activities

1. Identify and demonstrate special power-steering repair tools before the class.

2. Using charts, overhead transparencies, and other instructional materials, discuss with the class each step in the repair procedure outlined in the content.

3. Following the power steering procedure in this module, have students repair the power-steering unit on their assigned tractors.

Suggested Instructional Materials and References

Instructional materials

1. Special tools for repairing power steering units.

2. Charts, overhead transparencies, and other instructional materials pertaining to the content.

3. A tractor for every two students

References

1. Implement and Tractor Service Manual.

2. Manufacturer's service manuals.

Suggested Occupational Experience

Have students overhaul the power steering unit on a tractor at a local agricultural machinery dealership under the supervision of the head mechanic. Have them parallel their work there with their classroom study and repair procedures.

X. To prepare and paint the tractor after it has been repaired

Teacher Preparation

Subject Matter Content

A steam cleaner should be used to remove grease, oil, dirt, and foreign materials from the outside surfaces of the tractor. The manufacturer's instructions for use of the steam cleaner and the recommended cleaning solution to use should be carefully followed when using the steam cleaner. Caution should be exercised to avoid letting steam come in contact with hydraulic lines, pressure bases, etc.

1. Remove all parts that would make it difficult to remove the paint from behind them.

2. Before sanding the tractor surface, cover all openings and other parts that are in danger of being damaged by the dust from the sander.

3. Sand the surface of the tractor.

   a. Using a power disk sander, sand all surfaces with #60 or #80 grit sandpaper.

   b. Use #30 grit sandpaper to remove heavy rust. However, if a rust inhibiting primer is used, it isn't necessary to sand down to bright metal.

   c. Wipe or wash off the sanded surfaces.

4. Prime base metal.

   a. Use a fish oil base rust inhibitive primer on soundly rusted metal and zinc chromate primer on clean metal.

   b. Strain primer before placing it in the spray paint gun.

c. Apply primer evenly on all surfaces avoiding build-ups that will cause the primer to run. If runs develop sand them off and reprime.

d. Sand all primed surfaces with #220 sand paper after the primer has dried.

5. Cover all parts that should not be painted or that should be painted a different color with masking tape or masking cream.

6. Move tractor into a suitable dust-free paint room or paint area.

7. Wipe off all surfaces to be painted with enamel thinner. This step will aid in knitting the primer coat and the fresh paint.

8. Mix paint according to the manufacturer's directions on the paint can. If the paint needs to be thinned use the thinner recommended by the manufacturer of the paint.

9. Apply a light first coat of paint to all and let dry.

10. Using a fine sandpaper, roughen up all painted surfaces. Wipe or blow-off all sanded surfaces.

11. Apply the second coat of paint.

12. Following the above procedures, paint all parts that have been removed or are to be painted a different color.

13. When the paint has dried thoroughly, install parts that were removed earlier.

14. If runs or sags occur in the paint, sand them off, reprime the sanded area, and repaint.

15. After the paint has thoroughly dried, install duals. Follow the instructions on the duals when installing on the tractor.

16. If problems develop in applying the paint caused by the spraying outfit, consult the operator's manual to correct these problems.

17. After the tractor has been painted, clean the paint gun in a recommended cleaner and wipe all parts dry.

Suggested Teaching-Learning Activities

Have students prepare their tractors for painting and paint them, following the steps outlined in the subject matter content.

Suggested Occupational Experiences

Have students prepare their tractors for painting and paint them at a local agricultural machinery dealership.

Suggestions for Evaluating Educational Outcomes of the Module

The following criteria should be used to evaluate the educational outcomes of this module:

1. How efficiently the student performs the overhaul tasks in his tractor.
2. The quality of work done by the student
3. The understanding the student has of the nature of the work to be done
4. The ability of the student to use references in carrying out his overhaul tasks
5. The ability of the student to detect malfunctions in the tractor
6. The aggressiveness of the student in carrying out overhaul procedures
7. The cleanliness of the student in overhaul procedures
8. The running efficiency of the overhauled tractor under load, as measured by the dynomometer.

Source of Suggested References

1. Farm Tractor Guide. Pittsburgh: Gulf Oil Corporation, Gulf Building, 1964. No charge.
2. For Better Diesel Engine Overhaul, Form 466M. Hagerstown, Indiana: Perfect Circle Corporation, 1961. No charge.
3. For Better Gasoline Engine Overhaul, Form 1227. Hagerstown, Indiana: Perfect Circle Corporation, 1961. No charge.

4. Implement and Tractor Service Manual. Kansas City, Missouri: Implement and Tractor Publications, Inc., 1014 Wyandotte St., $54.00.

5. Mechanics Study Guide -- Transmission Theory. Racine, Wisconsin: Industrial Service Department, J. I. Case Company.

6. Perfect Circle Service Manual. Hagerstown, Indiana: Perfect Circle Corporation, 1961. No charge.

7. Piston Rings, Pistons, and Cylinders, Form 2013. Hagerstown, Indiana: Perfect Circle Corporation, 1963. No charge.

8. Manufacturer's service manuals available through the major line agricultural machinery dealers and manufacturers.

THE CENTER FOR RESEARCH AND LEADERSHIP DEVELOPMENT
IN VOCATIONAL AND TECHNICAL EDUCATION
THE OHIO STATE UNIVERSITY
980 KINNEAR ROAD
COLUMBUS, OHIO, 43212

INSTRUCTOR NOTE: As soon as you have completed teaching each module, please record your reaction on this form and return to the above address.

1. Instructor's Name_____

2. Name of school_____ State_____

3. Course outline used: _____Agriculture Supply--Sales and Service Occupations
_____Ornamental Horticulture--Service Occupations
_____Agricultural Machinery--Service Occupations

4. Name of module evaluated in this report_____

5. To what group (age and/or class description) was this material presented?____
_____

6. How many students:
   a) Were enrolled in class (total) _____
   b) Participated in studying this module _____
   c) Participated in a related occupational work experience program while you taught this module _____

7. Actual time spent teaching module:

		Recommended time if you were to teach the module again:
_____hours	Classroom Instruction	_____hours
_____hours	Laboratory Experience	_____hours
_____hours	Occupational Experience (Average time for each student participating)	_____hours
_____hours	Total time	_____hours

(RESPOND TO THE FOLLOWING STATEMENTS WITH A CHECK (✓) ALONG THE LINE TO INDICATE YOUR BEST ESTIMATE.)

	VERY APPROPRIATE	NOT APPROPRIATE
8. The suggested time allotments given with this module were:	___.___.___.___.___	
9. The suggestions for introducing this module were:	___.___.___.___.___	
10. The suggested competencies to be developed were:	___.___.___.___.___	
11. For your particular class situation, the level of subject matter content was:	___.___.___.___.___	
12. The Suggested Teaching-Learning Activities were:	___.___.___.___.___	
13. The Suggested Instructional Materials and References were:	___.___.___.___.___	
14. The Suggested Occupational Experiences were:	___.___.___.___.___	

(OVER)

15. Was the subject matter content sufficiently detailed to enable you to develop the desired degree of competency in the student? Yes_____No_____
Comments:

16. Was the subject matter content directly related to the type of occupational experience the student received? Yes_____No_____
Comments:

17. List any subject matter items which should be added or deleted:

18. List any additional instructional materials and references which you used or think appropriate:

19. List any additional Teaching-Learning Activities which you feel were particularly successful:

20. List any additional Occupational Work Experiences you used or feel appropriate:

21. What do you see as the major strength of this module?

22. What do you see as the major weakness of this module?

23. Other comments concerning this module:

_____ _____
(Date) (Instructor's Signature)

_____
(School Address)

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OFFICE OF EDUCATION

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M E M O R A N D U M

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) James W. Hensel (Agency) The Center for Vocational and Technical Education

(Address) 980 Kinnear Road, Columbus, Ohio 43212

DATE: August 4, 1967

RE: (Author, Title, Publisher, Date) The Center for Vocational and Technical Education, "Course Outline for Agricultural Machinery--Service Occupations," August, 1965

Supplementary Information on Instructional Material

Provide information below which is not included in the publication. Mark N/A in each blank for which information is not available or not applicable. Mark P when information is included in the publication. See reverse side for further instructions.

(1) Source of Available Copies:
Agency The Center for Vocational and Technical Education
Address 980 Kinnear Road, Columbus, Ohio 43212
Limitation on Available Copies No Limit Price/Unit $ 7.50/set
(quantity prices)

(2) Means Used to Develop Material:
Development Group National Task Force
Level of Group National
Method of Design, Testing, and Trial Part of a funded project of the USOE, OE-5-85-009; materials based on research from state studies; see preface material in the course outline.

(3) Utilization of Material:
Appropriate School Setting Post high school
Type of Program General post high school class in agricultural machinery
Occupational Focus Agricultural machinery service occupations
Geographic Adaptability Nationwide
Uses of Material Instructor course planning
Users of Material Teachers

(4) Requirements for Using Material:
Teacher Competency Background in agricultural machinery
Student Selection Criteria Post high school, mechanical aptitude, high school background, goal in agricultural machinery service occupation.
Time Allotment Estimated time listed in module. (P)

Supplemental Media --
Necessary x
Desirable ____ (Check Which)

Describe Suggested references given in module. (P)

Source (agency)
(address)

Content of a Course for
Several Levels of Employment in

AGRICULTURAL MACHINERY--SERVICE OCCUPATIONS

Teaching Modules Making Up This Course

Note: It is not implied that the sequence in which the modules are presented below is the order in which they are to be taught.

1. Organization and Management of Agricultural Machinery Dealerships
2. Agricultural Machinery Service Department Operating Procedures
3. Agricultural Machinery Parts Department Operating Procedures
4. Agricultural Salesmanship
5. Human Relations in Agricultural Occupations
6. Metal Fusion and Fabrication Welding
7. Agricultural Machinery Assembly and Lubrication
8. Mechanical Power Transfer Systems
9. Hydraulic Power Transfer Systems
10. Adjustment, Maintenance, and Repair of Tillage, Planting, Spraying, and Fertilizing Machinery
11. Adjustment, Maintenance, and Repair of Crop Harvesting Machinery
12. Adjustment, Maintenance, and Repair of Small Gasoline Engines
13. Tractor Tune-up and Maintenance
14. Gasoline Tractor Engine Systems
15. Diesel Engine Systems
16. Tractor Repair

Publications on Off-Farm Agricultural Occupations
Available From
The Center for Research and Leadership Development
in Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio, 43212

This publication is one of a series relating to Off-Farm Agricultural Occupations developed at The Center for Vocational and Technical Education under a grant from the Division of Adult and Vocational Research, U. S. Office of Education. Each of these publications was designed for a specific purpose. However, they are designed to complement and reinforce each other. It is suggested that persons using any of these materials will want to familiarize themselves with the other publications in this series. Following is a complete listing of this series.

1. Policy and Administrative Decisions in Introducing Vocational and Technical Education in Agriculture for Off-Farm Occupations

2. Vocational and Technical Education in Agriculture for Off-Farm Occupations

3. Summary of Research Findings in Off-Farm Agricultural Occupations

4. Planning and Conducting Cooperative Occupational Experience for Off-Farm Agriculture

5. Occupational Guidance for Off-Farm Agriculture

6. Horticulture - Service Occupations
(Course outline and twelve modules)

7. Agricultural Supply - Sales and Service Occupations
(Course outline and twelve modules)

8. Agricultural Machinery - Service Occupations
(Course outline and sixteen modules)

9. Agricultural Chemical Technology
(Course outline and nine modules)

PREFACE

This publication is one of a series developed by a national task force at The Center for Vocational and Technical Education to assist state and local vocational education leaders in developing programs to prepare youth and adults for employment and/or advancement in off-farm agricultural occupations.

This project had its origins in the National Research Coordination Conferences on Off-Farm Agricultural Occupations sponsored by The National Center for Advanced Study and Research in Agricultural Education and the Agricultural Education Branch of the U. S. Office of Education in May of 1963 and January of 1964. These conferences were designed to assist states in undertaking studies of off-farm agricultural occupations training needs.

Subsequently, the Center was given a grant by the Bureau of Adult and Vocational Research to synthesize these studies, develop needed instructional and program materials, and conduct training conferences on their use.

The task force of 30 people from 16 states has included personnel with a wide range of backgrounds and responsibilities in agricultural education, vocational education, agricultural technology, and agricultural industry. Several project advisory meetings were held to secure needed counsel from diverse, but relevant groups and to help the task force maximize the potential benefits and uses of these materials.

Primary leadership for the development of this publication was provided by Mr. Alan Kahler. Assisting him on the project were Mr. V. B. Hairr, Mr. Earl Scott, and Mr. Martin Rehmert.

In developing these instructional materials, prime consideration was given to the data revealed by the studies of agricultural business and employee training needs conducted in several states. Current and projected employment opportunities dictated the areas in which instructional materials were developed. In addition, these studies identified those occupations which require knowledge and skill in agriculture. They also contributed to the development of the publication series through the identification of specific competencies needed by individuals for entry and persistence in agricultural occupations.

Members of the task force were aided in the development of these publications through personal visitations to outstanding existing off-farm agricultural occupational programs. Frequent consultations with trade association educational committees and agricultural industry leaders concerned with personnel development were helpful

in further "keying" these materials to employment needs. Existing materials were carefully reviewed and evaluated in terms of their utility in the preparation of these workers and, when suitable, were recommended as a part of these publications. References are also made to other instructional materials and sources designed to aid teachers and supplement and reinforce project materials.

Following the first draft of each publication by the Center, copies were sent to a wide range of knowledgeable individuals for review and evaluation. Reviewers included experienced teachers in vocational agriculture and other vocational services, college and university specialists in the appropriate subject-matter area, supervisory and research personnel, and agricultural business and industrial leaders. Many of their comments and suggestions were incorporated into the revision. However, the final responsibility for the content rests with the project staff.

It should be recognized that these materials are still developmental in nature. Although considerable time and effort have been expended to bring them to this stage of development, it is recognized that they are not the final answer in planning and conducting off-farm agricultural education programs. We hope that the experiences gained through the utilization of these materials during the coming year will assist us in their further refinement.

Your attention is directed to the evaluation form which accompanies each module. Persons using these materials are asked to complete the form and return it to the Center. We believe these evaluations, based on actual experiences, will provide a valuable basis for further improvement and will help identify voids in existing materials.

ROBERT E. TAYLOR
Director
The Center for Research and
Leadership Development in
Vocational and Technical Education

Introduction

Programs in vocational agriculture are being expanded and new programs are being developed at the post-high school level throughout the nation, to train persons for occupational entry and advancement in the agricultural machinery service occupations. Research indicates that many occupational opportunities exist in the agricultural machinery industry. According to the 1965 Farm Fact Book, the average farm size has increased in all states. The size of the commercial farm will probably continue to increase. As commercial farms become larger and their methods of production more technical in nature, they will require a wider variety of services from agricultural machinery dealerships in order to function efficiently. The need for competent employees in the agricultural machinery industry is further exemplified by the interest which has developed on the part of employers in hiring competent people to fill positions in the service occupations in their dealerships.

The Vocational Education Act of 1963 has made it possible to establish programs for preparing personnel for jobs in the agricultural machinery service occupations. In order to prepare workers to assume these positions in the local agricultural machinery dealership requiring knowledge and skill in agriculture, it is necessary to have programs established to provide the appropriate classroom, laboratory, and occupational experience to develop the competencies workers need to be successful on the job. Herein lies the opportunity and challenge for those entrusted with programs at the high school and post-high school levels to prepare service workers for jobs in agricultural machinery dealerships.

The materials presented in this area were developed to aid teachers who are offering programs for employees of agricultural machinery businesses. These materials should be considered developmental in nature and persons who use them should integrate them carefully into a well-planned program supplementing them with other appropriate materials.

Enclosed with these materials are evaluation forms which will be used to guide the improvement of future publications. Please fill out an evaluation form following completion of each module. This will assist in a systematic evaluation of materials developed at The Center.

AGRICULTURAL MACHINERY--SERVICE OCCUPATIONS

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AGRICULTURAL MACHINERY--SERVICE OCCUPATIONS

Purpose of Course

To develop the competence needed at the post-high school level for occupational entry and advancement in service occupations in agricultural machinery dealerships.

Occupations or Levels of Employment for Which Course Is Intended

Agricultural machinery set-up man
Agricultural machinery mechanic's helper
Agricultural machinery mechanic
Agricultural machinery parts man
Agricultural machinery service supervisor

Suggested Time Allotments

(See Table on Page 4 and time suggestions for each module.)

Persons to be Served

1. Farmers who have left the farm seeking employment elsewhere

2. High school graduates desiring employment in the agricultural machinery service occupations who did not receive training for these occupations in high school

3. High school graduates who need a higher degree of competence for occupational entry into these occupations

4. High school dropouts who are capable of mastering the skills, abilities, and understanding necessary for occupational entry in the agricultural machinery service occupations and who show an earnest desire for such employment

5. Unemployed persons capable of carrying out the responsibilities of these jobs and who show an earnest desire for occupational entry in the service occupations in agricultural machinery dealerships

6. Persons presently engaged in these occupations desiring to update their understandings, skills, and abilities

Supporting Education Needed

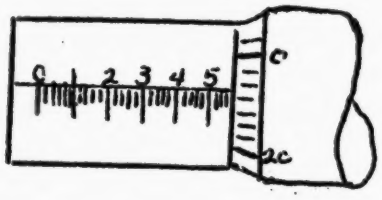
Due to the difference in the educational backgrounds of the people for whom this course is intended, probably no specific course should be required before a person is allowed to enroll in the course. Desire for occupational entry and potential ability for carrying out the functions of

these occupations should be considered the prerequisites for enrolling in the course. Most students will likely be deficient in mathematics, communications, and reading comprehension. Instruction that will correct these deficiencies should be offered concurrently with instruction in the modules making up the course in agricultural machinery. Care should be exercised to make certain that these courses develop those abilities, skills, and understandings needed by agricultural machinery service employees.

The mathematics instruction course should include the use of fractions, decimals, ratios, areas, percentages, measurements, etc. Instruction should be centered around situations that an agricultural machinery service employer will confront in his job. The following problems illustrate the proper approach to teaching mathematics to support this course.

1. The diameter of the two pulleys connected by a belt are, respectively, 15 and 8 inches. The smaller pulley makes 600 r.p.m. How many r.p.m. is the larger pulley turning?

2. A mechanic overhauling an engine checked a shaft for wear. Using a micrometer observe the following setting on the micrometer of ten measuring the shaft. What was the thickness of the shaft?



The instruction in communications should include study of proper use of forms used by the agricultural machinery dealer, conversational speech, letter writing, describing part failures on machines, etc.

The specific supporting competencies to be taught concurrently with the modules will be dictated by the deficiencies of the group enrolled in the course.

Suggestions for Introducing the Course

At the first class meeting the instructor should give the enrollees a broad overview of the course and develop enthusiasm on the part of the enrollee for the course. The instructor should discuss with the enrollees the following items during this meeting.

1. Why the course is needed
2. What the course is to do
3. The major areas to be dealt with in the course
4. How the course will benefit the enrollee and why the major course areas are important in the course

5. How the teaching will be done -- the class schedule, the occupational experiences to be provided at the school and on the job
6. The role of the classroom instructor
7. What is expected of the student
8. What level of occupations and the level of employment that the course may lead to through proper study, training, and application
9. Job possibilities upon completion of the course

It is important that all these points be made clear to the enrollees, and that they accept them as being important. Opportunities for enrollees to discuss these points and to ask questions are essential. The idea of cooperation and working together should be emphasized at the first class meeting. It is usually good to get into the course itself during the first class period. The extent of this work may be limited, but the important thing is to begin--and to make an effective beginning!

Modules Needed in Each Occupation or Level of Employment
and
"At School" Time Allotments*

Teaching Modules:	Agricultural Machinery Set-up Man	Agricultural Machinery Mechanic's Helper	Agricultural Machinery Mechanic	Agricultural Machinery Service Department Manager	Agricultural Machinery Parts Man
1. Organization and Management of Agricultural Machinery Dealerships	18	18	18	18	18
2. Agricultural Machinery Service Department Operating Procedures	66	66	66	66	66
3. Agricultural Machinery Parts Department Operating Procedures					54
4. Agricultural Salesmanship	30	30	30	30	30
5. Human Relations in Agricultural Occupations	24	24	24	24	24
6. Metal Fusion and Fabrication Welding		48	48	48	
7. Agricultural Machinery Assembly and Lubrication	138				
8. Mechanical Power Transfer Systems			60	60	60
9. Hydraulic Power Transfer Systems			210	210	210
10. Adjustment, Maintenance and Repair of Tillage Planting, Spraying and Fertilizing Machinery		282	282	282	282
11. Adjustment, Maintenance, and Repair of Crop Harvesting Machinery		198	198	198	198
12. Adjustment, Maintenance, and Repair of Small Gasoline Engines		108	108	108	
13. Tractor Tune-up and Maintenance		72	72	72	72
14. Gasoline Tractor Engine Systems			42	42	42
15. Diesel Engine Systems			36	36	36
16. Tractor Repair			504	504	
TOTAL "At School" Time	276	846	1698	1698	1092

*Time is stated in clock hours.

Nature of the Course

This course is a vocational technical education program in that it is specialized education for work in a particular non-professional occupation or cluster of occupations. The course is designed for use in junior or community colleges, vocational schools, technical institutes, and branches of universities serving areas usually larger than local school districts. The area school program is discussed in detail in the publications entitled,"Vocational and Technical Education in Agriculture for Off-Farm Occupations," and "Policy and Administrative Decisions in Introducing Vocational and Technical Education in Agriculture for Off-Farm Occupations."

The course is designed to develop the degree of competency needed for initial employment in the various service occupations in agricultural machinery dealerships. The course is not intended to develop the degree of competence needed by the highly skilled employee in any of the service occupations. Further training in special schools conducted by the agricultural machinery companies for which the enrollee is employed may be necessary to develop higher degrees of skill.

The course is so designed that part of the preparation for these occupations can be carried out in the high-school vocational agriculture program. The high-school vocational agriculture program can provide adequate training for gainful employment at the set-up man and mechanic's helper levels of employment. Training for occupational entry as a parts man, mechanic and service department manager should be provided at the post-high school level in area vocational schools. If part of the instruction is provided at the high-school level and part in the area school, the two programs should be coordinated to provide the best possible total educational program, thus eliminating waste and frustration. In addition to preparing set-up men and mechanics' helpers, the high-school vocational agriculture program can provide instruction in production agriculture and mechanics basic to all the agricultural machinery service occupations.

Two approaches should be considered in providing this training in the area school; and if it is necessary, both may be taken at the same time. First, instruction can be provided daily for those who are able to attend classes daily. Second, classes could be scheduled in the evening for those who are employed during the day at other jobs. These persons desire to prepare themselves for occupational entry in new occupations. Those presently employed in these occupations who desire to update their skills and abilities may attend night classes. The approach used in the area school will be dictated by the needs of the group the course is to serve. It is important for those who administer the course to realize that the responsibility of the area school is to provide educational opportunities for persons 16 years of age to 60 years of age, and that their programs should satisfy the needs of people of all ages with all types of educational backgrounds.

Use of the Course Materials

This course is made up of sixteen modules. Each module is a complete, self-contained part of the course that may or may not be taught in the sequence given in the course outline. Not all modules may be needed to meet the needs of the students to be taught. The experience and educational background of the students will dictate the modules that should be included in the course.

Each module consists of (1) a major teaching objective, (2) a suggested time allotment for school instruction and occupational experience, (3) an introduction to the module, (4) the competencies to be developed, (5) suggested instructional materials and references for use in teaching the module, and (6) suggestions for evaluating the educational outcomes of the module.

For each competency four kinds of information is included: (1) subject matter content, (2) suggested instructional materials and references, (3) suggested occupational experience needed to develop each competency, and (4) suggested teaching-learning activities.

The subject matter content provides an overall view of the important aspects of each competency that should be stressed by the teacher. It may include charts, tables, graphs, drawings, etc. The content may be in topical outline or paragraph form. The subject matter content as included in each competency is not complete enough for all lesson preparation. The teacher must use the references at the end of each competency and other references to supply the additional information that he needs to teach.

Under the section entitled "Suggested Instructional Materials and References," are listed materials that may be used by the instructor in developing the competency. These are suggestions, and should help the instructor identify other materials and references that could be used in teaching.

Specific activities that may help the teacher to develop the competence of his students are listed under "Suggested Teaching-Learning Activities." In the main, these activities emphasize student involvement in carrying out the activity. Since new materials are continually becoming available, the instructor should supplement each list with new strip films, movies, etc., that he is familiar with which will improve his instruction. In the modules emphasizing machinery and tractor adjustment, maintenance, and repair, the teaching-learning activities provide the basic instruction needed to develop the competence of the student. Care should be exercised, however, to avoid making the course a classroom teacher-centered learning situation.

Under suggested occupational experience, activities are identified that should be carried out on-the-job at the agricultural machinery dealership. These will further implement or put the final touches on

the development of the competency. These activities are just as important to effective teaching as is the subject matter content and the teaching-learning activities. Care should be exercised to make certain that there is a high correlation between what is being taught in the classroom and shop and the learning activities of the student at the agricultural machinery dealership.

Adapting the Course to the Needs of the Enrollee

Due to the difference in the educational background, age, and experiences of the people for whom the course is intended, the course pursued by the enrollees will vary. The course will need to be more basic in nature for the individual that may not have completed high school. For those who are presently employed in agricultural machinery service occupations who desire to update their skills and abilities, the course would be more specialized in nature. It will be necessary for the person setting up the course to group the enrollees according to their instructional needs, determine the content of the course needed by the enrollees, and set up a program to fit these needs. The modular concept upon which this course has been developed provides this flexibility.

Courses should be scheduled so as to make the most efficient use of teacher time and school facilities and yet provide the level of instruction to which the student is entitled. Using the modular concept, this can readily be accomplished. Students planning on occupational entry in several different occupations could be brought together and taught at the same time. For example, students training to be mechanics and set-up men could be taught agricultural machinery salesmanship at the same time. Students of other courses could also be included in this class. When necessary, the trainees may be divided into separate classes for more specific training.

Cooperating with Representatives of Industry

It is imperative that local industry representatives be involved in the organization and implementation of this program. These people when formed into and used as an advisory council can provide valuable assistance in advising on course content, equipment needed in the instructional program, training stations for the enrollees, and help in the placement of enrollees after completing the course. Relationships should be established with the agricultural machinery dealers' association, and where possible, with major-line company officials. These relationships will help the instructor place the enrollees at the time of graduation.

Providing Supervised Occupational Experience

Supervised occupational experience is an integral part of this course. Experience gained while on the job cannot be duplicated in the

classroom or the school shop. The occupational experience program should if at all possible, be carried on at the time the student is attending classes. The classroom instruction should be supplemented on the job. In the event that occupational experience cannot be provided concurrently with the class instruction, other provisions should be made to provide this experience. If this approach is used, experience to be provided on the job should be highly correlated with the classroom instruction. If the occupational experience is to be provided during the summer months, extreme care should be exercised to avoid making the program merely a summer work program that is aimed only at helping the agricultural machinery dealer out during his busy season.

Careful attention should be given to the selection of training centers that are to provide these experiences. They should be agricultural machinery dealerships that can provide an atmosphere condusive to learning and that will create a strong desire in the student to become a part of the agricultural machinery industry. The manager of the dealership must be sympathetic to the program and provide capable and responsible employees to work with the trainee. It may be necessary for the instructor to educate the managers of the training centers to the objectives of the program, and their responsibilities in providing the best possible training program for the trainee. Providing supervised occupational experience for off-farm occupations in agriculture is discussed in detail in the publication entitled, "Planning and Conducting Cooperative Occupational Experience in Off-Farm Agriculture," available from the Center for Vocational and Technical Education.

Providing Competent Instructors

Due to the technical nature of the content included in this course, teachers and area school administrators may need to solicit the help of industry people to teach part of the course. Only individuals who are considered highly competent as mechanics, parts men, or service department managers should be selected to fill these positions. It should be realized, however, that these people will not be proficient in the method of teaching. Having little or no training in this area, they will need a great deal of help as they teach. If possible, they should be trained in the method of teaching prior to their beginning to teach. However, if this is impossible, they should be given short-course instruction in the method of classroom teaching as they teach the course, and should work closely with a qualified teacher to develop this skills in this area.

Selection of Enrollees

Applicants for the course should be highly screened to make sure that the right people are enrolled. Desire for occupational entry and potential ability for carrying out the functions of these occupations should be considered when screening applicants. A battery of tests

should be administered to each applicant and should be analyzed by a person competent in this field. Included in this battery of tests should be interest inventories, aptitude tests, and achievement tests. When an individual is analyzed in this manner, a clearer picture of the whole individual will emerge, and a decision concerning his potentail ability and interests can be made more wisely. Data received through the battery of tests should be combined with information received through personal interview and from those who are well acquainted with the individual. Selection of the individuals should be based on this information.

The Setting for the Development of the Course

It was a growing awareness of the urgent need for more definite information on the requirements for occupational education involving competencies in agriculture that brought state leaders in agricultural education and representatives from the United States Office of Education together at planning conferences at the then National Center for Advanced Study and Research in Agricultural Education at The Ohio State University in May, 1963, and January, 1964. At these planning conferences, procedures were outline for use in investigating off-farm occupations in agriculture. In January and April, 1965, advisory conferences were held at the National Center to preview preliminary research reports. As a result, the Center was urged to develop curriculum guides and course materials that would implement these findings. Due to the magnitude and variety of occupations found to involve competencies in agriculture, it was recommended that the National Center prepare course materials in four areas; namely, ornamental horticulture at the high-school level, agricultural supply--sales and service at the high school and post-high school level; agricultural mechanization at the post-high school level; and agricultural chemicals at the technician level.

As a result of the action of these conferences and the receipt of a grant from the Division of Adult and Vocational Research of the U.S. Office of Education, selected persons were brought to the Center to develop program guides and course materials in the areas identified.

The selection of the areas in which to develop course materials, the occupations for which the courses were to be developed, and the content of the courses and the modules were determined by the research reported to the Center by the states. In the agricultural mechanization area, studies revealed that the largest number of employment opportunities, as well as those presently employed, were in the agricultural machinery industry. Findings further revealed that in this industry over 50 per cent of the opportunities for employment and the number presently employed are in the service occupations. Data presented on the following page are typical of the findings of the states concerning the employment opportunities in the agricultural machinery industry.

Level of Employment	IOWA (Statewide) Presently Employed	IOWA (Statewide) Increase in Five Years	OKLAHOMA (Statewide) Presently Employed	OKLAHOMA (Statewide) Increase in Five Years
Managers	1,064	139	363	31
Department Managers	244	53	35	22
Sales	745	170	202	167
Clerical	632	70	72	19
Service	3,574	518	1,233	887
Total	6,260	959	1,905	1,125

After reviewing the data, it was decided by the staff members at the Center that the most logical selection of an area in which to develop course materials in the agricultural mechanization area was in the agricultural machinery service occupations.

The studies reported to the Center by the states were again the bases to identify the competencies that persons employed in the agricultural machinery service occupations needed in order to effectively perform their jobs. The state studies also helped identify the degree of proficiency needed in the competencies for initial employment. A summary of their findings are presented in the publication entitled, "Summary of Research Findings in Off-Farm Agricultural Occupations," available from the Center for Vocational and Technical Education.

Involvement from Industry and Agricultural Educators in the Development of the Course

Throughout the development of the course, personnel from the agricultural machinery industry were consulted for advice and suggestions as to content for the course (and modules), the time that should be spent in each module, and ways of implementing the needed instruction. The persons consulted included parts men and mechanics employed in agricultural machinery dealerships, agricultural machinery dealership managers, branch house representatives and major-line agricultural machinery company officials.

As each module was developed, it was submitted to industry representatives for preliminary evaluation. The suggestions made by these people were incorporated into the modules. The modules were then submitted to selected people who are recognized authorities in the field of agricultural machinery for a final review. Among these people were

agricultural engineers; agricultural educators; agricultural machinery parts men and mechanics at the local, district, and national levels; agricultural machinery dealership managers; instructors in area schools; and others who were capable of rendering a critical evaluation of the modules.

The following list of persons evaluated selected modules of the course materials within their area of specialization. Their comments and constructive criticisms aided materially in strengthening the value of these materials. However, the final responsibility for the course rests with personnel at the Center who developed these materials.

Mr. Robert Alfred
Parts Distributor
Massey-Ferguson, Inc.
Columbus, Ohio

Mr. R. C. Belt, Manager
R. C. Belt, Inc.
Washington Court House, Ohio

Mr. George B. Blum, Jr.
Assistant Professor of Agricultural Engineering
North Carolina State University
Raleigh, North Carolina

Mr. C. E. Boggs
District Service Manager
Allis Chalmers Manufacturing Co.
Columbus, Ohio

Mr. Joseph Bradley
Bradley Implement Company
Algona, Iowa

Professor C. E. Bundy
Teacher Educator in Agricultural Education
Iowa State University
Ames, Iowa

Dr. R. W. Canada
Professor of Agricultural Education
Colorado State University
Ft. Collins, Colorado

Mr. Richard Carr
District Service Manager
John Deere Company
Columbus, Ohio

Mr. L. A. Coomer
General Supervisor
Farm Equipment Service
180 North Michigan Avenue
Chicago, Illinois

Mr. Ray Cunningham
Assistant District Service Manager
International Harvester Co.
Columbus, Ohio

Mr. Emory H. Dixson
Educational Consultant
Hobart Welding School
Troy, Ohio

Mr. Raymond C. Dunlavy
Supervisor of Training
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Dr. Lewis Eggenberger
Teacher Educator
Agricultural Education Department
Texas Technological College
Lubbock, Texas

Professor J. M. Fare
Agricultural Engineering
Department
North Carolina State University
Raleigh, North Carolina

Mr. Alfred Fozer
Field Engineer
The Lincoln Electric Company
Columbus, Ohio

Mr. Cliff Gerstenberger
Secretary-Treasurer
Iowa Retail Farm and Power
Equipment Association, Inc.
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Mr. L. L. Gibbons
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Mr. G. E. Henderson
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Dr. Thomas Hoerner
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Ames, Iowa

Dr. Van H. Jarret
Associate Professor of
Agricultural Education
Utah State University
Logan, Utah

Mr. Arthur Johnson
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Dr. Carlton Johnson
Associate Professor of
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Mr. Robert E. Julian
Vocational Agriculture Instructor
Amphitheater High School
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Dr. W. M. Kirkpatrick
Associate Professor of
Agricultural Engineering
California State Polytechnic
College
San Luis Obispo, California

Mr. Loren Larson
Parts Man Instructor
Alexandria Area Vocational School
Alexandria, Minnesota

Mr. M. G. McCreight
Assistant Professor of
Agricultural Education
University of Nebraska
Lincoln, Nebraska

Mr. John Miller
District Service Manager
International Harvester Company
Columbus, Ohio

Mr. Harold M. Nestor
Instructor in Hydraulics
Columbus Area Technician School
Columbus, Ohio

Mr. A. F. Otto
District Parts Manager
John Deere Company
Columbus, Ohio

Mr. Harlan Ridenour
Director of the Ohio Vocational
Agriculture Curriculum
Materials Service
The Ohio State University
Columbus, Ohio

Mr. George Schelin
Mechanics Instructor
Alexandria Area Vocational School
Alexandria, Minnesota

Mr. Ralph G. Schweizer, President
Burlington Farm Machinery Corp.
Burlington, Iowa

Mr. Earl Scott
M.D.T.A. Instructor
Jefferson Area Schools
Jefferson, Ohio

Mr. John Shuey
District Dealer Development Manager
International Harvester Company
Columbus, Ohio

Mr. T. J. Wakeman
Department of Agricultural
Engineering
Virginia Polytechnic Institute
Blacksburg, Virginia

Mr. Dan Walton
District Service Manager
Massey-Ferguson, Inc.
Columbus, Ohio

Mr. Charles Whitney, Secretary
Farm Power and Equipment
Dealers of Ohio
Columbus, Ohio

Mr. Ivan Winland
Coordinator
Jefferson Area Schools
Jefferson, Ohio

Mr. James W. Zepplin
Wausau Technical Institute
Wausau, Wisconsin

Suggestions for Evaluating the Course

The following criteria should be used in evaluating the effectiveness of the course.

1. Number of enrollees completing the course who have been employed in the agricultural machinery service occupations for which they were trained

2. Number of persons employed in the service occupations a year or more after completion of the course

3. Acceptance of the course by present and future employers

4. Employer evaluations of the quality of work done by employees who have completed the course

5. Number of students who are continuing their training after employment

6. Reaction of enrollees toward the course of study

7. Enrollment trends in the course
8. Reasons given by enrollees who terminated their employment
9. Ability to place students after completing the course
10. Number of former students who have advanced to a higher level of employment
11. Social mobility of the enrollee after completion of the course
12. Parental evaluation of the course
13. School administration of the course

Suggested Instructional Materials and References for the Course

1. "A Day to Remember," 16mm film, 28 minutes. Available from the John Deere District Branch Houses.
2. "A Step Ahead--In Careers in Agriculture," 16mm film, 14 minutes. Your Local New Holland Machinery dealer.
3. "Arc Welding at Work," 16mm film. General Electric Company, Schenectady, New York. Free.
4. "Arc Welding Electrode Selection," 16mm film, 20 minutes. Hobart Technical School, Troy, Ohio. Free.
5. "Ball Bearing Maintenance." New Departure, Division of General Motors, Bristol, Connecticut.
6. "Causes and Cures of Common Welding Troubles," slides (12). Hobart Technical School, Troy, Ohio. Price: $1.25.
7. "Dynamic Careers Through Agriculture," 16mm film, 28 minutes. Farm Film Foundation, 1425 H Street, Northwest, Washington, D. C., 20005.
8. "Factors to Consider in Selecting Electrodes," Chart 35" x 28" Hobart Technical School, Troy, Ohio. Price: $1.25.
9. "Farm Tractor Maintenance," filmstrip set. University of Nebraska, Agricultural Education Department, College of Agriculture, Lincoln, Nebraska.
10. "Getting Along With Others," 16mm film, 29 minutes. Business Education Films, 5113 - 16th Avenue, Brooklyn, New York.
11. "Good and Bad Weld Plastic Replicas," set of 10. Hobart Technical School, Troy, Ohio. Price: $6.

12. "Learning Arc Welding Skills," Set of three filmstrips, 136 frames. Lincoln Electric Company, P. O. Box 3035, Cleveland, Ohio, 44117. Price: $5.00.

13. "Magic Wand of Industry," 16mm film, 25 minutes. Lincoln Electric Company, Cleveland, Ohio. Free.

14. "Quite Naturally," 16mm film. The Timken Roller Bearing Company, Canton 6, Ohio.

15. "Your Attitude is Showing," sound filmstrip, 12 minutes. Charles Steadman, Teacher-Trainer in Distributive Education, University of Pittsburg, Pittsburg, Pennsylvania.

16. Opaque Projector

17. Movie Projector

18. Combination filmstrip and slide projector

Suggested Tools and Equipment

No.	Items
1	Electric Impact Wrench
1	Wet Valve Refacer
1	Valve Seat Grinder inc. box
1	Valve Seat Cart
1	Armature Growler 120 volts A.C. 60 cycle
1	Grinder Sander
1	Floor Press Set (with accessories)
1	Electric Drill HD 1/2" Millers Falls
1	Electric Drill HD 3/4" Millers Falls
1	Bench Grinder 1 HP amp .13; 115v, 50/60 cycle rpm 1725, rec. wheel dia. 10" arbor dia. 3/4"
1	Electric Shears #16 for cutting 18 ga. and up
1	High Speed Hoist 2-ton
1	Ball Bearing Trolley 2-ton
2	Steel Storage Cabinet, swinging door style with lock (36" x 21" x 78")
1	File Cabinet 4-drawer legal
1	Pipe Threaders Set 1/8"-2"
1	Power Chisel Kit
1	Battery Tester
1	Battery Charger (5 yr. warranty, 6 & 12 volts, 100/50 amps silicone rectifier
1	Spark Plug Cleaner with 709 stand

No.	Items
1	Parts Cleaning Tank (25-50 gal., air agitated, sludge hose, lint filter, 2 shelves)
1	Exhaust Gas Analyzer
1	Welding & Cutting Outfit
1	Air Compressor (2 HP - 254 age motor 115/220V with 2-6269 belt guard, 60 gal. tank)
1	Electric Welder
1	1/3 HP Grinder: (includes eye shields and light, 2 standard wheels)
1	Service Jack
1	Engine Stand
1	Service Desk
1	Wheel Dolly
1	Snap Ring Plier Set
1	Valve Key Replacer
1	Valve Guide Cleaner
1	Carbon Scraper
1	Hose Clamp Pliers
1	Electrical Test Kit
1	Wheel Dressing Attachment (with diamond)
1	Carbon Arc Torch
1	Welding Cart
1	1 1/2 ton all purpose jack
1	Lathe Bit Kit
1	Steel Shelving Open
1	Shop Tool 30" ht
1	Welding helmet
2	Box type welding goggles
1	Tire tester tank
1	Mechanics creeper
1	Tire Bead Breaker
1	Tie Rod Separator
1	Tie Rod Separator
1	Comb. Tire Hammer
1	Grease & hub cap tool
1	Soft face hammer
1	Soft face hammer
1	Tubing cutter
1	Flaring tool
1	Kal Dwell-Tach Tester
1	Kal-Reg. Tester
1	Kal Atl-Reg Tester
1	Kal-Lite
1	Kal Remote Starter Switch
1	Kal-Start Circuit Tester
1	Kal-Pump Tester
1	Kal-Spark Tester

No.	Items
1	Stand for testers
1	Heavy-Duty Puller
1	Medium-Duty Puller
1	Slide-Hammer Puller
1	Light-Duty Puller
2	Reversible 3 1/2" Jaw
1	Yoke for 2 Jaws
1	Universal Wheel Puller
1	Striking Wrench
1	Bearing Separator
1	Step Plate Adapter Set
3	Step Plate Adapter
2	Narrow Jaws
1	Cap Screw Crossarm
1	Short Puller Rod
1	Single Puller Jaw
3	Reversible 4 5/8" Jaws
2	Pilot Bearing Jaw
1	Blind Bearing Puller
1	12-ton Hydraulic Ram
1	3-leg Yoke
1	2-leg Yoke
3	10" Jaw and Link
3	8" Jaw and Link
3	6" Jaw and Link
1	3-leg Yoke
1	SE91-0-8 Hand Shield
1	Oil Measure 1-quart
1	Oil Measure 2-quart
3	Drain Pans
1	Oily Waste Can 8.1 gal.
1	Water can (radiator filler)
1	Pressure Gun
1	Wheel bearing packer
1	Suction gun
1	Tractor funnel
1	Anti-freeze tester
2	25-ft. Trouble lights
2	Pour spout
1	Air Transformer
1	Air Dusting gun
1	Spray Gun
1	Suction feed cup and attach
1	Extra can and cover
1	25" rubber air hose
1	Cyl. Wall Deglazer (2-3")
1	Cyl. Wall Deglazer (2 3/4-3 7/8")

No.	Items
1	Cyl. Wall Deglazer (3 3/4-5 3/4")
1	Cyl. Wall Deglazer (5-7")
1	Ridge reamer (3-5")
1	Gas can
7	Adjustable wrench (click stop)
2	Vice grip wrenches (10" with cutter)
2	Vice grip welding clamps
2	Vice grip bending tools
2	General Fire extinguishers CO^2
2	Cutting tip
1	Heating tip
2	Welding tip
1	Exhaust Hose 6010' length
1	Tripod Projector screen 60" x 60" with white matte fabric model holiday projection table with extension cord and blanket
15	Tool Chest
15	Midget socket set 1/4"
15	Flex sockets 3/8"
15	Shallow Hex sockets
15	Deep Hex sockets
15	Speeders
15	Nut spinners
15	Plastic handles
15	Slide Bars
15	Ratchet Adapter
15	Ratchet
15	Square socket 1/4"
15	Square socket 5/16"
15	Square socket 3/8"
15	Ratchet spinner
15	Universal joint
15	Extensions 3"
15	Extensions 4"
15	Extensions 6"
15	Extensions 12"
15	Extensions 1"
15	Nut speeder
15	Nut spinner
15	Sliding Bar 12"
15	Extensions 3"
15	Extensions 5"
15	Extensions 10"
15	Universal Joint
15	Double Hex sockets
15	Heavy duty ratchet
15	Sliding Head
15	Ratchet Adaptor
15	Nut spinner head

No.	Items
15	Extension bar 3"
15	Extension bar 6"
15	Extension bar 12"
15	Heavy Duty sockets 15/16
15	Heavy Duty sockets 31/32
15	Heavy Duty sockets 1"
15	Heavy Duty sockets 1 1/16
15	Heavy Duty sockets 1 1/8
15	Heavy Duty sockets 1 3/16
15	Heavy Duty sockets 1 1/4
15	Heavy Duty sockets 1 5/16
15	Heavy Duty sockets 1 3/8
15	Heavy Duty sockets 1 7/16
15	Heavy Duty sockets 1 1/2
15	Heavy Duty sockets 1 9/16
15	Heavy Duty sockets 1 5/8
15	Heavy Duty sockets 1 11/16
15	Heavy Duty sockets 1 3/4
15	Heavy Duty sockets 1 13/16
15	Heavy Duty sockets 1 7/8
15	Heavy Duty sockets 2"
15	Box socket set (Box wrenches)
15	Box socket set (Box wrenches - dwarf)
15	Ignition wrench set
15	Combination wrench set (open and box)
15	Tappet wrench set
15	Screw Driver set (std. tip)
15	Screw Driver set (phillips tip)
15	Chisel and punch set
15	Screw Drivers (spark tester) 5 1/8"
15	Screw Starter (5 1/4" length)
15	Pry Bar (16")
15	Hack saw (10-12" blades)
15	Ratcheting box socket
15	Ball peen hammer (4 oz.)
15	Ball peen hammer (12 oz.)
15	Plastic hammer 1#
15	Feeler gauge
15	Wire spark plug gauge
15	Carbon scraper
15	Wire brush
15	Valve lifter
15	Valve key replacer
15	Valve spring compressor
15	Ignition plier
15	Gripping plier (optional-47B)
15	Needle nose plier
15	Diagonal cutter

No.	Items
15	Battery plier
15	Point file
15	Spark plug socket
1	Torquemeter
1	Combination wrench 1 1/16
1	Combination wrench 1 1/8
1	Combination wrench 1 1/4
1	Combination wrench 1 5/16
1	Combination wrench 1 3/8
1	Combination wrench 1 7/16
1	Combination wrench 1 1/2
1	Combination wrench 1 5/8
1	Hex head wrench
1	Phillips offset screwdriver 6"
1	Phillips offset screwdriver 9"
2	Offset screw driver 12"
1	Stud remover
1	Extractor set
1	Ratcheting box socket
1	Tune-up kit
15	Long tapered punches 3/8" sq. stock point 3/16" length 8"
15	Long tapered punches 7/16" sq. stock point 1/4" length 8 1/2"
15	Long tapered punches 1/2" sq. stock point 5/16" length 9"
15	Long tapered punches 9/16" sq. stock point 3/8" length 9 1/2"
15	Long drift punch 7/32" dia. 4 1/2" length (overall length 8")
15	Long lining-up punch 9/16 sq. stock 5/32 point 9 3/16" (tapered 14" overall length)
1	Long flat chisel stock 3/4" edge 7/8" length 16"
1	Long flat chisel stock 7/8" edge 1" length 18"
15	Joint gripping plier 9 1/2" long
1	Valve spring compressor
1	Rim wrench 13/16"-3/4"-7/8" 15/16" 10" arm
1	Tire valve tool
1	Rim tool 19 1/8 W length end 9/16" and 5/8" for split rims and rimbrocks
1	Curved tire removing tool width 1 3/8" length 18"
1	Straight tire removing tool width 1 3/8" length 18"
1	Vinylite cover for refacer
1	Collot 1/4" to 3.8" stem capacity

No.	Items
1	Collot 1/2" to 11/16" stem capacity
1	Ball peen hammer 2 oz.
1	Brass hammer 1#
1	Flexible grip-it tool 15" long; 8" flexible section
1	Magnetic pick-up tool 6" long
1	Magnetic pick-up tool 9"
1	Magnetic pick-up tool 16 1/2"
1	Inspection mirror 16 1/2" long Mirror 1 11/16" x 2 9/16"
1	Piston ring compressors 2 bands capacity 2 1/8"-5 Ht 3 1/2"
1	Piston ring compressor 4 bands capacity 3"-7" Ht 6 1/2
1	Piston Ring compressor 1 band capacity 1 1/2"-3" Ht 2"
1	Tap and Die set 4-36 to 12-24
1	Tap and Die set 1/4 to 1/2
1	Tap and Die set 9/16 to 3/4
2	Tap and Die set 3/4 to 1"
1	Electric soldering gun
1	Heavy duty busing driver set
1	Battery cable puller
1	Small general puller
1	Booster cable set
1	Battery terminal spreader
1	Battery post and terminal brush
1	Battery service kit (complete)
1	Wheel puller
1	Wheel puller adaptor
1	Electric drill HD 1/4:
1	Electric drill bench stand for 3/4" drill
2	Drill grinding attachment 1/8" to 1/2" dia. Floodlight eye shield 2-25 w. 115 v. rights for above grinder
1	Grinder pedestal for above grinder with coolant bucket
4	Bench vises 5" jaws
15	All purpose work bench 6' x 34' x 34"
1	Heavy duty adj. steel shelving for book storage, closed back and ends (37 3/8" x 12 5/16" x 86")
1	Pipe wrenches 6"
1	Pipe wrenches 8"
1	Pipe wrenches 10"
1	Pipe wrenches 12"
1	Pipe wrenches 14"
1	Pipe wrenches 18"

No.	Items
1	Ball peen hammer 8 oz.
1	Ball peen hammer 16
1	Ball peen hammer 20
1	Ball peen hammer 24
1	Ball peen hammer 32
1	Ball peen hammer 40
1	Ball peen hammer 48
15	Small pressure oilers 5-oz.
15	Pint size pressure oiler
15	Putty knives 2 1/2" blade scraper
15	Putty knives 4" blade scraper
8	Steel tape rules 10 ft.
1	Chipping hammer
1	Blacksmith hand hammer
1	Pexto tin snips 3" cut
1	Master torch and cylinder
1	Pipe cutter CPA 1/8"-2"
1	Pipe Vise cap. 1/8"-2"
1	Reamer pipe capacity 1/4"-2"
4	Micrometer 4"-1" by .001"
1	Rule depth gauge 0-5" with 6" rule and rod
1	Comb. set 12" blade
1	Outside calipers 6"
1	Inside micrometer 6 rods 2"-8" in case
1	Inside calipers 6"
1	U. S. Standard gauge #0-36
1	Gooseneck wrecking bar 1/4" x 24"
2	"C" clamps 6"
1	Bench drill vise cap. 3"
1	Porter bolt and wire cutter 36"-5/8"
1	Small engine tester Ing-coil
1	Dial indicator
1	Telescopic gauge set
1	Valve guide driver set
1	Ring expander tool
1	Hydraulic pressure gauge 0-10,000
20	Box type goggles
	Respirators
	5lb. spool wire solder
	1lb. soldering paste
24	Bulbs (25 watt-120 volt)
12	Bulbs (75 watt, rough service)
4 doz.	2-10 3/4 x 13" friction tape
2 doz.	#123 3/4 x 20' electrical tape
1 roll	1/4 x 60 yds. Masking tape
1 roll	1/2 x 60 yds. Masking tape
1 roll	3/4 x 60 yds. Masking tape
1 roll	1" x 60 yds. Masking tape
1 roll	2" x 60 yds. Masking tape

No.	Items
12 pts	3D Permatex aviation gasket cement
12 tubes	1c Permatex #1 formgasket
1	Solderless terminal kits
12	Parts cleaning brushes
10	Cartridges lubriplate all purpose grease
10	Cartridges molith #2 lubriplate moly-grease
1	Bolt Asst., includes cap screws, cotter pins, metal screws, machine screws, and cabinet
1	Grease fitting assortment
6 tubes	#348 Permatex valve grinding comp.
1	Wire cup brush 4" dis.
1	Wire cup brush 6" dis.
56	Wood file handles for 6-8" files Link Long Ferruled #2
28	Wood file handles for 8-10" files Link Long Ferruled #3
63	Wood file handles for 10-12" files Link Long Ferruled #4
6 pr.	Welding gloves
3	Cylinders replacement
15	File Card and brush
25 lb.	Arc Rod 3/32" welding
50 lb.	Arc Rod 1/8" welding
100 lb.	Arc Rod 5/32 welding
10 lb.	1/16" Bronze Rod Welding
10 lb.	1/8" Bronze Rod Welding
1 doz.	Bench dusters
30	Hack saw blades
1	60 grit refacing wheel
15	Sets Mill file double cut (flat) 6"-8"-10" with kit bag
15	Sets Mill file double cut (half round) 6"-8"-12" with kit bag
15	Sets Mill file double cut (round) 6"-8"-10"-12" with kit bag
1	Ring groove cleaning wool
1	Carbon brush 1/4" stem, std.
1	Carbon brush 1/4" stem, spiral twist
1	Carbon brush 1/4" stem, cut type
2	Sets high speed drills by 1/16" - 1/2" (29)
1	High speed drill 1/2" shank
7	High speed drill 1/2" shank
2	Sanding Disc Pad 7", use on ES-71A sander

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13. Choosing Your Occupation. Washington, D. C.: The Superintendent of Documents, U. S. Government Printing Office, 1962. $.15 a copy.

14. Dealer's Management Manual, may be available from major companies' district representatives and local managers.

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16. Education, an Investment in People. Washington, D. C.: Education Department, Chamber of Commerce of the United States. Price: $1.50.

17. Engineering Bulletin, AD 206. Chicago, Illinois: Automotive Diesel Engines, Standard Oil Company.

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19. Farm Tractors-Basic Principles, Operation and Maintenance. New York: American Oil Company, Engineering Bulletin No. FT-53.

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a. Service Department
Tractor and Implement
Ford Motor Company
2500 E. Maple Road
Birmingham, Michigan

b. J. I. Case Company
Racine, Wisconsin

c. International Harvester Company
180 N. Michigan Avenue
Chicago, Illinois

d. Oliver Corporation
400 W. Madison
Chicago, Illinois

e. Allis-Chalmers Corp.
Milwaukee, Wisconsin

f. Massey-Ferguson, Inc.
Indianapolis Training Center
6143 Brookville Road
Indianapolis, Indiana

g. Deere and Company
Moline, Illinois

h. Service Department
Minneapolis-Moline
Hopkins, Minnesota

THE CENTER FOR RESEARCH AND LEADERSHIP DEVELOPMENT
IN VOCATIONAL AND TECHNICAL EDUCATION
THE OHIO STATE UNIVERSITY
980 KINNEAR ROAD
COLUMBUS, OHIO, 43212

INSTRUCTOR NOTE: As soon as you have completed teaching each module, please record your reaction on this form and return to the above address.

1. Instructor's Name _____

2. Name of school _____ State _____

3. Course outline used: _____Agriculture Supply--Sales and Service Occupations
_____Ornamental Horticulture--Service Occupations
_____Agricultural Machinery--Service Occupations

4. Name of module evaluated in this report _____

5. To what group (age and/or class description) was this material presented? _____
_____

6. How many students:
   a) Were enrolled in class (total) _____
   b) Participated in studying this module _____
   c) Participated in a related occupational work experience program while you taught this module _____

7. Actual time spent teaching module:

		Recommended time if you were to teach the module again:
_____hours	Classroom Instruction	_____hours
_____hours	Laboratory Experience	_____hours
_____hours	Occupational Experience (Average time for each student participating)	_____hours
_____hours	Total time	_____hours

(RESPOND TO THE FOLLOWING STATEMENTS WITH A CHECK (√) ALONG THE LINE TO INDICATE YOUR BEST ESTIMATE.)

	VERY APPROPRIATE	NOT APPROPRIATE
8. The suggested time allotments given with this module were:		
9. The suggestions for introducing this module were:		
10. The suggested competencies to be developed were:		
11. For your particular class situation, the level of subject matter content was:		
12. The Suggested Teaching-Learning Activities were:		
13. The Suggested Instructional Materials and References were:		
14. The Suggested Occupational Experiences were:		

(OVER)

15. Was the subject matter content sufficiently detailed to enable you to develop the desired degree of competency in the student? Yes_____No_____
Comments:

16. Was the subject matter content directly related to the type of occupational experience the student received? Yes_____No_____
Comments:

17. List any subject matter items which should be added or deleted:

18. List any additional instructional materials and references which you used or think appropriate:

19. List any additional Teaching-Learning Activities which you feel were particularly successful:

20. List any additional Occupational Work Experiences you used or feel appropriate:

21. What do you see as the major strength of this module?

22. What do you see as the major weakness of this module?

23. Other comments concerning this module:

_____ (Date)

_____ (Instructor's Signature)

_____ (School Address)

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COUNCIL FOR DISTRIBUTIVE TEACHER EDUCATION

PROFESSIONAL BULLETIN SERIES

NUMBER 5

Distributive Education Library Lists

Kenneth A. Ertel
University of Idaho
Moscow, Idaho

Gary R. Smith
Highland High School
Pocatello, Idaho

This bulletin was produced and distributed by:

Distributive Education Division
State Board for Vocational Education
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OFFICE OF EDUCATION

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DISTRIBUTIVE EDUCATION LIBRARY LIST

CDTE Study Number 5

Kenneth A. Ertel
University of Idaho
Moscow, Idaho

Gary R. Smith
Highland High School
Pocatello, Idaho

FOREWORD

The council for Distributive Teacher Education was organized in 1961. Membership in the organization consists of teacher educators and other distributive education personnel with an interest in advancing distributive teacher education. The primary interests of the Council are research and publication.

This library list for distributive teacher education was developed with the hope that it will be valuable to institutions preparing teacher coordinators and others who will teach distributive subjects on the secondary and adult levels. In order to facilitate the collection and use of the distributive education materials listed in the bibliography, street addresses have been included where known. This information is enclosed in parentheses and follows the standardized listing. While most listings are arranged according to subject matter, some materials, such as the publications from the U. S. Office of Education, are listed according to the publisher for the sake of brevity and convenience.

This report was compiled by Kenneth A. Ertel, Teacher Educator for Distributive Education, University of Idaho, Moscow, Idaho, and Gary R. Smith, Coordinator of Distributive Education, Highland High School, Pocatello, Idaho. It was edited by the charter president of CDTE and published through the courtesy of the Idaho State Board for Vocational Education. Requests for copies should be addressed to the authors.

Reno S. Knouse
Charter President, CDTE
State Teacher Educator for Distributive Education
School of Business
State University of New York at Albany

October, 1964

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INTRODUCTION

The purpose of this bibliography is to make available a list of library materials for the use of distributive teacher educators who prepare teachers of high school cooperative part-time classes, of pre-employment classes, of junior college or mid-management classes, and of adult preparatory and extension classes. The teacher educator must also provide teachers with the background to organize and administer adult distributive education programs.

The teacher of distributive education must translate the subject matter content of the field of distribution, including marketing and management, into a classroom presentation designed to enhance learning. The teacher must have substantive background in the discipline of distribution, the subject matter content inherent to employment in the distributive field. This background must necessarily involve a strong program in business administration and marketing. Therefore, a special section of recent literature in the areas of marketing, merchandising, retail store operation and supervisory management is included. The list is limited to these areas since this is the apex of a business administration program leading toward teacher education for distribution.

The qualified teacher of distribution must have the tools of teaching, including a philosophy of and an understanding of both secondary and adult education. This presumes a background of special and professional education courses designed to provide competencies

as a teacher of distribution. Therefore, a section of materials relevant to such courses as Methods and Materials in Distributive Education, etc., and the professional education materials related to this area are included.

An orientation to philosophy and practice is developed in the section on vocational education.

This suggested list of library materials may prove helpful to those distributive teacher educators who are concerned with providing a library of suitable materials for preparing distributive education teacher coordinators and other professional personnel. The list is in no way all-inclusive and undoubtedly will need continuing revision. Suggestions and comments will be most important in helping to maintain a comprehensive list of library materials.

Many excellent state publications were not listed as they are included in the Distributive Education Bibliography published by the University of Texas. There has been no attempt to include articles in current periodicals which are, for the most part, listed in the Business Education Index. Suggested high school texts and library lists are likewise omitted inasmuch as they are included in A Library for Distributive Education published by Ohio State University.

The assistance of staff members of the College of Business Administration and the College of Education, University of Idaho, for their efforts in evaluating the selected library materials is deeply appreciated.

DISTRIBUTIVE EDUCATION - PROFESSIONAL

PRESENT CONCEPTS AND PHILOSOPHY
of
DISTRIBUTIVE EDUCATION

Arnold, Richard A., et al. An Annotated Bibliography of Periodical Literature Relating to Distributive Education 1947-1961. East Lansing, Michigan: Office of Research and Publications, College of Education, Michigan State University, 1962.

Bridging the Gap from Theory to Practice. Blacksburg, Virginia: Distributive Education Department, Virginia Polytechnic Institute, n.d.

Brown, W. C. Diversified Occupations Graduates of 1952: A Follow-up Report. Columbia, Missouri: University of Missouri, 1959.

Burchill, G. W. Work Study Programs for Alienated Youth. Chicago: Science Research Associates, 1962.

Bureau of Business Education, 721 Capital Avenue, Sacramento, California

Publications include:
Business Management Series, Human Relations in Business. 1960.
Business Work Experience, Seasonal Sales Training. 1959.
California's Business Economy. 1960.
The Marketing Series, Fundamentals of Salesmanship. 1959.
The Marketing Series, Our System of Distribution. 1961.
The Marketing Series, Principles of Retailing. 1960.
The Marketing Series, Retail Buying. 1961.
The Marketing Series, Small Business Management. 2 vols. 1958.
Retail Personnel Development Series, Markup and Merchandise Planning. 2 vols. 1957.
Retail Personnel Development Series, Retail Buying Techniques and Sales Promotion. 2 vols. 1957.

Carter, Fairchild H. The Role of Distributive Teacher Educators in Adult Education. Council for Distributive Teacher Education, Professional Bulletin No. 3. Bloomington, Indiana: Division of Distributive Education, School of Education, Indiana University, 1963.

Central Region Research Reports. State Supervisor and Teacher Educators of Distributive Education, Central Region. Bloomington, Indiana: Department of Distributive Education, Indiana University.

Donaldson, LeRoy J. An Evaluation of Instruction in Co-operative Distributive Education Programs in Illinois. Central Region Research Report No. 5. East Lansing, Michigan: Department of Teacher Education, College of Education, Michigan State University, 1959.

Haines, Peter G., et al. Training Placements of Co-operative Part-Time Students in Relation to Opportunities in Distribution. Central Region Research Report No. 4. Grand Forks, North Dakota: Department of Distributive Education, University of North Dakota, n.d.

Haines, Peter G., and Samson, Harland E. Training Placements of Co-operative Part-Time Students in Relation to Opportunities in Distribution. Central Region Research Report No. 3. Cedar Falls, Iowa: Department of Business Education, Iowa State Teachers College, n.d.

Kozelka, Robert, et al. Training Placements of Co-operative Part-Time Students in Relation to Opportunities in Distribution. Central Region Research Report No. 2. East Lansing, Michigan: College of Education, Michigan State University, 1958.

Meyer, Warren G. Needed Research in Distributive Education. Central Region Research Report No. 1. Minneapolis, Minnesota: College of Education, University of Minnesota, n.d.

Meyer, Warren G., et al. The 1960 Progress Report on Distributive Education in the Central Region. Central Region Research Report No. 7. Minneapolis, Minnesota: College of Education, University of Minnesota, 1960.

Policies and Practices of Department Stores as Related to Executive Trainees. Central Region Research Report No. 10. Bloomington, Indiana: Department of Distributive Education, Indiana University, 1960.

Samson, Harland E., et al. Survey of Distributive Education State Supervisors. Central Region Research Report No. 6. Cedar Falls, Iowa: Department of Business Education, Iowa State Teachers College, 1960.

OX Teacher Training Courses in the Central Region. Central Region Research Report No. 11. Cedar Falls, Iowa: Department of Business Education, State College of Iowa, 1963.

O source only
Chamber of Commerce of the United States, 1615 H Street, N. W., Washington 6, D. C.

Economic Series of Booklets. Some of the titles in the economic series of booklets are:

Free Markets and Free Men, n.d.
How Competitive is the American Economy?, n.d.
Why the Businessman?, n.d.
(Many additional titles are available)

Classroom Layouts for a Distributive Education Classroom. Columbus, Ohio: Distributive Education Materials Laboratory, Ohio State University, n.d. (127 West 17th Avenue)

Coordinators Guide, Distributive Education. Olympia, Washington: State of Washington, State Board for Vocational Education, 1961 (revised).

0X Coordinators Handbook, Arizona Distributive Education. Phoenix, Arizona: Distributive Education Service, Arizona State Department of Vocational Education, 1963. (412 State Building)

0X Council for Distributive Teacher Education. Distributive Education, A Position Paper. Washington: U. S. Office of Education, 1963.

Criteria for the Evaluation of a Distributive Education Program. Series A. Bulletin No. 108. Springfield, Illinois: State Board for Vocational Education, 1949.

D. E. Workshop Reading Reports, June, 1960. Stillwater, Oklahoma: Supervisor, Distributive Education, 1960. (419 Gardiner Hall)

DECA Handbook. Washington: Distributive Education Clubs of America, 1959.

0X Delta Pi Epsilon. Improving Research in Business Education. Cincinnati, Ohio: South-Western Publishing Company, 1962.

0X "Distributive Education: An Answer to the Training Needs of Business," Special Supplement, Washington Report. Washington: Chamber of Commerce of the United States, February 21, 1964.

Distributive Education Bibliography, 1961 Supplement. Austin, Texas: Distributive Education Department, Division of Extension, The University of Texas, 1961.

Distributive Education Cooperative Program. Curriculum Bulletin 95. Cincinnati, Ohio: Supervisor of Business Education, Cincinnati Public Schools, 1962.

Distributive Education Coordinator's Handbook. Richmond, Virginia: Distributive Education Service, State Board of Education, 1954.

0X Dorr, Eugene L. A Case Study of Weaknesses in Coordination Practices. Council for Distributive Teacher Education, Professional Bulletin No. 2. Phoenix, Arizona: Distributive Education Service, State Department of Vocational Education, 1962. (400 Arizona State Building)

X Douglas, Lloyd V., et al. Teaching Business Subjects. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1963.

X _____. Business Education. Washington: Center for Applied Research in Education, 1963. (1808 Adams Mill Road, N.W.)

X Education and Training for Distribution. Washington: Organization for European Economic Cooperation, n.d. (2000 P Street, N.W.)

Effective Distributive Education Practices. Philadelphia, Pennsylvania: The Educational Service Bureau, Department of Educational Administration, Teachers College, Temple University, 1960.

Erickson, Lawrence W., and Oliverio, Mary Ellen. Evaluative Criteria for Survey Instruments in Business Education. Sacramento, California: Bureau of Business Education, Division of Vocational Education, University of California, 1960.

O X Evaluation of Your Cooperative Part-Time Distributive Education Program. Austin, Texas: Distributive Education, Texas Education Agency, 1963.

Evaluative Criteria Distributive Education. Washington: National Study of Secondary School Evaluation, 1960.

Evaluative Criteria for Distributive Education. Washington: American Vocational Association, 1954.

X Expendable Supplies for a D.E. Classroom. Columbus, Ohio: Distributive Education Materials Laboratory, Ohio State University, 1964. (127 West 17th Avenue)

Greer, Edith S., and Harbeck, Richard M. What High School Students Study. O.E. 33025. Washington: United States Department of Health, Education, and Welfare, Government Printing Office, 1962.

Haas, Kenneth B. Distributive Education. 2nd ed. New York: Gregg Publishing Division, McGraw-Hill Book Co., Inc., 1949.

_____. Tested Training Techniques. New York: Prentice-Hall, Inc., 1950.

O X Haines, Peter G., and Tedder, Herbert H. Distributive Education Training Guides. Cincinnati, Ohio: South-Western Publishing Co., 1963.

O X Handbook for Distributive Education. Austin, Texas: Texas Education Agency, 1963.

O X Harms, H. Methods in Vocational Business Education. 2nd ed. Cincinnati, Ohio: South-Western Publishing Co., 1963.

How to Teach. Business Education Publication No. 92, Instructional Methods Series. Sacramento, California: State Department of Education, 1960.

O X How to Teach Business Subjects. Business Education Publication No. 108, Instructional Methods Series. Sacramento, California: State Department of Education, 1963 (revised).

Hudson, Maud A. A Sponsor Development Program. Norfolk, Virginia: Distributive Education Department, City Public Schools, n.d. (735 Pembroke Avenue)

Introduction to Distributive Education. Sacramento, California: State Department of Education, Division of Instruction, 1961.

Job Description Manual. Columbus, Ohio: Distributive Education Materials Laboratory, Ohio State University, 1963. (127 West 17th Avenue)

Job Descriptions, Distributive Education. Columbus, Ohio: Distributive Education Materials Laboratory, Ohio State University, 1961. (127 West 17th Avenue)

Knouse, Reno S. Needed Improvements in Distributive Teacher Education. Council for Distributive Teacher Education, Professional Bulletin No. 1. East Lansing, Michigan: Michigan State University, 1962.

A Library for Distributive Education. Columbus, Ohio: Distributive Education Materials Laboratory, Ohio State University, 1964. (127 West 17th Avenue)

List of Studies Made at University of Minnesota in Business and Distributive Education. Minneapolis, Minnesota: Distributive Education, College of Education, University of Minnesota, n.d.

Mason, R. E. Methods in Distributive Education. Danville, Illinois: The Interstate Publishers and Printers, 1963.

Mayer, Forrest L. Business Education Curriculum for Distributive Education Teachers. Hayward, California: Alameda State College, 1960.

National Education Association, 1201 Sixteenth Street, N.W., Washington, D. C. 20036

Includes:
Adult Education Bibliography, n.d.
Focus on Public School Adult Education, n.d.
In-Service Training for Teachers of Adults, n.d.
Vocational, Technical, and Practical Arts Education, n.d.
(Additional titles are available)

Nichols, Daryl E. Selection, Placement and Evaluation in Distributive Education. Evanston, Illinois: Evanston Township High School, 1961 (revised).

"On-The-Job Training," Special Supplement, Washington Report. Washington: Chamber of Commerce of the United States, June 28, 1963.

An Outline for a Local Plan for Vocational Distributive Education. Indianapolis, Indiana: State Board for Vocational Education, n.d. (230 State House)

Programmed Review of the Ten-Hour Orientation Program for Beginning Teachers of Distributive Education. Harrisburg, Pennsylvania: Vocational Education Division, Department of Public Instruction, Commonwealth of Pennsylvania, 1961.

Related Guide to Distributive Education. Publication No. 122-G. Jefferson City, Missouri: Distributive Education, State Department of Education, 1959.

Samson, Harland E. Master Reading List for Distributive Education. Cedar Falls, Iowa: State Teachers College of Iowa, 1961.

Scannell, Edward E. Off-Campus Responsibilities of Distributive Teacher Educators. Council for Distributive Teacher Education, Professional Bulletin No. 4. Cedar Falls, Iowa: Iowa Distributive Education Services, Department of Business Education, State College of Iowa, 1963.

Selected Problems in Education for Distribution. Cedar Falls, Iowa: Distributive Education, Business Education, State College of Iowa, 1962.

A Sponsor Development Program. Bulletin DE-6. Des Moines, Iowa: Division of Vocational Education, Department of Public Instruction, 1960.

Student Manual for Occupational Relations. Minneapolis, Minnesota: College of Education, University of Minnesota, Nicholson Hall Bookstore, 1959.

Studies in Distributive Education. Sacramento, California: Division of Instruction, California State Department of Education, 1961.

Study Guide for Teaching Vocational Distributive Education Subjects. (Appendix to Study Guide separate). Harrisburg, Pennsylvania: Vocational Education Division, Department of Public Instruction, Commonwealth of Pennsylvania, 1959.

Teachers Manual for Occupational Relations. Minneapolis, Minnesota: The College of Education, University of Minnesota, 1960. (Nicholson Hall Bookstore)

Teaching Aids for High School D.E. Classes. Columbus, Ohio: Distributive Education Materials Laboratory, Ohio State University, 1957. (127 West 17th Avenue)

Tonne, Herbert A. Principles of Business Education. 3rd ed. New York: McGraw-Hill Book Co., Inc., 1961.

Training for Specific Needs. New York: National Retail Merchants Association, 1958. (100 West 31st Street)

Warmke, Roman F. Distributive Education Issues. Monograph 102. Cincinnati, Ohio: South-Western Publishing Co., 1961.

GENERAL SOURCES - DISTRIBUTIVE EDUCATION

Aids to Teachers of Retailing. New York: New York School of Retailing, Washington Square, n.d.

Baer, Max F., and Roeber, Edward C. Occupational Information: Its Nature and Use. Chicago: Science Research Associates, Inc., 1951.

Bibliography of Teaching Materials in Business Education. New York: New York University Press, Washington Square, n.d.

Briggs, T. H. Improving Instruction. New York: The MacMillan Co., 1953.

Brown, E. J. Managing the Classroom. New York: Ronald Press Co., 1952.

Business Education Index. Denver, Colorado: Delta Pi Epsilon, University of Denver, issued annually.

Calvert, R., and Steele, J. E. Planning Your Career. New York: McGraw-Hill Publishing Co., Inc., 1963.

Conant, James B. The American High School Today. New York: McGraw-Hill Book Co., Inc., 1959.

_____. Slums and Suburbs. New York: McGraw-Hill Book Co., Inc., 1961.

Dame, J. Frank, and Brinkman, Albert R. Guidance in Business Education. Cincinnati, Ohio: South-Western Publishing Co., 1954.

Galbraith, J. K. The Affluent Society. Boston: Houghton-Mifflin Co., 1958.

Hoving, Walter. The Distribution Revolution. New York: Ives Washburn, Inc., 1960.

Johnson, H. Webster, and McFarland, Stuart W. How to Use the Business Library. Cincinnati, Ohio: South-Western Publishing Co., 1957.

Management Aids for Small Manufacturers. San Francisco: Small Business Administration, 1964. (525 Market Street)

Mazur, Paul E. The Standards We Raise. New York: Harper and Brothers, 1953.

Morse, Arthur D. Schools of Tomorrow--Today. Garden City, New York: Doubleday and Company, Inc., 1960.

Nolan, C. A., and Hayden, Carlos K. Principles and Problems of Business Education. 2nd ed. Cincinnati, Ohio: South-Western Publishing Co., 1958.

Scott, George A. Your Future in Retailing. New York: Richards Rosen Press, 1961. (13 East 22nd Street)

Suggestions for a Basic Economic Library for Secondary Schools. New York: Joint Council on Economic Education, 1961. (2 West 46th Street)

Super, Donald E. The Psychology of Careers. New York: Harper and Brothers, 1957.

Tonne, Herbert A., et al. Methods of Teaching Business Subjects. New York: McGraw-Hill Book Co., Inc., 1957.

Using Current Curriculum Developments. Association for Supervision and Curriculum Development. Washington: National Education Association, 1963. (1201 16th Street, N.W.)

Views on Business Education. Chapel Hill, North Carolina: The School of Business Administration, The University of North Carolina, n.d.

Visual Aids for Business Education. Monograph 92. Cincinnati, Ohio: South-Western Publishing Co., October, 1961.

THE ADULT PROGRAM - PROFESSIONAL BOOKS

possible source

Adult Education Association of the U. S. A., 743 North Wabash Avenue, Chicago, Illinois

Leadership Pamphlet Series. Some titles are:

Planning Better Programs, n.d.
Taking Action in the Community, n.d.
How to Teach Adults, n.d.
Training Group Leaders, n.d.
Conducting Workshops and Institutes, n.d.
(Additional titles are available)

Adult Programs Handbook, Arizona Distributive Education. Phoenix, Arizona: Distributive Education Service, Arizona State Department of Vocational Education, 1963. (412 State Building)

possible source

American Educational Research Association. Review of Educational Research. Adult Education. Washington: National Education Association, 1959.

Business Education for Adults in the Junior College. Monograph C-5. Cincinnati, Ohio: South-Western Publishing Co., 1957.

Handbook of Adult Education in the United States. Chicago: Adult Education Association of the U. S. A., 1960. (743 North Wabash Avenue)

Kelley, C. The Workshop Way of Learning. New York: Harper and Brothers, 1958.

Knowles, M. S. The Adult Education Movement in the United States. New York: Henry C. Holt and Co., 1962.

National Education Association, Adult Education Service, 1201 16th Street, N.W., Washington, D. C.

Some titles in the Adult Education series publications are:

Adult Education Bibliography, n.d.
Adult Leadership Bibliography, n.d.
Selected Bibliography on Conference Leadership, n.d.
(Additional titles are available)

An Overview of Adult Education Research. Chicago: Adult Education Association of the U. S. A., 1959. (743 North Wabash Avenue)

When You're Teaching Adults. Washington: National Association of Public School Educators, n.d. (1201 16th Street, N.W.)

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The following publications are available through the U. S. Government Printing Office, Washington 25, D. C.

Administration of Vocational Education. Vocational Education Bulletin No. 1, 1958.

Adult Education Services of State Departments of Education. Misc. No. 31, 1959.

Digest of Annual Reports of State Boards for Vocational Education, Distributive Education Section. Issued annually.

Educational Values in Club Programs. Office of Education Bulletin 82005, 1962.

Financial Management of Federal-State Education Programs. Office of Education Bulletin 10019, 1962.

Food Service Industry--Training Programs and Facilities. Office of Education Bulletin 82007, 1961.

Guide for Part-Time Instructors. Office of Education Bulletin 82003, 1960 (reprint).

Guide for Part-Time Instructors. Vocational Division Bulletin No. 259, 1959.

X Guide to Practical Research. Natalie Kneeland. Office of Education Bulletin 82011, 1963.

Guide to the Preparation of Training Materials. Office of Education, n.d.

X Guidelines for Teacher Education Programs in Distributive Education. Office of Education Bulletin 82010, 1962.

Management Training for Small Business. Office of Education Bulletin 82008, 1961 (reprint).

Organization and Effective Use of Advisory Committees. Office of Education Bulletin 84009, 1961.

Participation in Adult Education. Office of Education Circular No. 539, 1959.

Patterns of Research in Distributive Education. Office of Education Bulletin 82009, n.d.

Planning and Organizing an Export Trade Education Program. Office of Education Bulletin 82012, 1963.

Planning for Action in Distributive Education. Office of Education, n.d.

Post-High School Cooperative Programs. Office of Education Bulletin 82001, 1960.

Public Vocational Education Programs. Office of Education, n.d.

The Role of Teacher Education in Distributive Education. Vocational Division Bulletin No. 279, 1959.

Selection and Training of Part-Time Instructors. Vocational Division Bulletin No. 258, 1955.

Selection and Training of Part-Time Instructors of Distributive Education for Adults. Office of Education Bulletin 82002, 1960 (reprint).

Standard Industrial Classification for Use in Distributive Education. Office of Education Bulletin 82013, 1963.

Striving for Excellence in Distributive Education. 1961.

A Study of Curriculum Development in the High School Cooperative Program. Office of Education Bulletin 82000, 1960.

Supervision to Improve Instruction in Distributive Education. Office of Education Bulletin 82006, 1961 (reprint).

Training Opportunities in Outside Selling. Office of Education Bulletin 270, 1958.

Training for Students in the Food Industry. Office of Education Bulletin 82004, 1961.

Training Programs in Outside Selling. Office of Education Bulletin 269, 1958.

Trends in Distributive Education. Report of 1957 National Conference, 1958.

Vocational Education in Distributive Occupations. Vocational Division Bulletin No. 255, 1954.

Vocational Education in the Next Decade. (Summary separate), 1961.

Work Experience Laboratories. Distributive Education for Youth Series. Office of Education Bulletin 260, 1956.

VOCATIONAL EDUCATION - BASIC UNDERSTANDINGS

Administration of Vocational Education. Vocational Bulletin No. 1, U. S. Department of Health, Education, and Welfare, Office of Education. Washington: Government Printing Office, 1962.

American Educational Research Association. Review of Educational Research. "Vocational, Technical, and Practical Arts Education." Vol. 32, No. 4, Washington: National Education Association, 1962.

Barry, Ruth, and Wolf, Beverly. An Epitaph for Vocational Guidance: Myths, Actualities, Implications. New York: Bureau of Publications, Teachers College, Columbia University, 1962.

Bennett, Charles A. History of Manual and Industrial Education up to 1870. Peoria, Illinois: The Manual Arts Press, 1926.

_____. History of Manual and Industrial Education, 1870-1917. Peoria, Illinois: The Manual Arts Press, 1926.

Bishop, C. E., and Tolley, G. S. Manpower in Farming and Related Occupations. Raleigh, North Carolina: Department of Agricultural Economics, North Carolina State College, 1962.

Blackwell, Sara. Student Opinions Regarding Effectiveness of Two Types of Home Economics Programs. Ithaca, New York: College of Home Economics, Cornell University, 1962.

Burgener, V. E. What Happens to Distributive Enrollees in Illinois? A Survey of 1959-60 Students. Springfield, Illinois: State Department of Education, 1961.

California State Department of Education. Business Data Processing Technical Courses. Sacramento, California: The Department, 1962.

Careers for Women in Retailing. U. S. Department of Labor. Washington: Government Printing Office, n.d.

The Challenge of Jobless Youth. President's Committee on Youth Unemployment. Washington: Government Printing Office, 1962.

Clark, Harold F. Cost and Quality in Public Education. Syracuse, New York: Syracuse University Press, 1963.

Coon, Beulah I. Home Economics in the Public Secondary Schools. U. S. Department of Health, Education, and Welfare, Office of Education. Washington: Superintendent of Documents, Government Printing Office, 1962.

Current Issues in Higher Education. Washington: Association for Higher Education, National Education Association, 1962.

Dauwalder, D. D. Education and Training for Technical Occupations, Parts I and II. Sacramento, California: California State Department of Education, 1961.

Digest of Annual Reports of State Boards of Vocational Education. Fiscal year ended June 30, 1962. OE-80008-62. Washington: Government Printing Office, 1963.

Education for a Changing World of Work. Report of the Panel of Consultants on Vocational Education, Office of Education, U. S. Department of Health, Education, and Welfare. Washington: Government Printing Office, 1963.

Evans, Luther H., and Arnstein, George (eds.). Automation and the Challenge to Education. Washington: National Education Association, 1962.

Follet, Earl C., and Fratessa, Carolyn L. A Survey of the Educational Requisites for Technicians in Engineering and Scientific Data Processing Installations. SRI Project No. IM-4115. Menlo Park, California: Stanford Research Institute, 1962.

Gardner, John W. From High School to Job. 1960 Annual Report of Carnegie Corporation. New York: The Carnegie Corp., 1961.

Ginzberg, Eli, et al. Occupational Choice. New York: Columbia University Press, 1951.

Goals for Americans. President's Commission on National Goals. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1960.

Guides to Information Sources for Education in Distribution. U. S. Department of Commerce, O-596567. Washington: Government Printing Office, 1961.

Hawkins, Layton S., et al. Development of Vocational Education. Chicago: American Technical Society, 1951.

Henninger, G. Ross. The Technical Institute in America. New York: McGraw-Hill Book Co., Inc., 1959.

Illinois Board of Vocational Education and Illinois Vocational Home Economics Teachers Association. Home Economics Education--Suggested Scope and Sequence. Springfield, Illinois: The Association, 1961.

Keller, Franklin J. Vocationally Talented Pupils. New Brunswick, New Jersey: Division of Field Studies and Research, Graduate School of Education, Rutgers--The State University, 1962.

Levitan, Sar A. Vocational Education and Federal Policy. Kalamazoo, Michigan: W. E. Upjohn Institute for Employment Research, 1963.

Manpower, Challenge of the 1960's. U. S. Department of Labor. Washington: Government Printing Office, 1961.

Manpower Report of the President and a Report on Manpower Requirements and Resources, Utilization, and Training by the United States Department of Labor. Washington: Government Printing Office, 1963.

Michigan State Board of Control for Vocational Education. Michigan Vocational Education Evaluation Project. East Lansing, Michigan: College of Education, Michigan State University, 1962.

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APPENDIX

SOURCES FOR MATERIALS IN DISTRIBUTIVE EDUCATION

1. Periodicals:

   Adult Education
   American Business Education
   American Business Education Yearbook
   American Economic Review
   American Vocational Journal
   Audio Visual Review
   Balance Sheet
   Business Education Forum
   Business Education World
   Business Management
   Business Teacher
   Business Week
   Chain Store Age
   Delta Pi Epsilon Journal
   Department Store Economist
   Display World
   Distributor, The
   Forbes
   Fortune
   Journal of Business Education
   Journal of Marketing
   Journal of Retailing
   National Business Education Quarterly
   National Education Association Journal
   Nations Business
   Personnel Services
   Stores

2. Reference books on basic business and consumer education.

3. Colloquium papers (primarily McGraw-Hill and Prentice-Hall).

4. Secondary School textbooks on distributive education subjects.

5. Reference books and periodicals on retailing, salesmanship, and related subjects.

6. Bibliographies and source materials on distributive education (University of Texas and State Boards of Vocational Education).

7. Coordinators manuals.

8. State course of study outlines.

9. List of publications, National Retail Merchants Association.

10. Trade periodicals; i.e. grocers, service stations, furniture dealers.

11. Business Education Index. (Delta Pi Epsilon) This source lists a complete bibliography of all distributive education pamphlets,

periodical articles, books, master's theses, and doctoral dissertations.

12. Business Index.

13. United States Office of Education.

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

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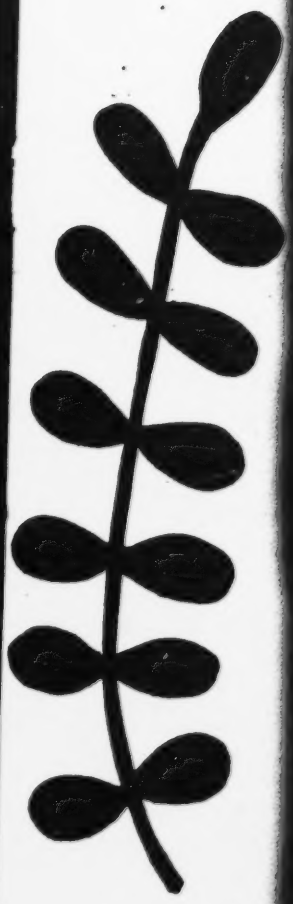
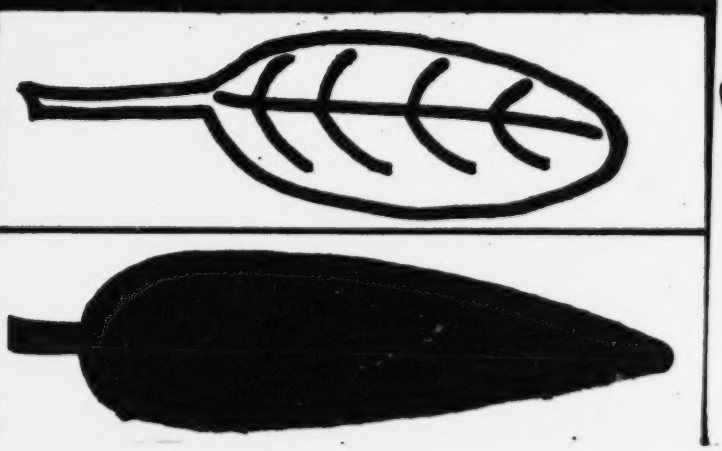
FUNDAMENTALS OF PLANT IDENTIFICATION

-a student study guide-





Agricultural Education Department
The Ohio State University
and
Agricultural Education Service
The Ohio State University
Columbus, Ohio
1967

VT 006 117

Suggestions For Using The Student Study Guide

Fundamentals Of Plant Identification

The student study guide on plant identification has been developed for use with the slide series, "Some Fundamentals Of Plant Identification." * Not included in the study guide is the section on flower characteristics of plants.

Write in spaces are provided throughout the guide for listing the names of plant characteristics. Those marked by a letter are individual characteristics, and those marked by a number are leaf characteristics or an entire plant.

It is suggested that the student first become familiar with the plant characteristics and later list the names of plants that have certain characteristics as outlined in the guide. The reference,"An Aid To The Identification Of 60 Ohio Plants," * and the slide series,"Some Common Crop And Weed Plants Of Ohio," * should be helpful in determing many of the plants and their characteristics.

This study guide should become a part of the student's notebook, and should serve as a basic reference in plant identification.

*Available from the Ohio Vocational Agricultural Instructional Materials Service.

MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) Harlan E. Ridenour (Agency) Agricultural Education Curriculum Material Service

(Address) Room 201, 2120 Fyffe Road, Columbus, Ohio, 43210

DATE: 24 July 1967

RE: (Author, Title, Publisher, Date) Clarence R. Fridline, Fundamentals of Plant Identification, Ohio, Agricultural Education Curriculum Material Service, 1967

Supplementary Information on Instructional Material

Provide information below which is not included in the publication. Mark N/A in each blank for which information is not available or not applicable. Mark P when information is included in the publication. See reverse side for further instructions.

(1) Source of Available Copies:
Agency Agricultural Education Curriculum Material Service
Address Room 201, 2120 Fyffe Road, Columbus, Ohio, 43210
Limitation on Available Copies None Price/Unit $ .15
(quantity prices) $ .15

(2) Means Used to Develop Material:
Development Group Teacher of Vocational Agriculture
Level of Group State
Method of Design, Testing, and Trial Conference with teachers of Vo Ag and Agronomists, Trial with students

(3) Utilization of Material:
Appropriate School Setting Comprehensive High School or Area Voc. School
Type of Program Productive Agr. in high school
Occupational Focus Farming or agronomy
Geographic Adaptability United States
Uses of Material Student Note book
Users of Material Students

(4) Requirements for Using Material:
Teacher Competency Teacher of Vo. Ag.
Student Selection Criteria 9th or 10th grade student in agr.

Time Allotment 5 hours

Supplemental Media --
Necessary X
Desirable ____ (Check Which)

Describe Slide series, Fundamentals of Plant Identification, 18 color slides and script, $3.00.
Source (agency) Agricultural Education Curriculum Material Service
(address) Room 201, 2120 Fyffe Road, Columbus, Ohio, 43210

Fundamentals Of Plant Identification

A Student Study Guide

Crop and weed plants are divided into two general groups: Dicotyledons (Dicots) and Monocotyledons (monocots)

Some of the general characteristics of the Dicot group are:

a. _____

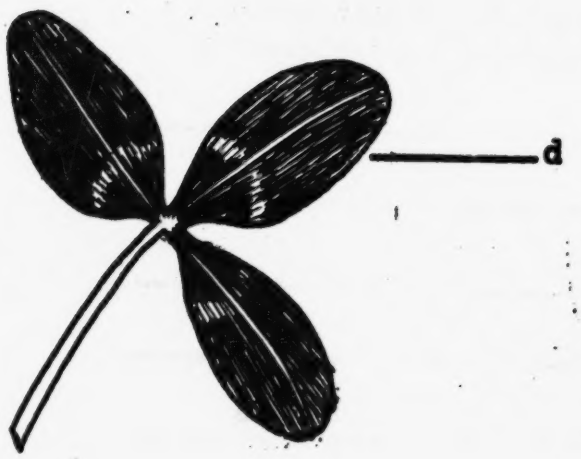
_____

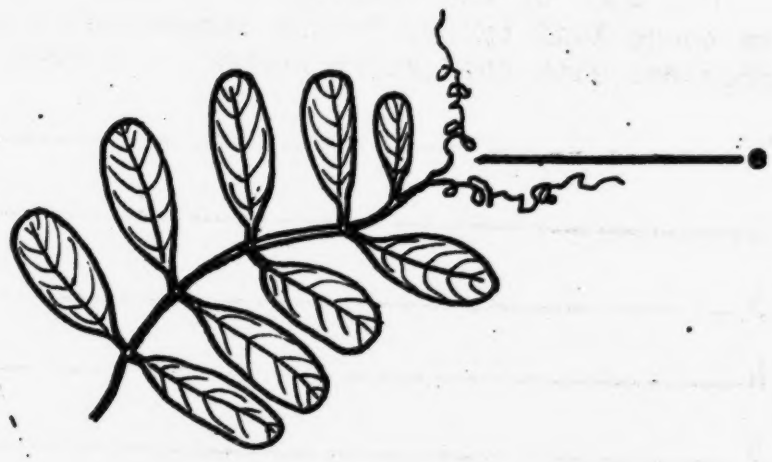
Leaf Types

Sketches 1 through 7 show different leaf types. In the numbered blank below each leaf type sketch write the name of the leaf type.

The lettered blanks are for plant characteristics. Write the name of the characteristic in the correct blank.

1 _____



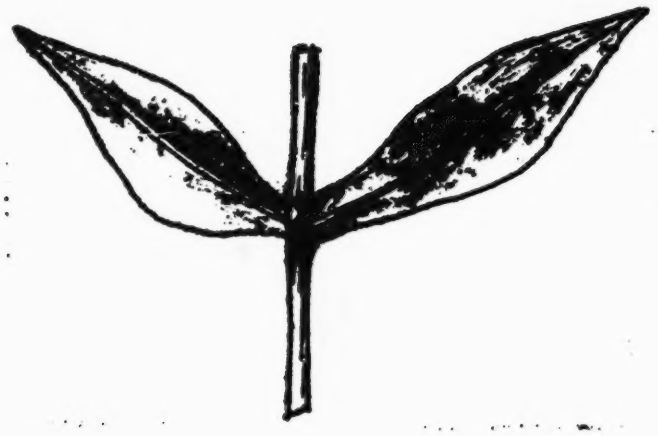


2 _____

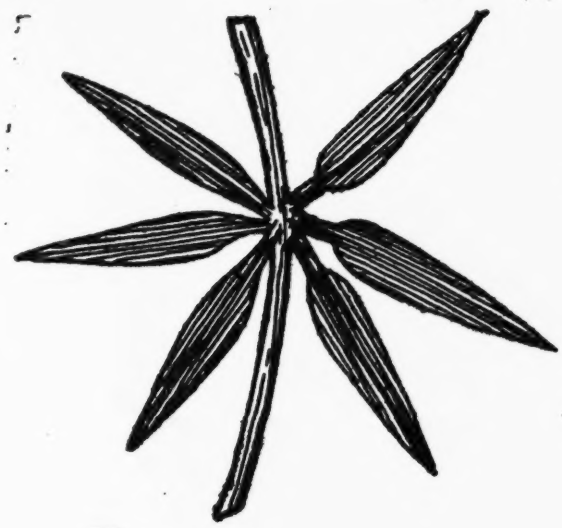
3 _____

Leaf Types

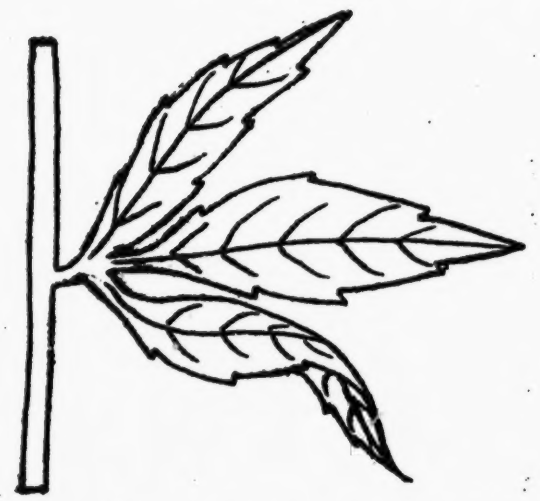
4 _____



5 _____



6 _____



7 _____

For each of the sketches a few to several different plants will have these leaf types. In the spaces below write the plant names to correspond with the sketch number. (example -- 2 red clover)

1 _____

2 _____

3 _____

4 _____

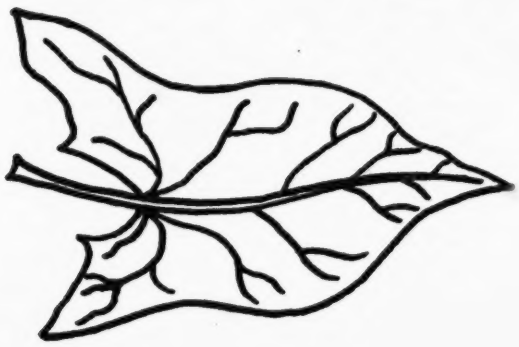
5 _____

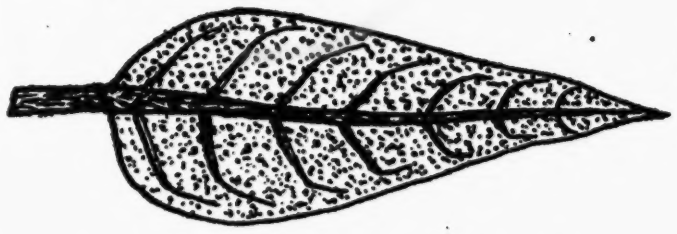
6 _____

7 _____

Leaf Shapes

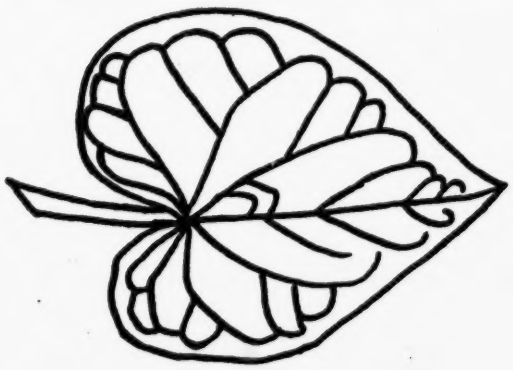
Sketches 8 through 13 show different leaf shapes. Write the correct name of the leaf shape below each sketch.

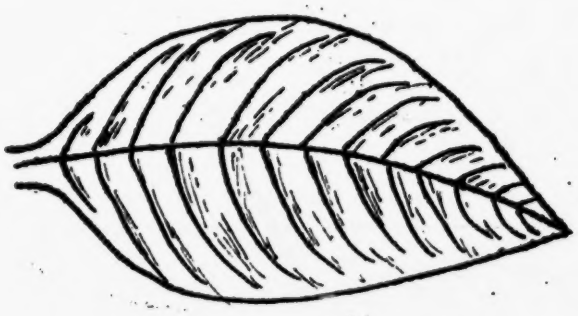




8 _____

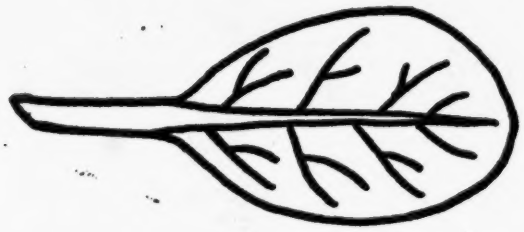
9 _____

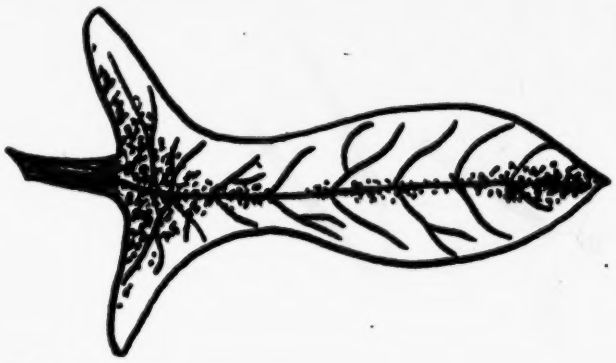




10 _____

11 _____





12 _____

13 _____

In the spaces below write the plant names with leaf shapes as shown in the sketches.

8 _____

9 _____

10 _____

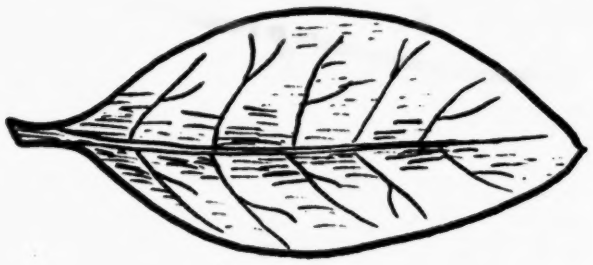
11 _____

12 _____

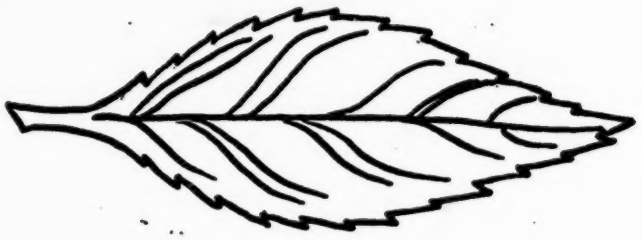
13 _____

Leaf Margins

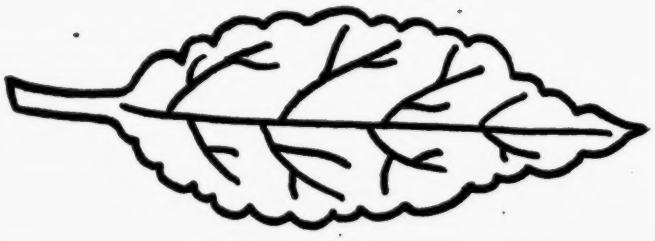
Sketches 14 through 19 show different leaf margins. Write the correct name of the leaf margin below each sketch.



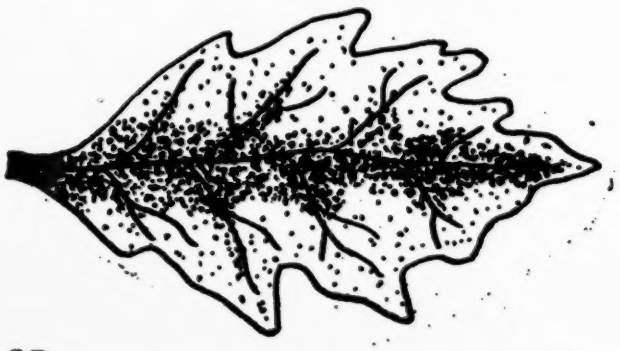
14 _____



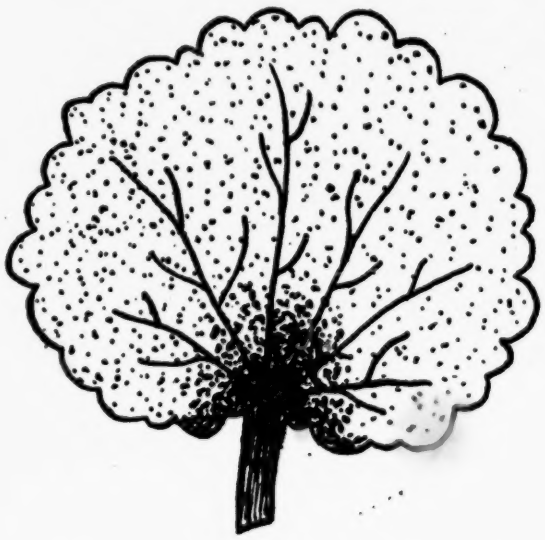
15 _____



16 _____



17 _____



18 _____

19 _____

In the spaces below write the plant names with leaf margins as shown in the sketches.

14. _____

15. _____

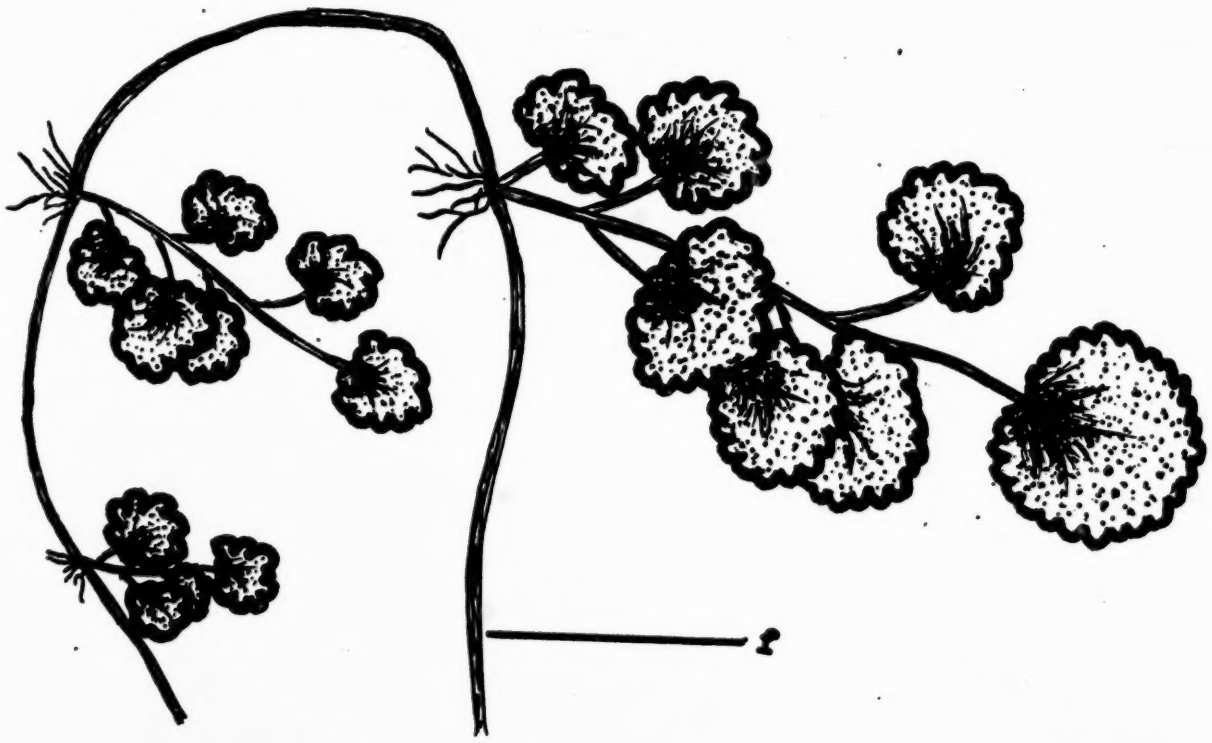
16. _____

17. _____

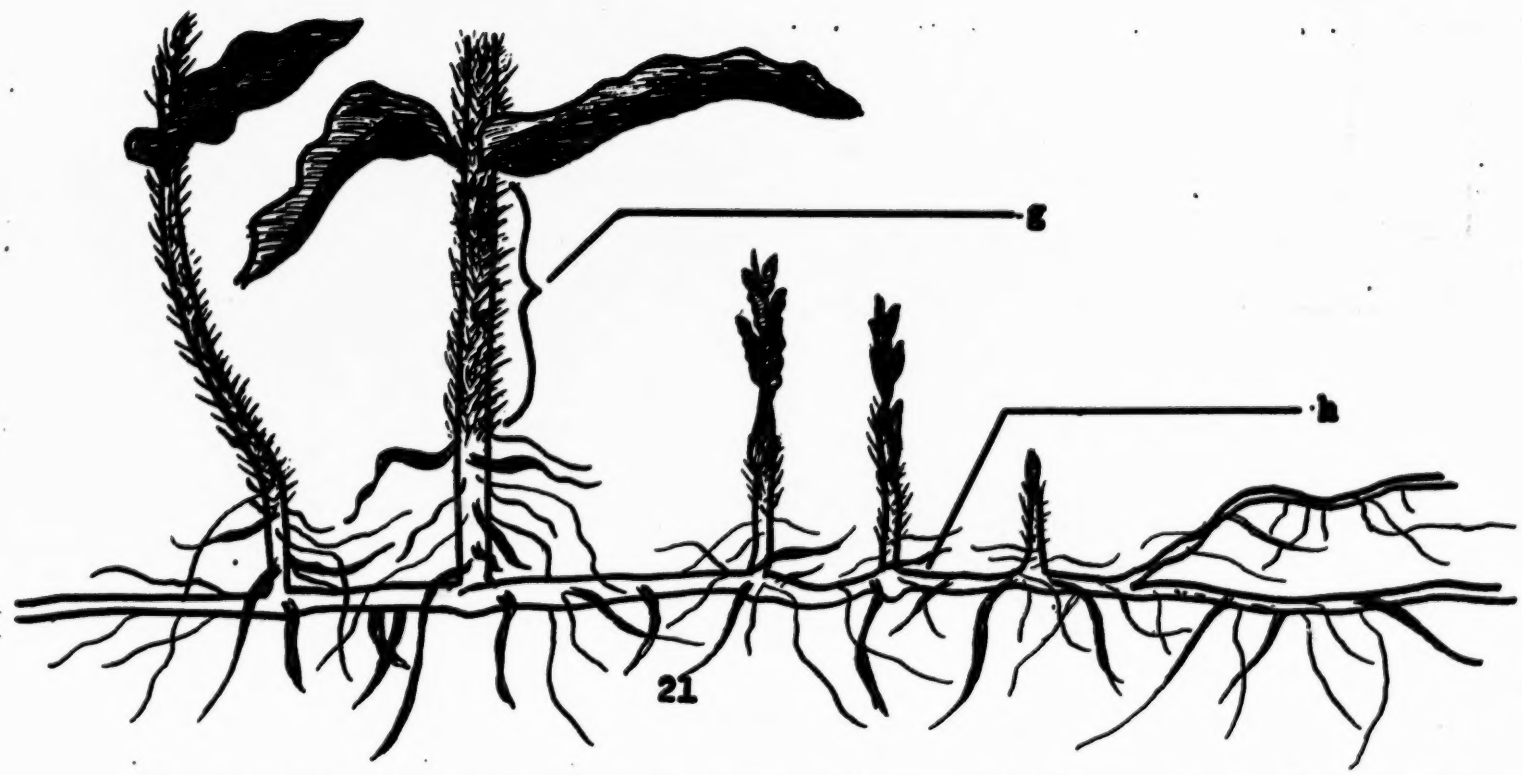
18. _____

19. _____

Some other plant characteristics are shown in sketches 20 and 21. Write the name of the characteristic in the blank provided.



20



21

Plants that have the characteristic as shown in sketch 20 are:

_____

_____

Plants that have the characteristic as shown in sketch 21 g are:

_____

_____

Plants that have the characteristic as shown in sketch 21 h are:

_____

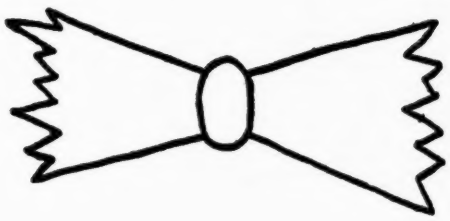
_____

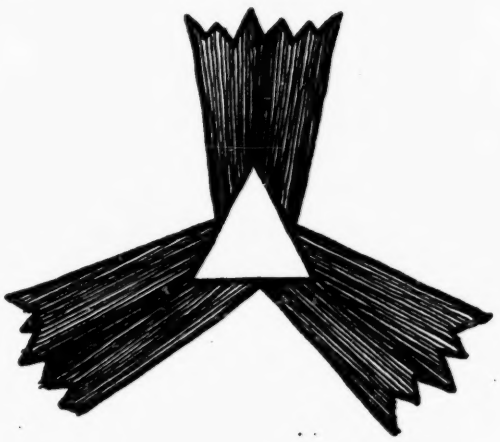
Some of the general characteristics of the Monocot plants are:

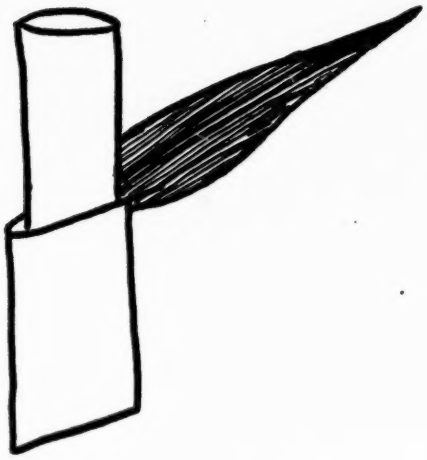
i. _____

_____

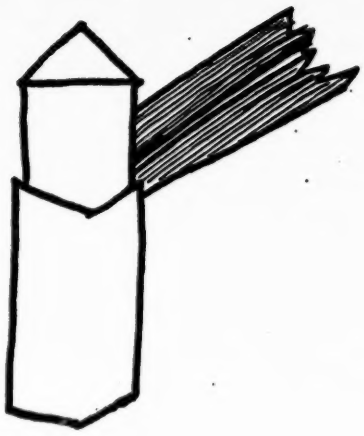
The sketches below describe three types of Monocot plants, in the blanks provided write the name of each type.



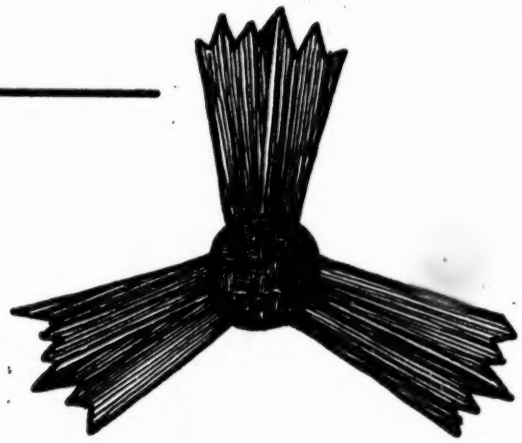


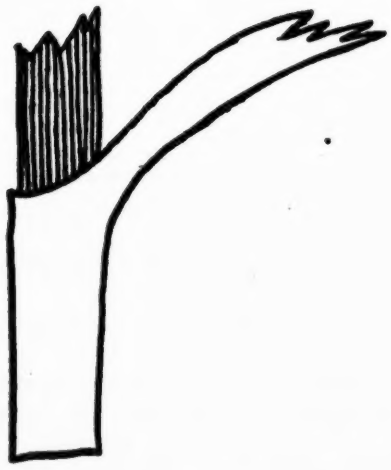


22 _____



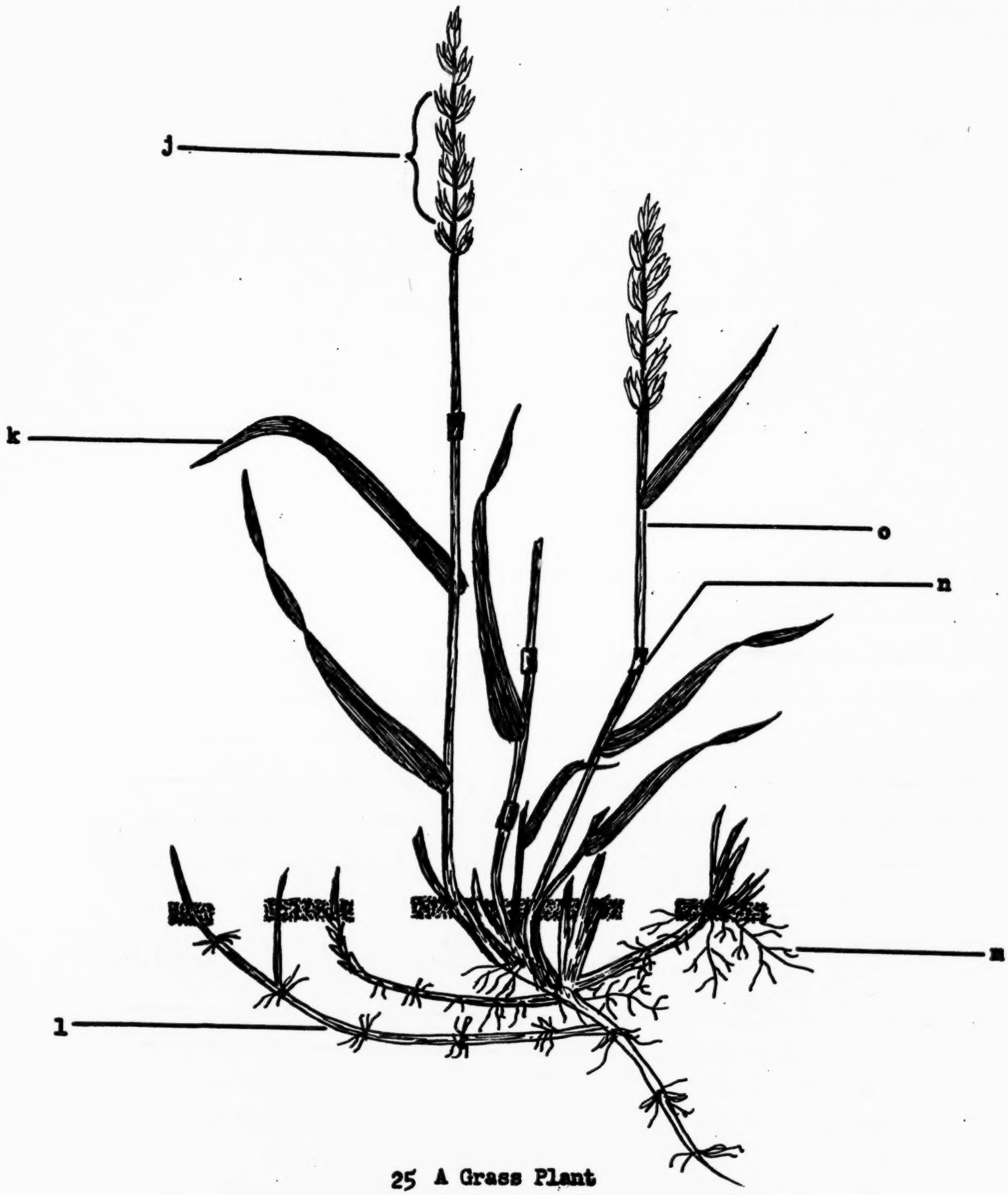
23 _____





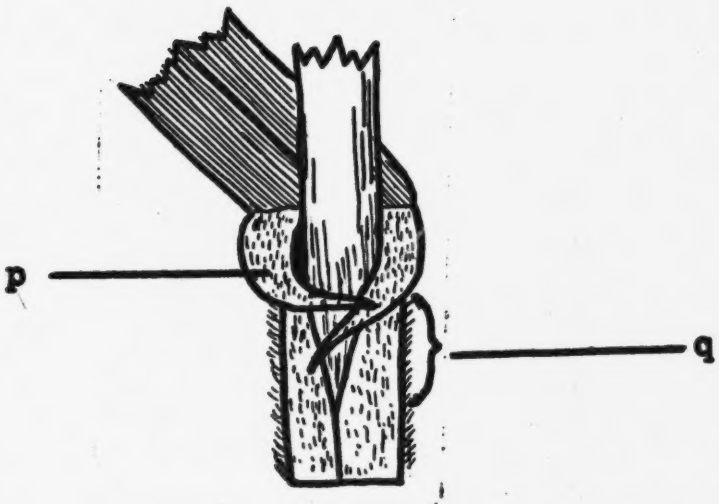
24 _____

In the sketch below is shown a grass plant, in the blank spaces provided write in the names of the plant parts.

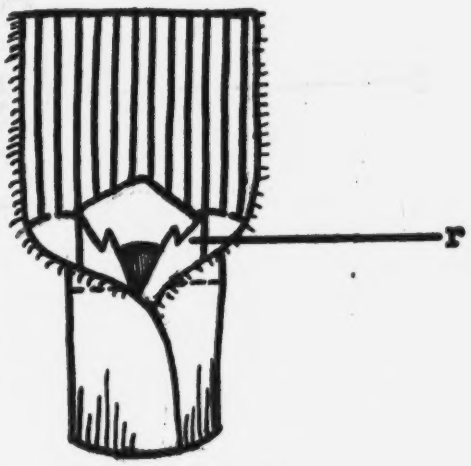


25 A Grass Plant

Sketches 26 and 27 show some characteristics of grass plants that will be helpful in identification. Write the name of the characteristic in the blank provided.



26



27

Grass plants that have the characteristic as shown in sketch 25 l are:

_____

_____

Grass plants that have the characteristic as shown in sketch 26 p are:

_____

_____

Grass plants that have the characteristic as shown in sketch 26 q are:

_____

_____

The characteristic as shown in sketch 27 r is helpful in identifying the following grass plants: (list plants that have this characteristic)

_____

_____

***** KEY*****

FUNDAMENTALS OF PLANT IDENTIFICATION-a student study guide

Page 1

a.	broad leaves, net veined leaves	1.	simple
b.	petiole	2.	trifoliate
c.	stipules	3.	pinnately compound
d.	leaflet		
e.	tendrils		

Page 2

4.	sessile	1.	many plants have simple leaves not necessary for students to list them all, but to list plants with leaf types in 2 and 3.
5.	perfoliate	2.	All of the clovers; alfalfa, lespedeza, soybeans
6.	whorl	3.	hairy vetch, wild carrot, birdsfoot trefoil (with 1 pair of leaflets at the base of the petiole).
7.	digitate	4.	sessile (without petiole) blackeyed Susan, peppergrass.
		5.	perfoliate (joined at the base) corn cockle.
		6.	whorl (not common) based leaves on chicory.
		7.	digitate - not common

Page 3

8.	saggitate (arrow shaped)	8.	hedge bindweed
9.	lanceolate (lance shaped)	9.	curled dock (also crimpled leaf edges)
10.	cordate (heart-shaped)	10.	buckwheat, wild buckwheat, velvet weed, annual morning glory.
11.	ovate (egg-shaped)	11.	common plantain, rough pigweed, leaflets of red, white and alsike clover, and soybean leaflets.
12.	spatulate (spoon shaped)	12.	leaflets of sweet clover, alfalfa, birds-foot trefoil and lespedeza, jurslane
13.	liastate (arrow shaped, with protruding basal lobes)	13.	field bindweed, sheepsorrel.

14.	entire	14.	leaflets of red clover, birdsfoot trefoil lespedeza and soybenas; buckwheat, sheep sorrel, wild buckwheat, smart weed, milk weed, purslave, field birds-weed, annual morning glory, common and buckhorn plantain.
15.	serrate (saw-toothed)	15.	leaflets of alfalfa (tips only), sweet and alsipe clover; giant ragweed, fleabane lamb's quarters, wild mustard, peppergrass.
16.	dentate	16.	winter cress, rough pigweed, chicory (some).
17.	pinnately lobed	17.	small ragweed, Canada thistle, chicory (some), horse nettle, jimson weed, wild mustard, winter cress.
18.	scallop - (not shown in slide series)	18.	velvet weed, ground ivy.
19.	palmately lobed	19.	giant ragweed.

20f. stolen
21g. pubescence
21h rhizome

Plants with characteristics as shown in 20f - white clover, ground ivy - grass plants - crabgrass and nimble will.

Plants with characteristics as shown in 21g - red clover, hairy vetch, soybeans, giant ragweed, fleabane, blackeyed Susan, velvet weed, milkweed, ground ivy, morning glory, buckhorn, corn cockle, mustard, rough pigweed.

Plants with characteristics as shown in 21h - sheepsorrel, Canada thistle, common milkweed, field and hedge bindweed.

i grass or grass-like plants; flower parts fewer; parallel veined leaves;
22. grass
23. sedge
24. rush

j. inflorescence
k. blade
l. rhizome
m. root
n. node
o. sheath

26p auricle

26q pubescence

27r ligule

25l (grass plants with rhizomes) brome grass, Canada and Kentucky bluegrass, redtop, nimble will, Johnson grass

26p (plants with auricles) tall fescue, quack grass, ryegrass, rye wheat (pubescent auricles), barley.

26q (pubescent plants) cheat (lower blades slightly), downy brome grass, quackgrass (lower sheaths and upper surface of blades), crabgrass (one specie), yellow foxtail (base of blade), giant foxtail (upper surface of blade), redtop (slightly on upper blade surface).

27r (plants with special ligule characteristics) timothy (notched), redtop (long and slender), fox tails (fringe of hair), Kentucky bluegrass (very small, almost absent).

VT 0099
JAN 4 1967

AGRICULTURAL EDUCATION

Agricultural Cooperative Training

VOCATIONAL AGRICULTURE

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ACKNOWLEDGEMENT

This course of study is designed for the vocational agriculture student of Texas who is enrolled in a Cooperative Part-time Training Program in Agriculture.

Much of the material for this course was prepared by J. T. Wiggs, Vocational Agriculture Teacher of Wills Point, Texas, who assisted at the Teaching Materials Center for a four-week period during the summer of 1966.

Members of the staff of the Teaching Materials Center contributed also to the preparation of the course of study.

Several sections of the materials are based upon work produced at the Center for Research and Leadership Development in Vocational and Technical Education at The Ohio State University, Columbus, Ohio.

John Holcomb, Coordinator
Teaching Materials Center

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TO: The ERIC Clearinghouse on Vocational and Technical Education
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(Address) Texas A&M University, College Station, Texas 77843

DATE: June 28, 1967

RE: (Author, Title, Publisher, Date) J.T. Wiggs, Vocational Agriculture Teacher, Wills Point, Texas; Members of the Teaching Materials Center

Title: Fertilizer Sales and Serviceman

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Assignment Sheet
for
AGRICULTURAL SALES AND SERVICE

UNIT: Agricultural Salesmanship

TOPIC: Introduction, Agricultural Salesmanship

OBJECTIVE: To develop an understanding of the importance of salesmanship in agricultural business.

REFERENCES: Required:

1. Information Sheet, "Agricultural Salesmanship"

Supplemental:

2. Feed and Farm Supplies, The University of Texas, Division of Extension, Distributive Education Division, Austin, Texas

3. Salesmanship Fundamentals, Ernest and Davall, 2nd edition, McGraw-Hill Book Co., New York, N. Y.

4. Let's Analyze and Sell, The University of Texas, Division of Extension, Distributive Education Division, Austin, Texas

QUESTIONS or ACTIVITIES:

1. Name and give an example from your experience of three reasons customers fail to buy.

2. What are the main differences between need and desire for a product?

3. What six things must the agricultural salesman know to be successful?

4. Give five principal advantages of agricultural sales as a career.

5. What is one of the best forms of advertising?

6. Who benefits from efficient selling?

UNIT: Agricultural Salesmanship
TOPIC: Introduction, Agricultural Salesmanship
(Assignment Sheet continued)

7. Good selling does two things connected with human wants. What are the two?

8. What five basic decisions are made by a customer before purchasing an item?

9. What product should be sold to a customer?

10. Give two things that help to make permanent customers.

11. Give a good short definition of "selling".

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Information Sheet
on
AGRICULTURAL SALESMANSHIP

Selling is the key function of all business activity. This is as true in agriculture as in other areas. Selling is the act of assisting and persuading individuals or groups to make a buying decision which is to the mutual advantage of both the buyer and the seller.

Selling is really explaining to, persuading, and reminding the public of a particular business concern and of the opportunities and values to be gained from doing business with this concern.

The retailer's function is that of selling goods and services to the ultimate consumer. This is the final step in the distribution of agricultural goods and services.

Efficient salesmen realize that customers are lost because of:

1. Poor service rendered
2. Discourteous treatment received
3. Indifferent attitude exhibited on the part of the salesman

The salesman must know the psychology of selling if he is to become a successful salesman. In other words, he knows that a customer buys primarily because of need and desire. These are influenced by reason, by emotion, or by a combination of these. A person may need something, but does not buy until he desires it, i. e., he feels the need.

In summary, to be successful, the agricultural salesman must know the selling process, the merchandise itself, and the firm, as well as understand himself, his relations to the customer, and the customer.

Here is an opportunity for a salesman to (a) deal directly with the public, (b) help other people make decisions, (c) face something new everyday, (d) know that his worth is quickly recognized in terms of advancement, and (e) enjoy the prestige of big business. This big business if made up of over 1,700,000 retail stores where Americans spend 70 percent of the family income each year.

Agricultural Salesmanship
(Information Sheet continued)

Good selling does not happen incidentally, but is the result of sound training.

Successful selling produces a satisfied customer who in turn becomes the best form of advertising.

The good salesman must realize that everyone benefits from efficient selling. High sales volume not only insures the salesman's position, but also lowers the price of products or services to the customer.

Good selling awakens and satisfies human wants. Selling is a challenge and every customer is an opportunity for a salesman to get positive reaction from the customer on five basic buying decisions, namely; the need, the thing, the source, the price, and the time. Selling is helping the customer to buy intelligently.

The customer will gain the most personal satisfaction from his purchase if the salesman makes sure that the product will best fit the customer's need. When the salesman demonstrates courtesy and a sincere interest to be of service, the result is a permanent customer.

*****

Material for this Information Sheet was taken from Module 4, Agricultural Supply, Sales and Service Occupations, The Center for Research and Leadership Development in Vocational and Technical Education, Columbus, Ohio.

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Assignment Sheet
for
AGRICULTURAL SALES AND SERVICE

UNIT: Agricultural Salesmanship

TOPIC: Meeting the Customer

OBJECTIVE: To develop an understanding of the importance and techniques in making a good impression with customers.

REFERENCES: Required:

1. Information Sheet, "Meeting the Customer"

Supplemental:

2. Let's Analyze and Sell, The University of Texas, Division of Extension, Distributive Education Division, Austin, Texas.

3. Feed and Farm Supplies, The University of Texas, Division of Extension, Distributive Education Division, Austin, Texas.

QUESTIONS or ACTIVITIES:

1. Why is the first contact with a customer very important?

2. Why should a salesman be well-groomed?

3. Why should a salesman like his work?

4. Give three "earmarks" of good salesmanship.

5. Give a short description of the proper way to treat a customer.

6. Select one of your classmates that you know well and fill out the "information needed about a customer" given in part 1-a of the information sheet you are using.

7. How could you secure the information you gave in question 6 if you did not know the person well, and if he were an adult?

UNIT: Agricultural Salesmanship
TOPIC: Meeting the Customer
(Assignment Sheet continued)

8. Pick a store (not the one in which you work) in which you purchased something recently and give your impressions about these characteristics of the store:
   a. Was the store neat and attractive? What made it appear that way?
   b. Was the store well-lighted?
   c. Did the equipment (not the merchandise) look good to you? Why or why not?
   d. Was the merchandise arranged in a manner you understood, or was it confusing to you? Why?
   e. Did the person who "waited upon you" have a pleasing appearance? Briefly describe him as he appeared that day.

9. Pick an item from the store in which you work or plan to work and give from memory these characteristics of the product:
   a. Why is it designed as it is?
   b. The trade name
   c. How it is constructed or manufactured
   d. Its special features
   e. In what other forms it is available
   f. What help the store can give if something "goes wrong" with the product

10. Now pick an item your family purchased recently from another store and give the same information as you gave in No. 9 from memory about it.

11. List the preparation a salesman needs to make before he is ready to make a sale.

12. What may cause a salesman to fail to be prompt in greeting a customer?

13. How does the salesman find out about a customer's problem?

14. Give three examples of proper methods of greeting a customer.

15. Give the elements of a good salutation to a customer.

16. Name 11 physical and physiological factors that cause a customer to want to buy a product.

17. Give eight good attitudes for salesmen.

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Information Sheet
on
MEETING THE CUSTOMER

The impression of the agricultural business that the customer carries away often results from his first contact with the salesman. Appearance and actions play an important part in forming this impression.

A well-groomed salesman attracts customers and inspries their confidence. Undivided attention on the job is essential to good salesmanship.

A good approach presupposes a proper attitude toward the job. Love for one's work is expressed in the enthusiasm with which it is carried out. Enthusiasm is shown through words, actions, and expression.

Salesmanship is demonstrated through promptness, alertness, and interest in the customer and his problems.

Treat the customer like a guest. This means that good manners and courtesy are practiced at all times; that the house is in order, neat and clean; that the merchandise is conveniently located; and that the salesman is trained in the fundamentals of selling to maximize the opportunity of being of service to customers.

Points to be considered when meeting the customer:

1. The preapproach Preparation

   a. Information needed about the customer

      (1) Name - Address
      (2) Personal characteristics
      (3) Mental make-up
      (4) Hobbies and interests
      (5) Common interests
      (6) Buying habits or policies

   b. Sources of this information

      (1) Participation in community activities and events
      (2) Chamber of Commerce information
      (3) Comments made by other members of civic clubs

Meeting the Customer
(Information Sheet continued)

(4) A personal notebook on customers
(5) Past sale records, credit department records
(6) Interview with people in the community
(7) Local newspaper

c. Check of facilities and surroundings

(1) General appearance of the store
(2) Lighting
(3) Equipment
(4) Merchandise arrangement
(5) Personnel

d. Knowledge of benefits the customer will receive from merchandise sold

(1) Design or appearance
(2) Quality of the source - trade name
(3) Composition and construction
(4) Special features
(5) Assortment of sizes, colors, and styles available
(6) Service available

e. Preparation by the salesman

(1) Neatness of appearance
(2) Preparation of an appealing display arrangement
(3) Knowledge of contents of the merchandise in stock
(4) Knowledge of the contents of newspaper advertising being circulated
(5) Knowledge of names, background, and interests of customers
(6) Knowledge of the competitors product
(7) Preparation of a few selling sentences
(8) Preparation of a record of common customer objections and development of methods of meeting them

2. Timingthe Approach

a. Importance of the impression created by the salesman's appearance and actions

b. Suggestions for:

(1) Promptness - clues for failure in being prompt:

Meeting the Customer
(Information Sheet continued)

(a) Involved group conversations of salesmen
(b) Stock duties
(c) Timidity in approaching customers
(d) Indifference to the needs of the customers

(2) Alertness - based on accurate and careful observation; look for clues on:
(a) How and when to greet the customer
(b) When to present the merchandise
(c) How to talk about merchandise

(3) Interest in customer's problem
(a) Take all the time necessary to understand his problem
(b) Probe to determine if problem is what customer first says that it is
(c) Determine the procedure to be followed to assist the customer with his problem

3. The Proper Approach - Greeting the Customer

a. Type of salutations

(1) Conventional
(2) Question
(3) Stating a fact about the merchandise

b. Elements of a salutation

(1) Courteous
(2) Short
(3) Requires no decision
(4) Affirmative
(5) Emphasizes the desire to serve

c. Tone of voice - pleasant, enthusiastic, distinct, articulate, ordinary

d. Facial expressions

(1) A pleasant smile
(2) Cheerful expression

Meeting the Customer
(Information Sheet continued)

Different physical and psychological factors, operating alone or together, motivate a customer to buy a product. Among them are comfort, pleasure, appetite, possession, fear, devotion, curiosity, ornamentation, imitation, construction, and loyalty.

Developing the proper attitudes necessary for success in meeting a customer is important if the student is to develop effective sales abilities. Among them are:

1. Developing professional feeling toward selling
2. Constant courtesy
3. Enthusiasm for selling
4. Interest in customer and his problems
5. Willingness to develop self-confidence
6. Developing sincere attitude of service
7. Developing integrity
8. Appreciating proper psychology such as gaining the customer's attention and interest, creating a desire, and ending with deaction on the part of the customer

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Assignment Sheet
for
AGRICULTURAL SALES AND SERVICE

UNIT: Agricultural Salesmanship

TOPIC: Presenting Supplies and Services to Customers

OBJECTIVE: To develop an understanding of the steps necessary to a successful sale.

REFERENCES: Required:

1. Information Sheet, "Presenting Supplies and Services to Customers"

Supplemental:

2. Let's Analyze and Sell, Division of Extension, The University of Texas, Austin, Texas

QUESTIONS or ACTIVITIES:

1. Give the four steps in a sale.
2. How does step 1 differ from step 2?
3. What brings about step 3?
4. What are some examples of motivating factors for farmers?
5. Name 4 ways attention is directed to a supply or service.
6. Tell how a potential customer may move from attention to interest to desire.
7. To conclude the sale, what does the salesman need to be able to do to secure action?

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Information Sheet
on
PRESENTING SUPPLIES AND SERVICES TO CUSTOMERS

Successful selling requires a careful presentation by the seller. A salesman must recognize the importance of each of the psychological steps in a sale. He must gain the attention, develop interest, kindle desire, and induce action on the part of the customer.

Attracting attention is one thing; developing interest is quite another thing. Attention is more or less involuntary. Almost anything can attract attention; interest is the result of voluntary reaction on the part of the customer. Interest comes only when attention is prolonged voluntarily and is accomplished by concentration.

Next, one must combine the merits of the article with the needs or wants of the customer to kindle desire. Then, by demonstrating a complete understanding of the interest, needs, desires, and motivating factors that cause a customer to buy, the salesman will be able to make a successful sale. Sales are made by showing the farmer how to increase yields, make more profit, or reduce the labor required, etc.

The attention of customers to a supply or service may be secured in many ways.

Reading an advertisement about a beef concentrate
Seeing a new herbicide on a TV commercial
Talking to a neighbor about his new 5-plow tractor
Mailing a circular on early fertilizer purchase discount
Meeting a new petroleum delivery truck on the road
Hearing from a friend about the good service on baler repairs
Reading in the newspaper about a new bulb shipment received at the garden center
Viewing an attractive display of seed at the supply center

Developing interest in a product can be initiated by the customer, the salesman, or serviceman.

Customers can move from the attention, interest, and desire steps very rapidly at times with little or no encouragement. Example - the customer sees a new field sprayer just the size and kind for which he has a preference--the desire is developed. Often, however, the customer's interest in a product needs to be kindled. This can be done by:

Presenting Supplies and Services to Customers
(Information Sheet continued)

Talking to him about the new features on this planter
Inviting him to a field day where the effectiveness of newly developed herbicides will be shown
Showing him the results of this product in test trials
Demonstrating how simple it is to mount this new corn picker
Pointing out to the customer the number of people in the community who are already using this feed, lawn seed, or grease

Desire for a product may be obtained by relating it to a need of the customer,

Explain how this feed will increase net income by improving an animal's rate of gain.
Show him, with proof from variety trials, how the new oat variety will stand, thereby reducing all those combining problems.
Show him that the chemical weed spray will reduce cultivation, allowing time to get the hay harvested, go fishing, etc.
Sell the merits of the tractor seat, not its cost.
Provide appointments for the customer to try the product on a trial basis.

To be able to present items effectively, you will need to:

Know the features of the item
Be able to answer all questions about the item
Demonstrate its use, operation, value, and advantages

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Assignment Sheet
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AGRICULTURAL SALES AND SERVICE

UNIT: Agricultural Salesmanship

TOPIC: Overcoming Customer Resistance

OBJECTIVE: To develop an understanding of the reasons for customer resistance and effective methods of overcoming them.

REFERENCES: Required:

1. Information Sheet, "Overcoming Customer Resistance"

Supplemental:

2. Let's Analyze and Sell, Division of Extension, The University of Texas, Austin, Texas

3. Feed and Farm Supplies, Division of Extension, The University of Texas, Austin, Texas

QUESTIONS or ACTIVITIES:

1. Give the "two sides" to every sale.

2. The customer must be convinced that the salesman's product is his best choice, based upon one or more of three factors. What are the three?

3. Give statements that will help overcome customer objection for a product:
   a. Need:
   b. Quality:
   c. Source:
   d. Price:
   e. Time:
   f. Thing

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Information Sheet
for
OVERCOMING CUSTOMER RESISTANCE

It is natural for people to have sales resistance. Most of them did not come by the money in their possession easily. It is perfectly natural for people to want to get all that they can for the money spent.

Each sale has two sides. The customer must sacrifice something in order to get something else. Since one cannot have everything, each sale means a choice between one product and another product or one product and another form of pleasure.

The customer must decide which of the choices will give the most satisfaction or pleasure.

It is the salesman's job to convince the customer that his product or service will provide this pleasure, satisfaction, or need. If this cannot honestly be done, perhaps he should not make the sale at all. Anything else is high pressure selling that is unethical and cannot be classified as salesmanship. It will invariably lead to ill will and dissatisfaction.

There are several reasons why customers are resistant to purchasing. The first objection is rarely the actual objection. Identify the real reason for such resistance and try to explain away the objection. To do this you are going to need to be well informed on the supply or service. Types of objections are:

1. Need - Objections to <u>need</u> are overcome by stressing the usefulness and benefits of the product.

2. Quality - Objections to <u>quality</u> are overcome by:

   a. Showing a better quality

   b. Pointing out a specific feature

3. Source - Objections to the <u>source</u> are met by:

   a. Providing names and experiences of satisfied customers

   b. Providing information about the company or by reference to national advertising

Overcoming Customer Resistance
(Information Sheet continued)

c. Courteously straightening out misunderstandings

d. Asking for a fair trial of this new firm or by offering something another firm does not carry

e. Others correcting the shortcomings of the salesman if he is at fault.

4. Price - Objections to price are overcome by:

a. Revealing hidden values - building up values

b. Emphasizing the quality or usefulness

c. Providing an article that is not as expensive and doesn't have as many selling points

d. Knowing competitors product so that any question or different values can be explained

5. Time - Objections to time are overcome by:

a. Making a future appointment

b. Inviting the customer to look at additional merchandise

c. Continuing to show a positive interest in the customer whether the salesman is busy or not

d. Trying to handle objections promptly as they arise

e. Not trying to close a sale until all bonafide objections have been satisfied. Make feelers during the sales presentation to preclude objections to a reasonable closing of the sale because of the time.

6. Thing - Objections to the thing are overcome by:

a. Showing more suitable goods

b. Admitting the validity of objection but showing another feature to offset the objection

Overcoming Customer Resistance
(Information Sheet continued)

c. Admitting that the objection is reasonable but showing that it does not really apply

d. Changing the objection into a selling point in favor of the article

e. Avoiding:

Generalizations which mean nothing
Contradiction of a customer's statement
Display of a negative or discouraging attitude

Again, do not pressure customers to purchase; they are not likely to return if pressured.

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Assignment Sheet
for
AGRICULTURAL SALES AND SERVICE

UNIT: Agricultural Salesmanship

TOPIC: Closing the Sale

OBJECTIVES: To develop the ability to secure the final step in the selling process;that of closing the sale.

REFERENCES: Required:

1. Information Sheet, 920-I-5.

Supplemental:

2. Feed and Farm Supplies

3. Let's Analyze and Sell

QUESTIONS or ACTIVITIES:

1. When is closing a sale easy and almost automatic?

2. What must be the attitude of the salesman toward his function in closing a sale?

3. When is the salesman justified in making concrete suggestions during the "closing" process?

4. When is the right time to close a sale?

5. What conditions precede sale closing?

6. What is the "choice method" in beginning to close a sale?

7. Give seven errors that often lead to failure to buy.

8. Give four good general points for recording sales.

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Information Sheet
on
AGRICULTURAL SALES AND SERVICE

Obviously, closing the sale is the most important of all the steps in the selling process. Everything that has been done so far comes to naught, if the customer leaves without making a purchase. Closing starts at the beginning of the sales presentation and "trial" closes are appropriate as it proceeds.

Customers resent being hurried into making a purchase. The salesman must take an active part in inducing a favorable action on the part of the customer, but his attitude must be one of helping the customer in making a wise decision.

Sales are lost because the salesman fails to tailor the sales presentation to the individual needs and requirements of the customer.

A salesman is performing a useful service by offering suggestions to customers who are not aware of their needs or to customers who rely upon displays to remind them of what they came to purchase.

Anybody can sell a customer something he wants. It takes a salesman to sell the customer needed items of which he was unaware.

Closing the sale will be more or less automatic if the need for the article has been definitely established. One of the salesman's functions is to help the customer decide by making "trial" closures.

Don't trip on the last step. The time to close the sale is just after the customer has decided to buy.

Indications that the customer is making up his mind occur when the customer asks the salesman to repeat the advantages of each item and when he wants unwanted goods removed. This is when the salesman should repeat the advantages of the item in which the greatest interest was shown by the potential customer.

The decision to buy occurs after the following conditions have been met:

1. The customer has exhibited attention, interest, and desire in the product.

Agricultural Sales and Service
(Information Sheet continued)

2. A relationship between need and the merchandise has been established.

3. All important objections have been overcome.

4. The price is low in comparison with value.

5. The product meets the customer's approval.

6. The customer has the power to make the purchase.

The above decision is reached by taking steps during the presentation to make buying "action" easy. Such steps include leading the customer to make a number of small favorable decisions himself, making these decisions progressively more forceful, seeking agreement more frequently as the presentation progresses, and narrowing the selection. This is done by concentrating upon items in which the customer is interested, by removing merchandise in which the customer is not interested, by repeating demonstrations in more detail, and by soliciting the opinion of others. Always ask for the order. Use the "choice" method in beginning the closing phase, i.e., 2 or 3 dozen.

Failure to close the sale may be due to:

1. Assuming that the customer is not going to buy

2. Hurrying the customer

3. Failing to help the customer decide

4. Stumbling over sales obstacles

5. Stressing the wrong selling points

6. Trying to force action

7. Being discourteous at any point in the process

When engaged in suggestion selling, the salesman must:

1. Make definite suggestions to the potential customer.

2. Give an acceptable justification for the suggestion made.

3. Demonstrate the merchandise thoroughly and unhurriedly.

Agricultural Sales and Service
(Information Sheet continued)

4. Not overwhelm the customer with more facts, decisions, etc., then he can face comfortably

Sales are often increased by displaying related merchandise, handling larger quantities, comparing with higher priced merchandise, introducing new merchandise, developing "special" sales, demonstrating new uses for merchandise, and specializing in merchandise for special occasions.

When recording the sale, the salesman, in preparing the sales check, should:

1. Write legibly.

2. Be accurate with items, amounts, and price.

3. List the complete name and address if needed for files or for delivery.

4. Write down any special directions needed to help the customer.

When operating a cash register, make change accurately. Never put a bill away until the customer is satisfied that he has received the correct change. Use the right compartment for paper money and change. Also, learn to count out change properly.

Just because the register bangs shut does not mean that the sale is completed. A proper, courteous farewell often means repeat visits by the customer.

Give the customer a friendly farewell whether or not he makes a purchase and invite him back soon.

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Assignment Sheet
for
AGRICULTURAL SALES AND SERVICE

UNIT: Agricultural Salesmanship

TOPIC: Fundamentals for Successful Selling

OBJECTIVES: To summarize and reinforce the steps in successful selling.

REFERENCES: Required:

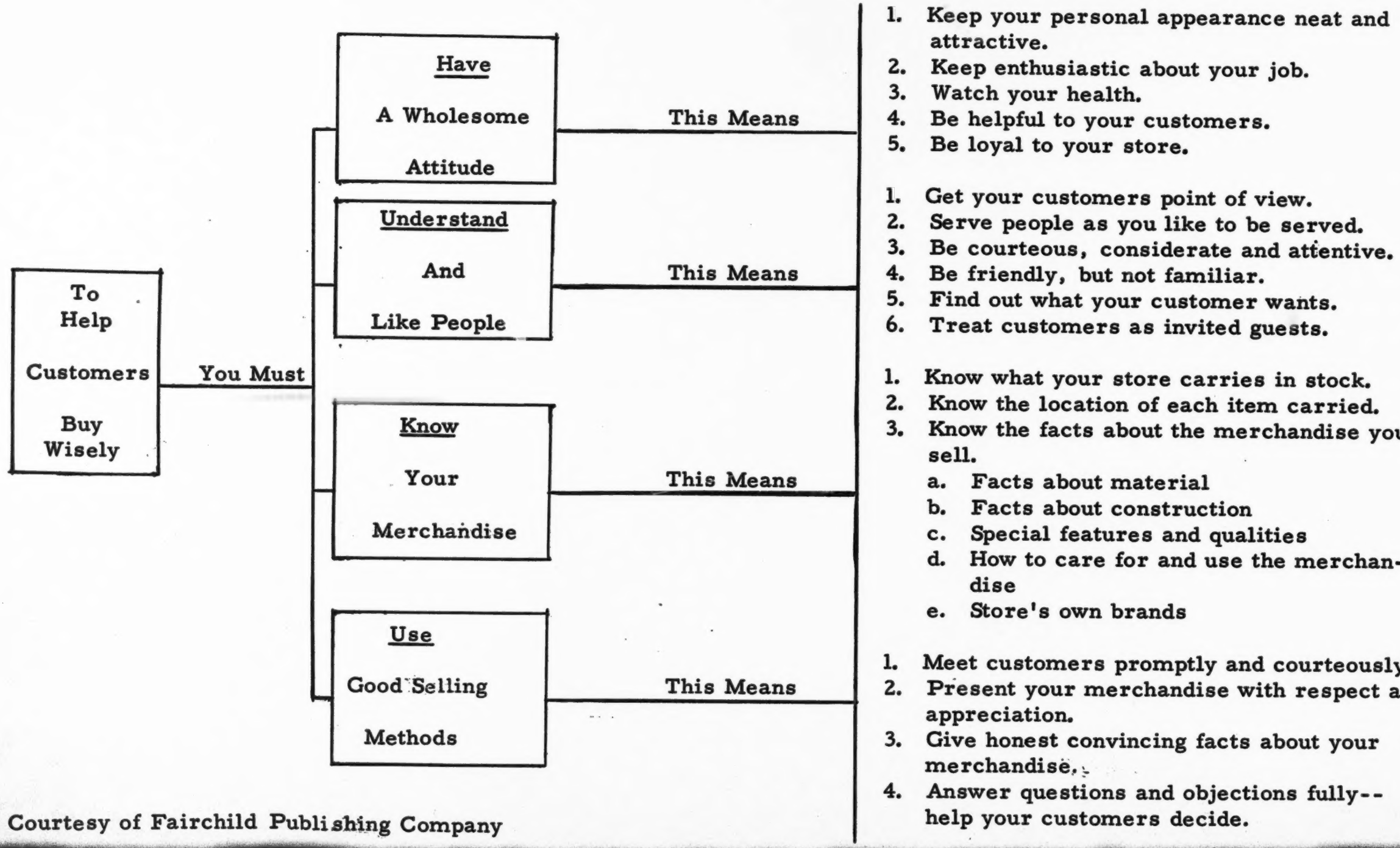
Information Sheet, 920-I-6.

QUESTIONS or ACTIVITIES:

1. If you are to be a successful salesman,
   a. What must you have?
   b. What must you understand?
   c. What must you know?
   d. What must you use?
2. Select the three items at the right of the page in which you feel you are strongest. Write a short paragraph on each explaining your strengths.
3. Select three items at the right of the assignment sheet in which you feel you need improvement. Write a paragraph on each, including how you think you can improve.

Information Sheet
for
AGRICULTURAL SALES AND SERVICE

Fundamentals for Successful Selling



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Assignment Sheet
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AGRICULTURAL SALES AND SERVICE

UNIT: Agricultural Salesmanship

TOPIC: Evaluating Salesmen

OBJECTIVES: To develop an understanding of the methods employed in eveluating sales personnel and to encourage self-evaluation.

REFERENCES: Required:

Information Sheet, 920-I-7

QUESTIONS or ACTIVITIES: In the information sheet accompanying this topic are four check sheets.

Your assignment is to fill out each check sheet, making two marks in each item.

The first mark, a small "x", is your evaluation of a salesman from whom you recently made a purchase. If you wish, use a different salesman for each sheet.

The second mark, a small "o", is your own performance in the place in which you work. Use any customer contact during the past two weeks, and use a different one for each sheet, if you wish, but make an honest appraisal of your performance.

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Information Sheet
on
AGRICULTURAL SALES AND SERVICE

Check Sheet -- Customer Approach

	Did so effectively	Did so partially	Did not	Could have
1. APPROACHED CUSTOMER PROMPTLY				
a. Was on the lookout for customers				
b. Stopped what he was doing				
c. Approached the customer mentally and physically				
2. WELCOMED THE CUSTOMER				
a. Smiled				
b. Used appropriate approach				
c. Treated the customer as a guest				
3. HELPED TO START CONVERSATION				
a. Adapted himself to situation				
b. Made comment about merchandise				
c. Anticipated customer's interest				

COMMENTS:

Agricultural Sales and Service
(Information Sheet continued)

Check Sheet -- Holding Customer's Interest

	Did so effectively	Did so partially	Did not	Could have
1. STUDIED THE CUSTOMER				
a. Did not jump at conclusions concerning customer's interest				
b. Sized up what would interest customer				
c. Made positive statements to reveal customer's interest				
d. Determined customer's buying motive				
e. Stimulated customer's want or desire for the merchandise				
2. DISPLAYED MERCHANDISE EFFECTIVELY				
a. Made merchandise stand out				
b. Handled merchandise appreciatively				
c. Appealed to customer's senses				
d. Showed merchandise in good light, at eye level, on all sides				
3. STRESSED CUSTOMER BENEFITS				
a. Showed customer how he would gain				
b. Showed customer how he would be served				
c. Showed customer benefits of owning				
d. Stressed to customer how merchandise would meet his problems				
e. Gave selling points convincingly				
4. USED DEMONSTRATION				
a. Encouraged customer to handle merchandise				
b. Interpreted value of merchandise in terms of dollars invested				
c. Dramatized features of merchandise				
d. Used showmanship advantageously				
e. Secured customer's participation				

Agricultural Sales and Service
(Information Sheet continued)

Check Sheet -- Meeting Objections

	EXCELLENT	GOOD	AVERAGE	FAIR
1. Allowed customer to state objections Let customer object fully Did not interrupt Understood customer Removed one objection at a time Did not argue				
2. Was prepared to meet objections Did not hesitate Had right complete answers Concentrated on what was coming next Retained control of situation Discovered real, underlying objection				
3. Anticipated Objections Welcomed customer objections Created customer confidence Convinced customer he needed merchandise Convinced customer he could afford merchandise Convinced customer his selection was wise				
4. Turned objections into selling points Used customer's own objections to heighten interest Clarified objections Translated objections into reasons Used objections to clinch a sale Used objections to establish customer confidence				

COMMENTS:

Agricultural Sales and Service
(Information Sheet continued)

Check Sheet -- Closing the Sale

	Did so effectively	Did so partially	Did not	Could have
1. NARROWED THE CHOICE				
a. Listened to customer's comments				
b. Compared items				
c. Eliminated rejected items				
d. Removed unwanted items				
e. Used testimonials				
2. ESTABLISHED A CHOICE				
a. Asked for customer agreement				
b. Used power of words as which, let's, etc.				
c. Suggested or assumed a decision				
d. Presented favorable alternatives				
e. Used terms or special services as an inducement				
3. KNEW WHEN CUSTOMER WAS READY TO BUY				
a. By facial expressions				
b. By positive interested actions				
c. By indirect agreement				
d. By weak objections				
e. By customer's question				
4. ASKED FOR ACTION				
a. Concentrated on item being sold				
b. Restated either part or all of the selling points				
c. Stressed benefits				
d. Asked a direct statement to secure action				
e. Asked for the sale				

Material for this Information Sheet was taken from Let's Analyze and Sell.

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Assignment Sheet
for
AGRICULTURAL SALES AND SERVICE

UNIT: Business Procedures

TOPIC: Importance of Accurate Records

OBJECTIVE: To develop an understanding of the necessity for accurate business records

REFERENCES: Required:

1 Information Sheet , 920-III-1

Supplemental:

2 Merchandising Products Used in the Farm Business, Ohio State University, Columbus, Ohio 43210

QUESTIONS or ACTIVITIES:

1. a. Give five reasons why management must have records.
   b. Which of the five is most important? Why?

2. What does an "operating statement" show?

3. How does a "balance sheet" differ from an "operating statement"?

4. Where does management get the "figure" for the operating statement and balance sheet?

5. Why are cash registers balanced daily?

6. Why are "merchandise purchases" not the total cost of the merchandise sold?

7. What are two good reasons for having periodic records of "stocks and inventories"?

8. If the firm in the "statement of operations" had received $1000 less during this year for storage and handling (with all entries being the same), what would have been the gross margin?

UNIT: Business Procedures
TOPIC: Importance of Accurate Records
(Assignment Sheet continued)

9. Where, in the "statement of operations" do you think these items are included?
   a. Wages paid a Co-Op Vocational Agriculture student?
   b. The electricity bills?
   c. A radio "commercial" for the firm?
   d. The sacks for small items of merchandise?
   e. The decrease in value of a delivery pick-up?

10. In the "sample balance sheet" why is there no entry under "accumulated depreciation" for land?

11. If on December 30, 1965, this firm had paid an additional $5000 of its "accounts payable", how would these four numbers have been changed?
   a. Cash on hand and in bank?
   b. Total assets?
   c. Accounts payable?
   d. Total liabilities?

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Information Sheet
on
IMPORTANCE OF ACCURATE RECORDS

Most people are familiar with the sales ticket and some of the other ordinary papers used in conducting business. These papers and procedures are so important in helping to make an operation successful that they need considerable attention.

To understand the importance of these items, an overview of the entire records of a business is necessary. Management of a business, to be successful, needs records of the business as a whole, and of each department, in order to:

1. Know the financial picture of the business at any given time.
2. Give proper information to board of directors, stockholders, and others involved.
3. Satisfy legal requirements.
4. Plan desirable changes in management and procedures.
5. Prepare state and federal tax returns.

One record needed by management is an "operating statement." It is sometimes called a "statement of operations" or a "profit and loss statement." These are prepared either annually, bienally, quaterly, or monthly, whichever is desired. The operating statement summarizes the receipts and expenses for a given period of time and shows the profit or loss for that period. Many businesses have this statement broken down by departments in order to ascertain the profit or loss of each department.

The other standard overall record used by businesses is the "balance sheet". The balance shows the financial condition of the business at a given time, but generally on the last day of the period covered by the operating statement. The balance sheet lists the assets, liabilities, and net worth of the business. The liabilities and net worth show the methods of obtaining capital for the business. The sum of the liabilities and net worth must "balance" with the assets of the business at any given time.

The balance sheet and the operating statement make up the financial report for a business.(Note attached sample forms.)

Importance of Accurate Records
(Information Sheet continued)

The daily, weekly and monthly records all help contribute to the final make-up of the "balance sheet" and'bperating statement".

A record of "cash sales" for the period desired (day, week, month, or quarter) must be secured. In addition, the cash register must be balanced daily to be sure that all cash is accounted for and that all records are correct.

"Charge sales" must be correctly made and entered in appropriate ledgers, according to the policies of the particular business.

Records must be made of all "merchandise purchases," including the cost of transportation and other incidental expenses.

Periodic records of "stocks and inventories" must be made, both for knowing the business' financial condition, and also for determining stock needs and sales.

In addition to those items directly concerned with sales, the costs of payroll, property expense taxes, supplies, services, advertising, interest, depreciation, losses and legal costs must be paid before any profit is returned to the business.

Importance of Accurate Records
(Information Sheet continued)

SAMPLE BALANCE SHEET, DECEMBER 31, 1965
ASSETS

CURRENT ASSETS:			
Cash on hand and in bank		$ 28,173.70	
Accounts Receivable -- Patrons	$ 26,060.54		
Less: Allowance for Doubtful Accounts	2,302.20	23,758.34	
Accounts Receivable -- Grain Firms		3,787.41	
Inventories		42,016.76	
Prepaid Items		6,319.38	
Total Current Assets			$104,055.59
INVESTMENTS:			
Stock, Bonds, and Credits in Other Companies			$ 10,667.15

	Cost	Accumulated Depreciation	Net
PLANT AND EQUIPMENT:			
Land	$ 2,326.39	$.....	$ 2,326.39
Buildings	245,749.02	87,007.97	158,741.05
Machinery and Equipment	73,488.70	39,452.33	34,036.37
Furniture and Fixtures	4,538.78	3,921.09	617.69
Total	$326,102.89	$130,381.39	$195,721.50
Total Plant and Equipment -- Net			$195,721.50
TOTAL ASSETS			$310,444.24

LIABILITIES

CURRENT LIABILITIES:	
Accounts Payable -- Trade and Others	$ 15,649.42
Federal Income Tax Payable	254.64
Dividends Payable on Capital Stock	2,272.00
Patronage Refunds Payable for Year 1964	21,624.51

Importance of Accurate Records
(Information Sheet continued)

SAMPLE STATEMENT OF OPERATIONS FOR YEAR ENDED DECEMBER 31, 1965

SALES		$1,562,702.44
Less Cost of Commodities Sold		1,478,914.33
Gross Selling Margin		$ 83,788.41
OTHER REVENUE		
Grinding, Cleaning, etc.	$ 8,701.31	
Storage and Handling	10,893.03	
Dividends, Patronage Refunds, etc.	665.41	
Total		$ 20,259.75
GROSS MARGIN		$ 104,048.16
EXPENSES		
Salaries and Wages	$40,247.18	
Heat, Power and Water	4,597.79	
Plant Repairs and Maintenance	3,737.88	
Insurance	3,942.74	
Interest	31.70	
Telephone	728.43	
Taxes	7,417.40	
Advertising	1,787.00	
Depreciation	12,116.40	
All Other Expenses	3,710.15	
Total		$ 78,316.67
NET MARGIN		$ 25,731.49
DISTRIBUTION OF NET MARGIN		
Provision for Dividend on Capital Stock-- 4%	$ 2,272.00	
Patronage Refund to Stockholders-- 2 and 1 1/2%	21,680.17	
Provision for Federal Income Tax	254.64	
Balance of Net Margin Retained	1,524.68	
Total	$25,731.49	

Importance of Accurate Records
(Information Sheet continued)

Employees' Taxes Withheld	$ 554.72	
Accrued Salaries, Property and Payroll Taxes	8,522.75	
Total Current Liabilities		$ 48,878.04

STOCKHOLDERS' EQUITY:

Capital Stock Authorized, 750 shares Par Value $100.00, 641 1/2 Shares Issued Including 73 1/2 Shares of Treasury Stock Outstanding. 568 Shares	$ 56,800.00	
Additional Paid-In Capital	4,132.00	
Retained Earnings	200,634.20	
Total Stockholders' Equity		$261,566.20
TOTAL LIABILITIES AND STOCKHOLDERS' EQUITY		$310,444.24

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Assignment Sheet
for
AGRICULTURAL SALES AND SERVICE

UNIT: Business Procedures

TOPIC: Sales Tickets

OBJECTIVE: To develop an understanding of the necessity for completeness and accuracy in sales tickets and skill in their completion.

REFERENCES: Required:

Information Sheet, 920-III-2

QUESTIONS or ACTIVITIES:

1. Secure 10 sales tickets of the type or types used in the place of business in which you are employed.

   Attach the first to a sheet of paper, and letter each part of the ticket in a manner similar to the sample in Information Sheet, 920-III-2. Letter the parts in the order in which you would fill out the ticket. Then, on another sheet of paper, give the reason or the use for each part represented by a letter.

2. In making change, the salesman uses the _____ denomination of bills and coins possible.

3. A numerical file accounts for _____ sales tickets.

4. A record of the customers' business is provided by by sales tickets in the _____ file.

5. Completely make out 9 sales tickets with at least 5 items each without repeating the same item,

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Information Sheet on SALES TICKETS

The heart of the accounting system is the billing of merchandise to customers. This is necessary to provide accurate records of transactions. Many businesses have triplicate sales tickets, one for the customer and two for the office files. Sales tickets need to be numbered consectively in advance for filing and checking purposes and to avoid loss of merchandise through carelessness. Sales tickets will provide the company with the following:

1. Information necessary to make an analysis of the day's business.

   a. Amount of cash taken in. This also serves as a check on the cash that should be in the cash register at the close of the day's business.

   b. The amount of merchandise sold

   c. The amount of sales tax collected

2. Information needed for the accounts receivable ledger for the customers who charged their purchases

3. A record of each transaction for future reference. After the information contained on the sales ticket has been recorded in the proper journals, the two copies should be filed as follows:

   a. One in a numerical file. Since all sales tickets are accounted for in this file, a sales person cannot accept cash from a customer, prepare a sales ticket, give the customer his copy, destroy the office copies and keep the money.

   b. One in a client file. This will serve as a record of the customers' business.

Many factors are important in the preparation of the sales ticket:

1. In spite of the importance of sales tickets, many mistakes are made in their use. Some common mistakes are as follows:

Sales Tickets
(Information Sheet continued)

(Use examples to show how important common mistakes are to the net profit of a business, e. g. , how much more is needed in sales to make up for an order for a ton of feed not filled.)

a. The ticket cannot be read

b. Some merchandise is not billed when sold

c. Price list and discount policies are not followed

d. Mistakes in arithmetic

e. Employees do not keep all of their sales tickets.

2. Although each business will have its own procedure for completing sales tickets, the following shows one procedure to follow in making out a sales ticket correctly: (A sample sales ticket is included.)

a. Enter the correct date.

b. Write the customer's correct name and address. If a partnership, it should be noted. The name and address becomes absolutely necessary if the purchase is charged.

c. Give a complete description of each article sold. Quantity and unit should be thought of as one item (for example, 100 lbs. of fertilizer or 10 gals. of insecticide).
The description should clearly designate the type of merchandise being sold, and not merely be a commodity classification. For example, 100# calf manna, not 100# feed. (On sales tickets, pounds are usually indicated by #.) This is necessary for checking price and for inventory controls. Show the price per unit for all merchandise. (Some sales tickets will have a column heading marked "price".) Bill all merchandise at the retail price. If the customer is entitled to a discount because of volume, damage, etc. , this amount is deducted from the retail price. Extensions must be mathematically accurate and legibly written.

d. Make a sub-total of the extension.

Sales Tickets
(Information Sheet continued)

e. Calculate the sales tax on all taxable items, and enter under the first total. (Sales tax policies will vary according to state laws.)

f. Next, calculate any delivery, mixing, grinding, or shelling charges, and enter under the sales tax calculations.

g. Add the extension column to obtain the grand total of charges for the sale.

h. Check the block on the ticket to indicate the method of payment (cash, check, charge, returned, account).

i. If settlement is to be made by a check larger than the ticket, total, it is necessary to note both the amount of the check on the face of the sales ticket, and the change to be given. A similar calculation is recommended when a large bill is given in payment.

j. Get the signature of the person receiving the merchandise when the settlement is other than cash.

k. When a customer pays on account, make out a sales ticket and mark the items for which he is paying (for example, fertilizer, feed, balance on note, etc.).

l. In all cases where an employee ruins a ticket for any reason, the word "void" should be written across the front of the ticket, and the original placed with the other tickets. Sales tickets must be numbered consecutively. Each ticket must be accounted for at the end of the day's business.

m. The salesman initials the ticket in the appropriate block.

Properly prepared sales tickets giving full information about the transaction provide the manager with the information he needs in conducting the business. Sales tickets may prevent many misunderstandings with customers when a transaction is questioned.

Sales Tickets
(Information Sheet continued)

SAMPLE FARM SUPPLY COMPANY
Farmerton, Texas

January 14 19 64 — a

Sold To John Jones & Sons — b

Address Farmerton, Texas

Quantity	Description	Price	Amount	
200	100# Bag 32% Refinaker	5.75	1150 00	c
	less 5% qty. discount		-57 50	c
			1092 50	c, d
1000#	Grinding	.15	150 00	f
1	Corn popper	3.25	3 25	
	Sales Tax		10	e
			1245 85	g
i	Check #1250.00			
	Purch. 1245.85			
	Change $ 4.15			

☐ Eligible ☐ Ineligible

Patronage Volume

j Received By: John Jones Salesman: Brown — m

Cash	Check	Charge	Returned	Account	
	✓ h				No. 47861

2446

Sales Tickets
(Information Sheet continued)

Making change following a purchase can be done accurately by using the following procedure:

1. Count from the cost of the purchase to the total amount of payment. For example, if the cost is $2.98 and a $5 bill is tendered, count "$2.99, $3.00, $4.00, $5.00."

2. Use the largest denomination of coins and bills possible in making change.

3. Positively identify the amount (e.g. $5, $10, etc.) of a bill or check and lay it on top of the cash drawer until after the change is given in order to avoid mistakes.

4. If in doubt as to the correct change, or if payment is by check, the computation should be made with pencil and paper.

5. Use a flannel board and proportionately enlarged coins and bills to bring the class into a discussion and demonstration on the change-making process.

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Assignment Sheet
for
AGRICULTURAL SALES AND SERVICE

UNIT: Business Procedures

TOPIC: Credit

OBJECTIVE: To develop an understanding of the need for and function of agricultural credit and the function of the agricultural business in supplying credit.

REFERENCES: Required:

1. Information Sheet, 920-III-3
2. How to Use Your Bank, L-389, Texas Agricultural Extension Service
3. Profitable Farm Management, Hamilton, J. E. W. R. Bryant, Prentice-Hall Inc., Englewood Cliffs, N. J., pp. 99-115, (State Adopted Text.)

QUESTIONS or ACTIVITIES:

1. Give 7 sources of credit for farmers.
2. What is the difference between "Productive Credit" and "Consumptive Credit"?
3. What does the business extending credit need to know about a credit customer? (The business firm is the "lender"; the customer, the "borrower".)
4. What are three advantages of the use of checks in paying bills?
5. Give 5 good rules in check writing.
6. Assume that a customer has requested that you write a check for his signature in the amount of his bill, $127.65. Obtain a blank check and write it out, leaving the signature space blank. Attach it to the sheet you are using to answer these questions.

UNIT: Business Procedures
TOPIC: Credit
(Assignment Sheet continued)

7. How does a draft differ from a check?

8. What is a "note"?

9. What is a "mortgage"?

10. If your firm has a written credit policy, secure a copy and attach it in your notes.

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Information Sheet on CREDIT

The capital required to finance modern farming operations is so great that most farmers must either borrow money to pay for their purchases or charge their purchases, making use of credit plans made available by businesses.

Credit is a very useful tool in conducting business. A vast majority of business done anywhere in the world proceeds with little transfer of actual cash. The retailer buys from the wholesaler or the distributor on credit just as the farmer buys on credit from the farm supply store.

Credit may be extended for only a short time (30 days or less, the same as cash) in which case the business establishment may do the financing. Credit may be extended for several months or longer, in which case a credit institution such as a bank or loan association will usually finance the purchase. Large amounts are secured by credit instruments such as commodity notes and mortgages.

Each business will establish credit policies. These policies will state the conditions under which credit will be extended, the maximum credit to be allowed, and the payment plans and penalties.

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Assignment Sheet
for
AGRICULTURAL SALES AND SERVICE

UNIT: Business Procedures

TOPIC: Determining Selling Price

OBJECTIVE: To develop an understanding of the factors that enter into the determination of the selling price of merchandise.

REFERENCE: Required:

Information Sheet, 920-III-4

QUESTIONS or ACTIVITIES:

1. What must the selling price of an article include besides the original cost?

2. Which 5 of the "overhead" cost items listed in the information sheet will remain almost the same from year to year?

3. Which three of the overhead items will fluctuate most widely?

4. When overhead costs vary little or not at all, what are they called?

5. Why is an increase in volume of business usually advantageous to the firm?

6. What is "markup"?

7. A merchant buys an item delivered to his store for $10.00. He prices it at $13.00.
   a. What is the markup?
   b. What is the percent markup?

8. What is gross margin? How does it differ from markup?

9. An item costing $10.00 is marked up to $13.00 and sold. What is the gross margin?

UNIT: Business Procedures
TOPIC: Determining Selling Price
(Assignment Sheet continued)

10. Give a "rule of thumb" for determining a necessary gross margin.

11. What are feed "turn over" goals higher than hardware?

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Information Sheet
on
DETERMINING SELLING PRICE

The original cost of merchandise is the actual purchase price, including the cost of transportation. The selling price must include the original cost plus merchandising costs, overhead costs, and a reasonable profit.

The overhead costs may reflect some, or all, of the following conditions:

1. Merchandise may become obsolete before sold.
2. Merchandise becomes shop-worn.
3. Some merchandise will be overstocked and will not sell.
4. The price of merchandise may drop before the stock is sold.
5. Interest on investment in inventory items.
6. Insurance on inventory items.
7. The cost of warehousing the merchandise
8. Delivery costs (to the customer)
9. Taxes on the merchandise carried in inventory
10. Theft of merchandise
11. Shrinkage of merchandise
12. Damage to merchandise in stock
13. Wages and salaries
14. Office and accounting expenses

Overhead costs may be grouped into areas of fixed costs (insurance, interest, taxes, etc.) which will be constant per $1,000 of inventory, and variable costs (raw materials, product containers, packaging materials, etc.) which change according to volume of business done, and the expenses of doing this business.

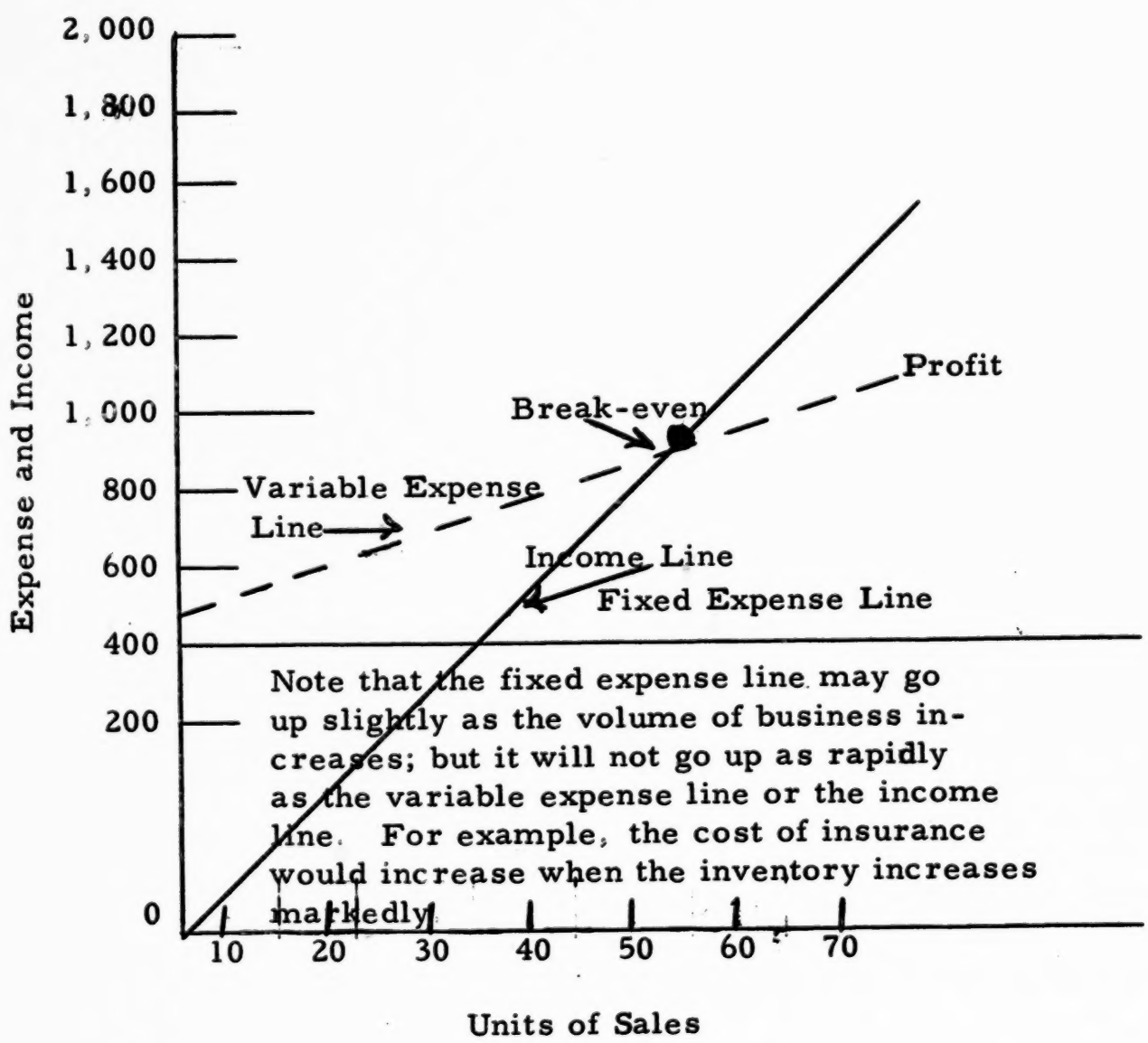
Determing Selling Price
(Information Sheet continued)

Some companies may find the annual cost of keeping items in stock as low as 10% of value while other companies may need an increase in cost of 15% or more in order to pay the expense of just keeping stock on hand.

In addition to overhead costs, some companies may provide free services to their customers. Services like mixing or spreading fertilizers will also increase the costs of doing business.

A graph may help explain the need for increasing the volume of business in order to cover both fixed and variable expenses and make a profit;

BREAK-EVEN CHART



Determing Selling Price
(Information Sheet continued)

The merchant must determine a selling price for his products that is high enough to cover the cost of the item, overhead expenses, service costs, and allow a reasonable profit.

There are two terms used to describe the difference between the merchant's cost of an item and his selling price.

1. "Markup" - The amount added to the cost to make the selling price. As a percentage, it is the relation of the amount of markup to the cost. For example,

Cost		Markup		Selling Price
20	+	5	=	$25

The markup is 25% of the cost.

Example:	Merchant purchases vegetable dust	$1.00
	Merchant prices vegetable dust at	1.25
	Cash markup.	.25
	Percent markup.	

$$\frac{\text{Cash marukp}}{\text{Purchase price}} = \frac{.25}{1.25} = 25\%$$

2. "Gross margin" - Is determined by dividing the markup by the selling price.

Example:	Merchant purchases vegetable dust from wholesaler for.	$1.00
	Merchant prices vegetable dust at	1.25
	Cash markup.	.25
	Percent gross margin	

$$\frac{\text{Cash markup}}{\text{Selling price}} = \frac{.25}{1.25} = 20\%$$

Markup and gross margin are often confused. They are always the same in dollars and cents; but never the same in percentage because markup is figured on cost and margin on selling price.

Examples of the gross margins and markups used by one farm supply business to cover their expenses and to secure a reasonable profit is as follows:

Determing Selling Price
(Information Sheet continued)

	Percent Gross Margin	Percent Markup
Fertilizer	12.0 %	13.6%
Grain	6.0 %	6.4%
Hardware	33.3%	50.0%
Commercial Feed	18.0%	22.0%

A rule of thumb that may be used to determine gross margin is as follows: In order to make a large enough profit to remain in business, the number of times an item turns over in stock during the year times the gross margin should equal 100.

Example: Refer to the vegetable dust used in the illustration for markup and gross margin.

Vegetable dust turnover 5 times in stock during the year.

5 x X (gross margin) = 100
5X = 100
X = 20% gross margin

The suggested turnover goals for one business are as follows:

Feed	15	Seed	8-10	Farm equipment . . .	3
Fence . . .	4	Oil & grease . .	4	Building material . . .	4
Paint . . .	4	Tires & tubes . .	4	Electrical merchandise	4
Hardware .	3	Miscellaneous merchandise . .	4	Farm supplies, general	4
Machinery .	4				

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Assignment Sheet
for
AGRICULTURAL SALES AND SERVICE

UNIT: Business Procedures

TOPIC: Business Records: Ordering and Receiving Merchandise

OBJECTIVE: To secure an understanding of business forms used in ordering and receiving merchandise.

REFERENCES: Required:

1. Information Sheet, 920-III-5

Supplemental:

1. Stockkeeping, Division of Extension, The University of Texas, Austin, Texas

QUESTIONS or ACTIVITIES:

1. Explain to the best of your knowledge who makes the decisions regarding what merchandise and how much to purchase in the business in which you work.
2. Secure a "purchase order" if one is available where you work and write up a sample order.
3. Why is it necessary to keep copies of purchase orders?
4. What is usually included in a "receiving record"?
5. Give two ways freight charges are handled.
6. What is a "bill of lading"?
7. What is an "invoice"?
8. How are invoices checked by business firms?
9. Explain the forms used for ordering and receiving goods in the business in which you work.

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Information Sheet
on
BUSINESS RECORDS: ORDERING AND RECEIVING MERCHANDISE

In purchasing and receiving merchandise in a business, the following are typical procedures and business forms used:

1. A decision is made on the type, amount, and cost of merchandise to be ordered, and the company from which it is to be ordered.

2. A purchase order is completed.

3. Company policy usually assigns the responsibility in ordering merchandise to specific employees. Duplicate records or purchase orders are kept in order to check them against the materials, the invoice, and bill of lading when merchandise is received. Note specifically on the sample purchase order the complete items, including the company's order number.

4. When the shipment is received, a "receiving record" or "receiving report" are typeical forms used to record the receipt of merchandise. Other similar records may be used.

5. The receiving record must be a complete record of the merchandise received, including its condition when received. The primary use of a receiving record is to check incoming merchandise against invoices and bills of lading.

6. Commercial carriers, such as railroads and trucking companies, will charge for hauling the products from the originating point to the delivery point. Prior to placing the order, an agreement should be made on who pays the delivery charges, the shipper or the receiver. Freight may be prepaid or sent C. O. D.

7. Forms used by the carriers are called "bills of lading" or "shipping records". An employee should know how to receive merchandise. He should understand the forms used.

8. The final business form to be considered in the ordering and receipt of merchandise is the "invoice". An invoice is a bill or statement due a company for merchandise delivered. Since

Business Records: Ordering and Receiving Merchandise
(Information Sheet continued)

the payment for goods is made from the invoice, it must be accurate. The invoice should be checked against all previous papers--the purchase order, the receiving record, and the bill of lading. All businesses have an established policy as to the checking of invoices for payment. The discount terms must appear on the invoice and be used in computing the amount to be paid.

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Assignment Sheet
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AGRICULTURAL SALES AND SERVICE

UNIT: Business Procedures

TOPIC: Inventories

OBJECTIVE: To develop an understanding of principles and practices used in maintaining and utilizing inventories.

REFERENCES: Required:

1. Information Sheet, 920-III-6

Supplemental:

2. Stockkeeping, Division of Extension, University of Texas, Austin, Texas

QUESTIONS or ACTIVITIES:

1. What is an inventory?
2. Why are inventories necessary?
3. What is meant by "inventory control"?
4. What is a perpetual inventory?
5. When are "physical inventories" made?
6. In addition to counting the items, what purposes are met by a physical inventory?
7. What four items of additional information will most inventories secure?
8. If a form (or forms) is used for making inventories in the business in which you work, secure a form, study it and attach it with your answers.

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Information Sheet on INVENTORIES

An inventory is a correct count of a concern's merchandise, including its value. An inventory is necessary for several reasons:

1. An accurate account of value is necessary for year-end or periodic analysis of the business.

2. Periodic merchandise counts enable the business to determine the freshness of its stocks, and to decide whether some items are obsolete.

3. Inventory counts will show the extent to which items are moving. They will show whether items are overstocked or understocked.

4. Physical count inventories are necessary to determine possible losses. (These are different than book inventories.)

Businesses will use inventories in additional ways. "Inventory control" is a system of keeping on hand adequate amounts of any given merchandise. A business needs to be sure that the customers' needs are met, but does not want to have surplus, outdated merchandise on hand which frequently may be in poor condition.

There are several types of inventories:

1. Perpetual inventories

   Many businesses have some or all of their stock listed so that they know at any given time the number of items of merchandise on hand. This is done by systematically adding the purchases to the inventory, and by subtracting the sales taken from the daily sales slips or totals which are then subtracted from these inventories, This results in maintaining a "book" inventory level as purchases and sales are made. To be sure it is correct, periodic physical counts must be made and checked against the perpetual inventory.

Inventories
(Information Sheet continued)

2. Physical inventory

The physical inventory is an actual count of all merchandise on hand at a given time. This must be done at the end of the fiscal year, and is of considerable value at other times during the year. Procedures in making the count will vary but will include many or all of the following procedures:

a. Arrange stock in an orderly fashion.

b. Check stock for condition; count only that which is salable.

c. Count and record every item, listing the cost price unless the particular business prefers that the selling price be used.

d. Keep inventories separate for different departments and types of goods.

e. Compute totals.

Businesses will have special forms used for taking the inventory. These forms may include:

1. Location of merchandise

2. Department to which merchandise is charged

3. Names of persons taking the inventory

4. Information concerning the age and/or quality of merchandise

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Assignment Sheet
for
AGRICULTURAL SALES AND SERVICE

UNIT: Business Procedures

TOPIC: Receiving and Storing Merchandise

OBJECTIVE: To develop an understanding of the steps involved in receiving and storing merchandise.

REFERENCES: Required:

1. Information Sheet, 920-III-7

Supplemental:

2. Stockkeeping, The Division of Extension, The University of Texas, Austin, Texas

QUESTIONS or ACTIVITIES:

1. When should damage be noted when unloading merchandise upon its receipt?
2. How should damage be noted?
3. How are "shortages" checked?
4. When should the quality of merchandise be checked?
5. Secure one of the receiving forms used in the firm in which uou work and attach it to this assignment.

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Information Sheet
on
RECEIVING AND STORING MERCHANDISE

One of the important functions of any agricultural business is the receipt and storing of merchandise. To properly receive merchandise, whether it be feed, fertilizer, chemicals or miscellaneous merchandise, several steps must be followed:

1. A definite plan must be used in unloading, moving, and storing items. This involves consideration of who does the work, how various types of merchandise must be handled (by hand, fork lift, etc.), and how and where it is to be stored.

2. Damage or breakage must be determined as the unloading proceeds. Both damage and breakage must be noted on the receiving form. Damaged merchandise must be destroyed, returned, or kept and sold at a reduced price. The person in charge should determine, at the time of unloading, whether there is any shortage.

3. The possibility of shortage must always be checked by exact count or weight at the time of receiving the merchandise. The quantity of goods received must always agree with the goods signed for on the bill of lading, or other shipment record.

4. Policies vary on checking goods against the invoice to check against substitutions. Invoices may be with the goods or they may arrive before the goods. The person checking the shipment should be sure that the merchandise received is in accord with the purchase order before signing the delivery slip. Many businesses will use a duplicate copy of their purchase order to check against merchandise received.

5. The quality of the merchandise, insofar as it can be determined by visual examination or by approved testing procedures, should be checked at the time of arrival. Quality must be checked against what was ordered to be sure it meets the standards specified in the order.

6. The employee who receives the merchandise will usually sign for it. He will also complete a receiving report for his business. Note on the receiving report form the fact that accurate count, condition of merchandise, description of merchandise as well as other pertinent facts, are listed.

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Assignment Sheet
for
AGRICULTURAL SALES AND SERVICE

UNIT: Business Procedures

TOPIC: Stocking and Merchandise Planning

OBJECTIVE: To develop an understanding of the importance of and methods used in properly stocking and in merchandise planning.

REFERENCE: Required:

Information Sheet, 920-III-8

QUESTIONS or ACTIVITIES:

1. In your opinion, how should a merchant determine how much of a particular product to stock?

2. What are the penalties for a merchant ordering merchandise
   a. too early ?
   b. too late?

3. Who should call attention to low stocks in a firm?

4. Name three items in the store or place of business where you work that have slow "turnover".

5. Name three items in the store in which you work that have rapid "turnover".

6. What is the reason for the difference in Nos. 4 and 5 above?

7. Draw a diagram of the place of business in which you work, drawing in the location of classes of merchandise.

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Information Sheet
on
STOCKING AND MERCHANDISE PLANNING

Businesses have numerous decisions to make in determining the quantity of any certain item to order. The quality of stock and time to order are also important. Some factors which businesses must keep in mind in ordering supplies are:

1. Will this merchandise have a slow or fast turnover?
2. Will it keep if some remains unsold?
3. What will be the probable demand for this product this year or this season?
4. When will the deman come?
5. How long will it take to get replacement merchandise?
6. How much money may we have tied up in inventory stock?
7. Where can we secure quality merchandise at the lowest cost?

Although only certain employees will have the responsibility of ordering stock, all employees must be responsible for calling attention to low stocks and for keeping the stock neat and orderly.

An employee should know the exact location of merchandise. He should have a good working knowledge of the amount of a product on hand at a given time in relation to the probable demand.

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Material for this Information Sheet was taken from: "Business Prodedures", Module 6, Agricultural Supply, Sales and Service Occupations. The Center for Research and Leadership Development in Vocational and Technical Education, 980 Kennear Road, Columbus, Ohio 43212.

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Assignment Sheet
for
FERTILIZER SALES AND SERVICE

UNIT: Introduction to Fertilizers

TOPIC: Importance of Fertilizers in Modern Farming

OBJECTIVE: To develop an understanding of the importance of fertilizers in modern farming.

INTRODUCTION: The farmer who consistantly produces high crop yields usually provides plenty of plant nutrients for the crops he is trying to produce. Soil fertility is one of the greatest factors in high yields. If is just as important to keep a plant fed as is the case with animals. Some soils are naturally fertile or productive and others will not produce plants profitably without being aided by the application of fertilizers or other soil amendments. No matter how poor a soil is, its productivity can be increased by the addition of water, organic matter, soil amendments, and/or fertilizers.

REFERENCES: Required:

1. The Fertilizer Handbook, National Plant Food Institute, pp. 13, 212-215.
2. Managing Southern Soils, Vanderford, pp. 217-218.
3. Using Commercial Fertilizer, McVickar, pp. 13-16.
4. Our Land and its Care, National Plant Food Institute, Washington D.C. pp. 20, 42-43.

QUESTIONS or ACTIVITIES:

1. What are the three major advantages of fertilizing crops?
2. In what way do plants resemble animals?

UNIT: Introduction to Fertilizers
TOPIC: Importance of Fertilizers in Modern Farming
(Assignment Sheet continued)

3. From what three sources do plants get their food?

4. In what three ways is plant food lost from the soil?

5. What four major factors influence the use of fertilizer?

6. What has been the increase in fertilizer use in Texas from 1945 to 1964?

7. What amount was expended for fertilizers and lime in Texas in 1963?

8. Does a deficiency in one plant food limit crop yields?

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Assignment Sheet
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UNIT: Introduction to Fertilizer

TOPIC: What is Fertilizer?

OBJECTIVE: To develop an understanding of the meaning of the term "fertilizer".

INTRODUCTION: Growing plants, just like animals, must have food for growth and development if their yield is maintained at the proper level. This food for plants is made up of certain chemical elements. A full understanding of the componets in various types of fertilizer will help the fertilizer sales and serviceman be of better service to the customers.

REFERENCES: Required:

1. The Fertilizer Handbook, National Plant Food Institute, pp. 63-108; 13-38.
2. Using Commercial Fertilizers, McVickar, pp. 13-16.

QUESTIONS or ACTIVITIES:

1. What is a fertilizer?
2. What is a plant nutrient?
3. Name the three most essential plant nutrients.
4. How many chemical elements are considered essential to plant growth?
5. Name ten of the above chemical elements.
6. Can all plant food elements be used in their elemental (most simple) form?

UNIT: Introduction to Fertilizers
TOPIC: What is Fertilizer?
(Assignment Sheet continued)

7. Why is the amount of plant food in a given weight of fertilizer only a portion of the total amount of fertilizer in that amount?

8. What are "straight" or fertilizer materials?

9. What is a "unit" of plant food?

10. What is a "complete" fertilizer?

11. What is a "mixed" fertilizer?

12. In what order is the percent of the three primary plant foods listed when speaking of fertilizers?

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UNIT: Introduction to Fertilizers

TOPIC: Forms of Fertilizers

OBJECTIVE: To develop an understanding of the various forms in which fertilizers are handled, sold, or applied.

INTRODUCTION: To get the maximum returns from fertilizer, it must be applied and used properly. The form in which it is applied will determine the extent of its use by the plants. A knowledge of these forms will help to use the fertilizer at maximum advantage.

REFERENCES: Required:

1. The Fertilizer Handbook, National Plant Food Institute, pp. 63-108.
2. Our Land and Its Care, National Plant Food Institute, pp. 46-49.
3. What is Fertilizer? pamphlet, National Plant Food Institute.

QUESTIONS or ACTIVITIES:

1. What three general forms are fertilizers produced?
2. Which liquid fertilizer turns to a gas in application?
3. What is a "suspension" type fertilizer?
4. What form of fertilizer is most commonly used?
5. What two forms does dry solid fertilizer come in?
6. What is an organic fertilizer?
7. Does animal manure have more value as fertilizer or organic matter?

UNIT: Introduction to Fertilizers
TOPIC: Forms of Fertilizers
(Assignment Sheet continued)

8. Which nutrient is most commonly applied in the liquid form?

9. What is the chief value of foliar application of liquid form fertilizer?

10. What advantage is liquid form of fertilizer?

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UNIT: Introduction to Fertilizers

TOPIC: How Fertilizers are Made

OBJECTIVE: To develop an understanding of how fertilizers are made.

INTRODUCTION: The manufacture of fertilizer in the United States has its beginning with the production of superphosphate from bones in a small plant in Baltimore in 1849. Today the manufacture of fertilizer is one of the largest units in the chemical industry. An understanding of the history and the other later developments in the making of fertilizers is very important.

REFERENCES: Required:

1. The Fertilizer Handbook, National Plant Food Institute, pp. 73-82.
2. Our Land and its Care, National Plant Food Institute, pp. 26-34; 50-53.
3. What is Fertilizer?, pamphlet, National Plant Food Institute.

QUESTIONS or ACTIVITIES:

1. When was fertilizer manufacturing started in the United States and what nutrient was produced?
2. Of what nutrient do we have an almost inexhaustable supply on hand?
3. What is the basic "building material" for all nitrogen fertilizers?
4. Name five sources of nitrogen.
5. What are two organic sources of nitrogen?

UNIT: Introduction to Fertilizers
TOPIC: How Fertilizers are Made
(Assignment Sheet continued)

6. What is phosphate largely derived or made from?

7. Which state supplies most of phosphate rock?

8. What state furnishes the largest amounts of potash?

9. Which chemical potash material furnishes most of the potash fertilizer?

10. Where do we get most of our materials for secondary and micro nutrient fertilizers?

11. What development in recent years in fertilizer production was primarily for saving labor?

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UNIT: Soils and Soil Problems

TOPIC: Taking and Using Soil Samples to Determine Fertilizer Needs.

OBJECTIVE: To develop an understanding of the taking and using of soil samples to determine fertilizer needs

INTRODUCTION: Each farm and many times each field presents an individual problem. People who strive for top yields and profit need as much specific information as they can secure. Chemical analysis of their own soils is the best starting point to find and correct soil problems.

REFERENCES: Required:

1. The Fertilizer Handbook, National Plant Food Institute, pp. 84-92.
2. Test Your Soil for Profit, Leaflet L-265, Texas Agricultural Extension Service.

QUESTIONS or ACTIVITIES:

1. What is a soil test?
2. What is included in a soil test?
3. Give nine steps in taking a soil sample.
4. Take a soil sample and send to the college or commercial soil testing laboratory for analysis.
5. Encourage test demonstrations using soil test recommendations.

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UNIT: Soils and Soils Problems

TOPIC: Interpreting Soil Test Results

OBJECTIVE: To develop an understanding of how to interpret soil test results.

INTRODUCTION: Regardless of the careful taking of a soil sample and giving the proper information, a person must be able to read the results of a soil test, and report and interpret them properly, in order to make the maximum use of the money spent on fertilizer materials.

REFERENCES: Required:

1. The Fertilizer Handbook, National Plant Food Institute, pp. 84-92.

Supplemental:

2. Test Your Soil for Profit, Leaflet L-265, Texas Agricultural Extension Service.

3. Soil Testing-What is it?, TAES - TAP 376.

QUESTIONS or ACTIVITIES:

1. What information is given on a soil test result?

2. What does each item of information mean?

3. Does the expected yield influence soil test results?

4. What two soil test values are used together with other factors to determine need for limestone?

5. Does "plant nutrients needed per acre" mean pounds of fertilizer or pounds of actual plant food?

UNIT: Soils and Soils Problems
TOPIC: Interpreting Soil Test Results
(Assignment Sheet continued)

6. Why is pH level important to plants?

7. When is a soil acid, neutral and alkline?

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UNIT: Soils and Soil Problems

TOPIC: The pH Range and its Relation to Crop Production

OBJECTIVE: To develop an understanding of the pH range of soils and its relation to crop production.

INTRODUCTION: One of the major soil characteristics that may determine whether a soil is satisfactory is the soil reaction or the pH range. This is the degree of acidity or "sourness" or alkalinity or "sweetness" of a soil. Most all plants will make better growth and production within a certain range of soil reaction or pH.

REFERENCES: Required:

1. The Fertilizer Handbook, National Plant Food Institute, pp. 15-27.
2. Our Land and its Care, National Plant Food Institute, pp. 18-19.
3. Soil Reaction (pH) Ranges, L-164, Texas Agricultural Extension Service.

QUESTIONS or ACTIVITIES:

1. What is pH range?
2. How many divisions are on a pH scale?
3. What pH ranges indicate acid or "sour" soils?
4. What pH range is neutral?
5. What pH range indicates alkaline or sweet soils?
6. Why are soils in humid areas like the south either acid or sour?

UNIT: Soils and Soil Problems
TOPIC: The pH Range and its Relation to Crop Production
(Assignment Sheet continued)

7. Which general groups of plants are more sensitive to pH range?

8. Is the availability of plant nutrients altered by the pH range?

9. What soil amendment is used to reduce or increase pH range more than other amendments?

10. What pH range is most desirable for the following crops:
    a. Corn
    b. Cotton
    c. Bermuda grass
    d. Grain sorghum
    e. Peaches

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UNIT: Soil and Soil Problems

TOPIC: Liming of Soils

OBJECTIVE: To develop an understanding of the materials and the value of liming soils.

INTRODUCTION: Lime has many beneficial effects on soils that are acid or sour. Actually it acts as a regulator and a soil amendment. Agricultural lime functions to help the soil in several ways. A knowledge of these helps and how they can be utilized will greatly benefit in increased yields.

REFERENCES: Required:

1. The Fertilizer Handbook, National Plant Food Institute, pp. 18-27.
2. Managing Southern Soils, Vanderford, pp. 190-216.
3. Our Land and its Care, National Plant Food Institute, pp. 18-19; 253

QUESTIONS or ACTIVITIES:

1. What is the major treatment for acid soils?
2. What are the three major functions of lime? Explain each.
3. What is a liming material?
4. Name four sources of lime in the south?
5. Name six ways soils responds from liming.
6. What kind of soil is usually more acid or in need of lime?

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UNIT: Soils and Soil Problems

TOPIC: Correcting Alkaline and Saline Soils

OBJECTIVE: To develop an understanding of how to correct alkaline or saline soils.

INTRODUCTION: Alkalinity and the excess accumlation of soluble salts in the soil can create as serious a problem as acidity. This is particularly true in the irrigated areas of Texas. In these areas, management practices to prevent saline or alkali soil conditions are very important. A better understanding of how to deal with these two soil problems will increase yield and profits.

REFERENCES: Required:

1. The Fertilizer Handbook, National Plant Food Institute, pp. 27-38.

2. Know Your Fertilizers, MP-572, Texas Agricultural Extension Service.

QUESTIONS or ACTIVITIES:

1. What are two ways soluble salts affect a soil?

2. What are three categories in describing saline or alkali soils?

3. What causes soluble salts to occur in soils?

4. How does salinity affect plant growth?

5. What is the first requirement for reclamation of saline soils?

6. What is the distinguishing characteristic of alkali soils?

UNIT: Soils and Soil Problems
TOPIC: Correcting Alkaline and Saline Soils
(Assignment Sheet continued)

7. What is the usual method of reclaiming alkali soils?

8. What are three general groups of chemical amendments used to correct alkali soils?

9. What is the most accurate method of determining saline or alkaline problems?

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UNIT: Sources of Fertilizer Nutrients

TOPIC: Nitrogen Fertilizers

OBJECTIVE: To develop an understanding of nitrogen fertilizers

INTRODUCTION: Nitrogen for fertilizers is derived or made from many sources and is available in various forms both organic and inorganic. It can be supplied as a liquid, solid, or gas, and is probably one of the most abundant of any of plant nutrients.

REFERENCES: Required:

1. 'The Fertilizer Handbook,' 4th edition, National Plant Food Institute, pp. 73-78
2. Our Land and Its Care, 4th edition, National Plant Food Institute, pp. 26-27
3. Know Your Fertilizers, MP-572, Texas Agricultural Extension Service
4. Fertilizers and Their Use, B-167, Texas Agricultural Extension Service

QUESTIONS or ACTIVITIES:

1. Does atmospheric nitrogen have to be combined with other elements, to be used by plants?
2. What plants convert atmospheric nitrogen to an available form by the help of bacteria?
3. Name 8 dry fertilizers that furnish a good source of nitrogen.
4. What chemical is the starting point for most nitrogen fertilizers?

UNIT: Sources of Fertilizer Nutrients
TOPIC: Nitrogen Fertilizers
(Assignment Sheet continued)

5. What two nitrogen fertilizers are easily placed in irrigation water?

6. Name 3 sources of nitrogen other than a commercial fertilizer.

7. Which nitrogen moves with soil moisture; nitrate or ammonium form?

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UNIT: Sources of Fertilizer Nutrients

TOPIC: Phosphorous Fertilizers

OBJECTIVE: To develop an understanding of phosphorous fertilizers

INTRODUCTION: The oldest commercial fertilizer production was in the field of phosphorous fertilizers. Most all phosphorous fertilizers are derived from raw rock phosphate and the extent to which it is processed, determines the types of fertilizers produced. Much of the phosphate rock comes from the state of Florida. More phosphate fertilizer is used by farmers than any other fertilizer.

REFERENCES: Required:

1. "The Fertilizer Handbook," 4th edition, National Plant Food Institute, pp. 77-80
2. Know Your Fertilizers, MP 572, Texas Agricultural Extension Service
3. Fertilizers and Their Use, B 167, Texas Agricultural Extension Service
4. Using Commercial Fertilizer, Mc VicKar, pp. 58-68

QUESTIONS or ACTIVITIES:

1. What is the basic ingredient of most all phosphate fertilizers?
2. Name 4 sources of phosphorous.
3. Name 5 phosphate fertilizers.
4. What phosphate fertilizer contains nitrogen?
5. Does phosphate move very much in the soil from where it is placed?
6. Which phosphorous fertilizer is a liquid?

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UNIT: Sources of Fertilizers

TOPIC: Potash Fertilizers

OBJECTIVE: To develop an understanding of potash fertilizers

INTRODUCTION: Pure potassium will burst into flame when exposed to the air. Thus, like nitrogen, it must be combined with other elements before it can be used as a fertilizer. Most soils have rather large amounts of potash, but many are deficient. The states furnishing much of the potash materials for fertilizer are New Mexico, California and Utah.

REFERENCES: Required:

1. "The Fertilizer Handbook", 4th edition, National Plant Food Institute
2. Know Your Fertilizers, MP-572, Texas Agricultural Extension Service
3. Fertilizers and Their Use, B-167, Texas Agricultural Extension Service
4. Using Commercial Fertilizers, McVicKar, pp. 69-76

QUESTIONS or ACTIVITIES:

1. What are the 3 compounds that furnish most of the potash?
2. What state produces most potash fertilizer material?
3. Name 3 other sources of potassium.
4. Does potassium remain where it is placed, or does it move in soils?

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UNIT: Sources of Fertilizer Nutrients

TOPIC: Secondary and Trace Elements

OBJECTIVE: To develop an understanding of secondary and trace elements

INTRODUCTION: Although called secondary or trace elements, these elements, when in such deficiency as to cause retardation of plant growth and low yields, may become very important. As continued high yields are carried off of the land, the secondary and trace elements will become more and more a major soil problem.

REFERENCES: Required:

1. "The Fertilizer Handbook", 4th edition, National Plant Food Institute, pp. 41-52
2. Our Land and Its Care, 4th edition, National Plant Food Institute
3. Fertilizers and Their Use, B-167, Texas Agricultural Extension Service
4. Know Your Fertilizers, MP-572, Texas Agricultural Extension Service

QUESTIONS or ACTIVITIES:

1. Name the 3 secondary plant nutrients.
2. Name 7 trace or micro nutrients.
3. Name the major sources of the 3 secondary nutrients.
4. Name the compounds that will furnish the trace or micro nutrients.

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UNIT: Functions of Plant Food Elements

TOPIC: Functions of Primary Plant Foods

OBJECTIVE: To develop an understanding of the functions of primary plant foods.

INTRODUCTION: Out of the sixteen essential plant food nutrients, thirteen are derived from the soil and must enter the plant mostly from the roots. The primary plant foods are so-called because of the excessive amounts that a plant uses of these elements. The function of these elements is of great importance in providing the plant's needs.

REFERENCES: Required:

1. The Fertilizer Handbook, 4th edition, National Plant Food Institute, pp. 39-41

2. Our Land and Its Care, 4th edition, National Plant Food Institute, pp. 26-31

QUESTIONS or ACTIVITIES:

1. Why are primary plant food elements so-called?

2. Give the function of nitrogen.

3. Give the function of phosphorous.

4. Give the function of potash.

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UNIT: Functions of Plant Food Elements

TOPIC: Functions of Secondary Plant Foods

OBJECTIVE: To develop an understanding of the functions of the secondary plant foods.

INTRODUCTION: The secondary plant foods are so-called because they are used less extensively by plants. This does not, however, lessen the need for these elements in a balanced nutrient program for these plants and the knowledge of the function of these elements is vitally important for proper crop yields.

REFERENCES: Required:

1. The Fertilizer Handbook, 4th edition, National Plant Food Institute, page 41

2. Our Land and its Care, 4th edition, National Plant Food Institute, pp. 32-33

QUESTIONS or ACTIVITIES:

1. Why are secondary plant food nutrients so-named?

2. Name 3 secondary plant foods.

3. Give the functions of each secondary plant food.

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UNIT: Functions of Plant Food Elements

TOPIC: Functions of the Micro Nutrients

OBJECTIVE: To develop an understanding of the functions of the micro nutrients or trace elements.

INTRODUCTION: The micro nutrients are so-called because they are required in small quantities. The micro nutrients are adequate in some soils but sandy soils sometimes are deficient. Though they are micro nutrients, or trace elements, when a soil is deficient in any one micro nutrient, the plants still suffer and production is reduced. A knowledge of these elements is important to fertilizer users.

REFERENCES: Required:

The Fertilizer Handbook, 4th edition, National Plant Food Institute, pp. 41-43

QUESTIONS or ACTIVITIES:

1. What are the micro nutrients commonly called?
2. Name the micro nutrients and give the functions of each.

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UNIT: Functions of Plant Food Elements

TOPIC: Nutrient Deficiency Signs in Plants

OBJECTIVE: To develop an understanding of nutrient deficiency signs in plants.

INTRODUCTION: Plants, like people and animals, need not only enough food, but they need a balanced diet, and when any one of the plant foods are deficient, the plant suffers, the yield is reduced, and profits are lost. A knowledge of the signs that plants indicate will help to correct deficiencies, maybe not on the present crop, but on future crop or plant production.

REFERENCES: Required:

1. The Fertilizer Handbook, 4th edition, National Plant Food Institute, pp. 43-52

2. Our Land and Its Care, 4th edition, National Plant Food Institute, pp. 35-39

QUESTIONS or ACTIVITIES:

1. Name two general types of deficiencies that occur in plants. Define each.

2. Name the deficiency signs in crops for the 3 primary nutrients.

3. Name the deficiency signs for the secondary nutrients.

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UNIT: Functions of Plant Food Elements

TOPIC: Plant Growth and Nutrient Uptake

OBJECTIVE: To develop an understanding of plant growth and uptake of nutrients.

INTRODUCTION: An understanding of how plants grow and utilize their nutrients will help a person know how to deal with soil and plant problems. The study of the absorption and utilization of these nutrients are vital and definitely affect the fertility program of crops.

REFERENCES: Required:

1. Crop Production in The South, Klingman, pp. 13-35
2. The Fertilizer Handbook, 4th edition, National Plant Food Institute, pp. 57-58

QUESTIONS or ACTIVITIES:

1. Why is it important to understand how plants grow?
2. How are plants like people and animals?
3. What is photosynthesis?
4. What is food?
5. Name 3 food elements used for growth and energy.
6. What is diffusion?
7. What is respiration in plants? Where does it occur in a plant?

UNIT: Functions of Plant Food Elements
TOPIC: Plant Growth and Nutrient Uptake
(Assignment Sheet continued)

8. Why is water absorption important to a plant?

9. What is the chief water absorbing part of the plant?

10. Name 3 ways water is lost from a plant.

11. How do the factors influencing rapid plant growth influence nutrient absorption by a plant?

12. The plant has a system of veins to move water, nutrients, and foods. What are they called?

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UNIT: Functions of Primary Plant Foods

TOPIC: Plant Food Removed by Crops

OBJECTIVE: To develop an understanding of the loss of plant food from the soil by removing or harvesting crops.

INTRODUCTION: Every time a crop it harvested from the soil, it carries with it great quantities of plant food nutrients. This plant food must be replaced or the fertility of the soil is greatly depleted. The yield and the quality of future crops, as well as the profit, will suffer. It is important to understnad the extent to which plant food is removed by certain crops, to be able to adequately maintain a good fertility level.

REFERENCES: Required:

1. The Fertilizer Handbook, 4th edition, National Plant Food Institute, pp. 52-55

2. Our Land and Its Care, 4th edition, National Plant Food Institute, pp. 24-25

QUESTIONS or ACTIVITIES:

1. How much plant food must be returned each year, just to "hold your own" in soil fertility?

2. Why does more plant food need to be replaced than is actually carried off?

3. How much plant food, per acre, is carried off of the soil by a 150 bushel to the acre corn crop?

4. How much plant food, per acre, is carried off of the soil by a cotton crop 1500 lbs. of seed and lint?

5. How much plant food is contained in 1000 lbs. of fat cattle (live weight)?

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UNIT: Principles Involved in the Use of Fertilizers

TOPIC: The Economic Principles of Fertilizer Use

OBJECTIVE: To develop an understanding of the economic principles involved in the use of fertilizers.

INTRODUCTION: High yields of a good quality crops are very essential for a successful farming program. Many times, the difference in profit and loss may depend upon adequate plant food applied correctly. The same principles of economic fertilizer use apply to the use of any item worth money, such as land, labor or chemicals. It will pay to add fertilizer as long as the cost of applying the fertilizer is lower than the added returns. An understanding of some of the factors of economics involved in the use of fertilizer will help to get more from your fertilizer dollar.

REFERENCES: Required:

1. The Fertilizer Handbook, 4th edition, National Plant Food Institute, pp. 133-137.

2. Our Land and Its Care, 4th edition, National Plant Food Institute, pp. 60-70.

3. Using Commercial Fertilizers, McVickar, pp. 113-116.

QUESTIONS or ACTIVITIES:

1. What three ways can the use of fertilizer result in greater profits?

2. What percent of the production from major crops comes from fertilizer?

3. Where does it pay to use fertilizer?

4. Name five fixed costs of crop production?

5. How are fixed costs of crop production and fertilizer costs related?

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UNIT: Principles Involved in the Use of Fertilizers

TOPIC: Soil Factors that Affect the Response to Fertilizers

OBJECTIVE: To develop an understanding of the soil factors that affect the response to fertilizer.

INTRODUCTION: It is well known that various soil and soil conditions greatly influence the response to fertilizers. This is because of their chemical composition, which causes them to respond differently to the same fertilizer application. A knowledge of some of these factors is important to profitable production.

REFERENCES: Required:

1. The Fertilizer Handbook, 4th edition, National Plant Food Institute, pp. 133-172.

2. Using Commercial Fertilizers, McVickar, pp. 119-124.

QUESTIONS or ACTIVITIES:

1. Name four soil factors that influence the response to fertilizer.

2. Why is it important to know something about soils when using fertilizer?

3. How does organic matter improve response to fertilizer?

4. How does the condition of a soil influence its response to fertilizer?

5. Does the availability of plant nutrients change with the pH range in a soil?

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Assignment Sheet
for
FERTILIZER SALES AND SERVICE

UNIT: Principles Involved in the Use of Fertilizers

TOPIC: Ratios and Minimum Grades of Fertilizer

OBJECTIVE: To develop an understanding of the fertilizer ratios and minimum grades.

INTRODUCTION: The grade or analysis of a fertilizer is designated by three numbers listed in the order of nitrogen, phosphorous, and potash. The three numbers give the guaranteed analysis of the three primary food nutrients. These are expressed in percentage, by weight. The ratio in which these are mixed together determines the grade ratio. An understanding of these grade ratios will help in making the decision as to which fertilizer will give best results.

REFERENCES: Required:

1. The Fertilizer Handbook, 4th edition, National Plant Food Institute, page 73,
2. Our Land and It's Care, 4th edition, National Plant Food Institute, pp. 56-57.
3. Using Commercial Fertilizer, McVickar, pp. 92-94.

QUESTIONS or ACTIVITIES:

1. What is the grade of a fertilizer and how is it expressed on a sack of fertilizer?
2. What is the ratio of fertilizer?
3. What is a "complete" fertilizer?
4. What is an "incomplete" fertilizer?
5. Are the percentages expressed on a bag, indications of the pure plant food form?

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Assignment Sheet
in
FERTILIZER SALES AND SERVICE

UNIT: Principles Involved in the Use of Fertilizers

TOPIC: Calculations for Recommendations

OBJECTIVE: To develop an understanding of the factors involved in calculating fertilizer recommendations.

INTRODUCTION: Most soil tests are returned to the person who sent the sample, expressing the fertilizer needs such as 30-60-30 per acre. The particular need may not be met in a given fertilizer. Calculations must be understood to be able to determine what plant food will be used to meet the needs as prescribed.

REFERENCES: Required:

1. The Fertilizer Handbook, 4th edition, National Plant Food Institute, pp. 82-88.

2. Our Land and Its Care, 4th edition, National Plant Food Institute, pp. 56-57.

Supplemental:

3. Soil Test Report - Texas A&M University, Agricultural Extension Service, Form D-5145.

QUESTIONS or ACTIVITIES:

1. How can you determine the fertilizer to buy for the soil test recommendation?

2. What fertilizers could you use to supply a 40-0-0?

3. Give one fertilizer and amount that would supply a 30-60-30.

4. Give a fertilizer and amount that would supply a 40-60-0.

5. What ratio is a 30-60-30?

UNIT: Principles Involved in the Use of Fertilizers
TOPIC: Calculations for Recommendations
(Assignment Sheet continued)

6. What ratio is a 40-60-0?

7. Give an example of a 1:2:1 ratio fertilizer.

8. How much nitrogen is in an 80 lb. sack of 20-0-0?

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Assignment Sheet
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FERTILIZER SALES AND SERVICE

UNIT: Methods of Applying Fertilizers

TOPIC: Principles Involved in Fertilizer Placement and Use

OBJECTIVE: To develop an understanding of the various principles involved in the proper placement and utilization of fertilizers.

INTRODUCTION: To get the maximum results from fertilizer, it must be used properly. The method of applying a fertilizer may sometimes affect the yield of a crop as much as the amount that is applied. The primary aim in applying fertilizers should be to get the proper amount of fertilizer in the soil where it will do the most good. To meet this goal, a thorough understanding of the placement principles are vitally important.

REFERENCES: Required:

1. The Fertilizer Handbook, 4th Edition, pp. 101-108, National Plant Food Institute
2. Out Land and It's Care, 4th Edition, pp. 48-49, National Plant Food Institute
3. Methods of Applying Fertilizer, National Plant Food Institute
4. Using Commercial Fertilizers, McVickar, pp. 136-156

QUESTIONS or ACTIVITIES:

1. Name 10 principles of fertilizer placement and use.
2. What is the primary aim in fertilizer placement?
3. How does irregular fertilizer distribution lower the efficiency of fertilizer?
4. Are nutrient elements in a dry soil used by the plant?
5. How does fertilizer applied too close to seed or young seedlings, damage the plants?

UNIT: Methods of Applying Fertilizers
TOPIC: Principles Involved in Fertilizer Placement and Use
(Assignment Sheet continued)

6. What two ways are nutrients lost when fertilizer is applied on the surface?

7. Does texture of soils affect frequency of application or amount of fertilizer to use?

8. Why is phosphorous usually placed close to the plant?

9. Name three reasons why localized placement of fertilizer, near the seed, is desirable.

10. What are three nutrients that can be absorbed by spraying on leaves?

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Assignment Sheet
for
FERTILIZER SALES AND SERVICE

UNIT: Methods of Applying Fertilizers

TOPIC: Common Methods of Applying Fertilizers

OBJECTIVE: To develop an understanding of the common methods of applying fertilizers.

INTRODUCTION: How a fertilizer is applied is probably as important as the amount that is applied. There are a number of methods of applying both dry and liquid fertilizers. A number of factors should be understood to more efficiently apply the fertilizer that is needed. The method used will depend upon the crop, the soil, climatic conditions, date and the rate of application, the equipment available, and the kind of fertilizer being applied.

REFERENCES: Required:

1. The Fertilizer Handbook, 4th Edition, National Plant Food Institute, pp. 101-108
2. Out Land and Its Care, 4th Edition, National Plant Food Institute, pp. 46-49
3. Methods of Applying Fertilizer, National Plant Food Institute

QUESTIONS or ACTIVITIES:

1. Name three general forms in which fertilizers are applied.
2. Name six factors that determine the method to use in applying fertilizer.
3. What are eleven common methods of applying fertilizer?
4. What two forms of fertilizer may be applied by airplane?
5. What two developments have aided in the application of nitrogen fertilizers?

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Assignment Sheet
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FERTILIZER SALES AND SERVICE

UNIT: Methods of Applying Fertilizer

TOPIC: Time of Fertilizer Application

OBJECTIVE: To develop an understanding of the time of applying fertilizers.

INTRODUCTION: The plants that are deficient or soils that are deficient can use the nutrients any time moisture and climatic conditions are favorable for plant growth and absorption. However, some fertilizers will greatly influence the efficiency of fertilizer application and utilization.

REFERENCES: Required:

1. The Fertilizer Handbook, 4th Edition, pp. 101-108, National Plant Food Institute
2. Our Land and Its Care, 4th Edition, page 47, National Plant Food Institute
3. Methods of Applying Fertilizers, National Plant Food Institute

QUESTIONS or ACTIVITIES:

1. During what months is most of the fertilizer sold and placed?
2. What disadvantage is this concentration of usage?
3. Does the seasonal operation of fertilizer plants make the fertilizer more expensive?
4. What are the advantages to the farmer in buying fertilizer during slack periods?
5. What storage facilities are necessary for keeping fertilizer on hand?
6. What are the disadvantages of storing fertilizer?
7. What is one disadvantage of early application?

Selection and Maintenance of Fertilizer Equipment
(Information Sheet continued)

2. Well coated with grease on all moving parts

3. Completely inspected and reconditioned

4. Stored in a clean dry shed

At the beginning of the following season, before using the fertilizer applicator, the operator should:

1. Remove the grease coating with a solvent or kerosene

2. Check to see that all moving parts move freely

3. Check all operating adjustments

4. Lubricate the implement thoroughly

Consulting the operator's manual on the particular type of fertilizer application equipment will give specific instructions on problems, care and operation.

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Material for this Information Sheet was partially taken from Agricultural Supply - Sales and Service Occupations, Module 9, Ohio State University, Columbus, Ohio.

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Information Sheet
on
SELECTION AND MAINTENANCE OF FERTILIZER EQUIPMENT

The fertilizer distributor, to maintain maximum results, must not only put on the desired amount of fertilizer per acre, but also place the desired amount for each plant in the correct place. In brief, the fertilizer equipment must:

1. Provide even distribution
2. Apply fertilizer properly

A wide variety of application equipment exists because of:

1. Types of fertilizer materials used
2. Varying rates of application needed
3. Varying placements desired
4. Areas to be fertilized

There are several systems of fertilizer application

1. Applying fertilizer alone
2. Applying fertilizer and seed in one operation
3. Tilling and applying fertilizer in one operation
4. Applying fertilizer through irrigation systems
5. Applying fertilizer by plane

Types of fertilizer application equipment comes in the following general types

1. Hand operated machines
   a. With wheels
   b. Without wheels
2. Broadcasters
   a. Full width trailers

Selection and Maintenance of Fertilizer Equipment
(Information Sheet continued)

b. Trucks, trailers, tractors, and wagons with spreading attachments, such as:

1. Rotary fans
2. Full width hoppers
3. Augers

3. Row distributors and drills

4. Machines with fertilizer attachments, such as:

a. Drills
b. Planters
c. Tillage equipment

5. Liquid and gaseous fertilizer equipment:

a. Anhydrous ammonia
b. Low pressure solutions
c. Non-pressure solutions
d. Foliar sprays

When selecting and buying fertilizer application equipment the following factors are important:

1. The applicator should be flexible in operation to meet the requirement of most fertilizer applications.

2. The applicator should be easy to fill and carry a large load.

3. The applicator should apply large and small amounts accurately and be easily adjusted.

4. The applicator should correctly place the fertilizer.

5. The applicator should be of sturdy construction, easy to maintain, and resist corrosion.

6. The applicator should be easily emptied and cleaned.

Since fertilizer applicators are used only for a few days in the year, they seldom wear out. The major damage to applicators is done by rust, corrosion and decay. To guard against these enemies, the fertilizer applicators should always be:

1. Thoroughly cleaned, including washing, before storing

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Assignment Sheet
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FERTILIZER SALES AND SERVICE

UNIT: Methods of Applying Fertilizer

TOPIC: Fertilizer Application Equipment

OBJECTIVE: To develop an understanding of fertilizer application equipment.

INTRODUCTION: Machines and equipment for the application of fertilizers comes in various types and sizes, depending upon the area, crop, conditions and practices. Fertilizer application equipment should be maintained to provide even distribution and placing of the fertilizer properly. An understanding of the various types of equipment available will help to meet the above goals.

REFERENCES: Required:

1. Information Sheet, "Selection and Maintenance of Fertilizer Equipment".
2. The Fertilizer Handbook, 4th edition, National Plant Food Institute, pp. 101-102.
3. Using Commercial Fertilizer, McVicker, pp. 157-163.

Supplemental:

4. Operator's Manuals of Fertilizer Equipment sold locally.

QUESTIONS or ACTIVITIES:

1. What are two major things fertilizer equipment must accomplish?
2. Why does a wide variety of fertilizer equipment exist?
3. Name five general systems of fertilizer applications.
4. What types of fertilizer applicator equipment is generally available?

UNIT: Methods of Applying Fertilizer
TOPIC: Fertilizer Application Equipment
(Assignment Sheet continued)

5. Name five important factors in selecting fertilizer equipment.

6. Name four factors in the proper care of fertilizer equipment.

7. Name four things to do before using fertilizer equipment.

8. When can a plane be used to an advantage in applying fertilizer?

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Assignment Sheet
for
FERTILIZER SALES AND SERVICE

UNIT: Regulations and Control

TOPIC: Regulations Controlling Fertilizer Manufacture and Use

OBJECTIVE: To develop an understanding of the regulations controlling fertilizer manufacture and use.

INTRODUCTION: Each state has a system of inspection and control of fertilizer manufacture, designed to protect the farmers as well as the manufacturers of fertilizer products. By careful sampling, testing, and inspecting, these agencies afford adequate protection to the farmers and manufacturers against an inferior product.

REFERENCES: Required:

1. "Texas Commercial Fertilizer Control Act of 1961", MP-513, Texas Agricultural Extension Service
2. 'Rules and Regulations;' Adopted by the Texas Feed and Fertilizer Control Service, MP-552, Texas Agricultural Extension Service
3. Our Land and It's Care, 4th Edition, National Plant Food Institute, pp. 59

QUESTIONS or ACTIVITIES:

1. What organization controls fertilizer manufacture, sale, and distribution in Texas?
2. Name three things that all states require of fertilizers.
3. What is a "commercial fertilizer"?
4. Can "commercial fertilizers" include animal excretions?
5. What is a fertilizer material?
6. Define a "mixed" fertilizer.
7. What are "specialty" fertilizers used for?

UNIT: Regulations and Control
TOPIC: Regulations Controlling Fertilizer Manufacture and Use
(Assignment Sheet continued)

8. Define "grade" of fertilizers.

9. What is a "bulk" fertilizer?

10. Name five things each fertilizer registration request must include.

11. How is an inspection fee determined and on what basis is it paid?

12. Can fertilizers contain pesticides or fungicides?

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Answer Sheet
for
AGRICULTURAL SALES AND SERVICE

UNIT: Agricultural Salesmanship

TOPIC: Introduction, Agricultural Salesmanship

1. a. Poor service rendered
   b. Discourteous treatment received
   c. Indifference on the part of the salesman

(Personal experiences may be varied)

2. Need - may or may not be recognized by the customer. It is based upon reason.
   Desire - is a feeling of need. It may not be based upon reason.

3. a. The selling process
   b. The merchandise
   c. The firm
   d. Himself
   e. His relation to the customer
   f. The customer

4. a. Deals directly with the public
   b. Helps others make decisions
   c. Something "new" every day
   c. Success is quickly recognized
   d. Enjoys high prestige

5. A satisfied customer

6. Everyone; the salesman, the firm, the customer and the public

7. a. Awakens human wants
   b. Satisfies human wants

8. a. His need
   b. The product needed
   c. The source (firm or store)
   d. The price
   e. The time

UNIT: Agricultural Salesmanship
TOPIC: Introduction, Agricultural Salesmanship
(Answer Sheet continued)

9. The product that best fits his needs

10. a. Courtesy
    b. Sincere interest

11. Helping the customer to buy intelligently

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Answer Sheet
for
AGRICULTURAL SALES AND SERVICE

UNIT: Agricultural Salesmanship

TOPIC: Meeting the Customer

1. The first contact gives the customer a lasting impression of the salesman and the business.

2. A well-groomed salesman
   a. Attracts customers
   b. Inspires customer confidence

3. Enthusiasm is difficult if the job is unpleasant.

4. a. Promptness
   b. Alertness
   c. Interest in the customer and his problems

5. The customer should be treated as a guest.

6. Exercise in recognition of personal characteristics

7. a. Participation in community activities
   b. Chamber of Commerce information
   c. Comments made by others
   d. A personal notebook on customers
   e. Past sales records
   f. Questions asked others
   g. Newspapers

8. Exercise in customer impressions. Depends upon the student's observations.

9. Exercise in product knowledge. Check for extent of knowledge.

10. Exercise in product knowledge, designed to make student aware of customer knowledge of produce.

UNIT: Agricultural Salesmanship
TOPIC: Meeting the Customer
(Answer Sheet continued)

11. a. Good appearance
    b. Stock displayed attractively
    c. Knowledge of merchandise
    d. Knowledge of firms advertising
    e. Knowledge of customer
    f. Selling sentences
    g. Knowledge of competitor's product
    h. Possible customer objections and methods of meeting them

12. a. Discussions with other employees
    b. Stock duties
    c. Timidity in approaching customers
    d. Indifference to customer needs

13. a. By taking the time to let the customer express the problem
    b. By asking questions to determine if the customer understands the problem
    c. By suggesting a procedure that will assist with the problem

14. Examples of
    a. Conventional -"May I help you, Mr. Jones (or sir)"
    b. Question - " Is this cold weather affecting your milk production, Mr. Brown?"
    c. Stating a fact about merchandise - "We've surely been selling a lot of that feed, Mr. Smith"

15. a. Courteous
    b. Short
    c. Requires no decision
    d. Affirmative
    e. Emphasizes the desire to serve

16. a. Comfort
    b. Pleasure
    c. Appetite
    d. Possession
    e. Fear
    f. Devotion
    g. Curiosity
    h. Ornamentation
    i. Imitation
    j. Construction
    k. Loyalty

17. a. Professional feeling toward selling
    b. Courtesy
    c. Enthusiasm
    d. Interest in the customer and his problems
    e. Willingness to develop self confidence
    f. Integrity
    g. Desire to be of service
    h. Appreciation of psychology

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Answer Sheet
for
AGRICULTURAL SALES AND SERVICE

UNIT: Agricultural Salesmanship

TOPIC: Presenting Supplies and Services to Customers

1. a. Attention
   b. Interest
   c. Desire
   d. Action

2. Attention may be involuntary. Interest is a voluntary reaction.

3. A combination of the needs or wants of the customer with the merits of the merchandise.

4. a. Desire for increased yields
   b. Desire for more profits
   c. Desire for less difficult work
   Others acceptable

5. a. Newspaper advertising
   b. TV or radio advertising
   c. Talk with a neighbor
   d. Direct mail circulars.
   Others acceptable

6. Student activity. He should include:
   a. Attention step
   b. Interest step
   c. Desire step

7. a. Know the features of the product
   b. Be able to answer questions about the product
   c. Be able to demonstrate the product, including its advantages

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Answer Sheet
for
AGRICULTURAL SALES AND SERVICE

UNIT: Agricultural Salesmanship

TOPIC: Overcoming Customer Resistance

1. The seller and the buyer must "give up" something to secure something. The seller "gives up" merchandise; the buyer, money. Each sale represents a choice.

2. The customer's (a) pleasure, (b) satisfaction, and/or (c) need

3. a. Need - Stress usefulness of a product
   b. Quality - Point out good features
   c. Source - Name satisfied customers; Provide company information or reliability
   d. Price - Revealing values of product
   e. Time - Show positive interest; Counter all objectives
   f. Thing (Product) - Showing suitability of the product

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Answer Sheet
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AGRICULTURAL SALES AND SERVICE

UNIT: Agricultural Salesmanship

TOPIC: Closing the Sale

1. When the need for the merchandise has been definitely established.

2. That of helping the customer make a wise decision.

3. When the customer is not aware of his needs or not well aware of product choices.

4. Immediately after the customer decides to buy.

5. a. The customer has exhibited attention, interest, and desire for the product.
   b. The relationship between the need and the product has been extablished.
   c. Objections have been overcome.
   d. The price is acceptable.
   e. The product is approved by the customer.
   f. The customer has the "power" (ability) to make the purchase.

6. Giving the customer a small decision to make, based upon the major decision to buy.
   Example:
   "Do you prefer the red or the green?"
   "Would you prefer sacks or paper bags?"

7. a. Assuming failure in the beginning
   b. Hurrying the customer
   c. Failing to help the customer decide
   d. Failing to overcome obstacles
   e. Stressing the wrong selling points
   f. Trying the force the customer
   g. Discourtesy at any point

8. a. Write legibly
   b. Accuracy
   c. Name and address completed
   d. Special directions noted

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Answer Sheet
for
AGRICULTURAL SALES AND SERVICE

UNIT: Agricultural Salesmanship

TOPIC: Fundamentals for Successful Selling

1. a. A wholesome attitude
   b. People
   c. Merchandise
   d. Good selling methods

2. (Student activity, written)

3. (Student activity, written)

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Answer Sheet
for
AGRICULTURAL SALES AND SERVICE

UNIT: Business Procedures

TOPIC: Importance of Accurate Records

1. a. (1) To know the financial status of the business
   (2) To give proper information to company officers and stockholders
   (3) To satisfy legal requirements
   (4) To plan for desirable change in management and procedures
   (5) To prepare tax returns

   b. To plan for desirable change in the business

2. Profit or loss for a stated period of time

3. A balance sheet shows all assets and liabilities. The two always are equal.

4. All daily records of the firm, including sales tickets, invoices of purchases, and other records.

5. To be sure that this part of the firms'records are correct for the day.

6. Because transportation and many other items of expense are involved in the true "cost" of the merchandise to the firm

7. a. To assist in determining the firms' financial condition
   b. To plan for purchases of stock

8. $103,048.16

9. a. Salaries and wages
   b. Heat, power and water
   c. Advertising
   d. All other expenses
   e, Depreciation

10. Because the land did not become less valuable

11. a. $23,173.70
    b. $305,444.24
    c. $ 10,649.42
    d. $305,444.24

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Answer Sheet for Test
on
IMPORTANCE OF ACCURATE RECORDS

1. Receipts
   Expenses
   Profit
   Loss

2. Financial condition

3. Planning purchases

4. Assets
   Liabilities

5. a. Asset
   b. Liability
   c. Asset
   d. Asset
   e. Liability

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Answer Sheet
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AGRICULTURAL SALES AND SERVICE

UNIT: Business Procedures

TOPIC: Sales Tickets

1. Activity

2. Largest

3. All

4. Client

5. Activity

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Answer Sheet for Test
on
SALES TICKETS

	T	F
1.	✓	
2.		✓
3.		✓
4.	✓	
5.		✓

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Answer Sheet
for
CREDIT

1. a. Merchants or dealers
   b. Individuals
   c. Commercial banks
   d. Insurance companies
   e. Federal Land Banks
   f. Production credit associations

2. Productive credit is used to make more money.
   Consumptive credit is used in a manner that is not designed to produce extra income.

3. a. The moral responsibility of the customer
   b. History of debt repayment
   c. The financial status of the customer (his repayment capacity)

4. a. Large amounts of cash are unnecessary.
   b. A cancelled check serves as a receipt.
   c. Risk of theft is small.

5. a. Write plainly, in ink.
   b. Completely fill the space for the amount of the check that is written.
   c. Numbers following the "dollar sign" should be placed as close as possible.
   d. Never erase on a check.
   e. The purpose should be placed on the check.

6. (Activity)
   (Examine check for proper execution)

7. The amount shown is paid by a third party, previously arranged and shown on the draft.

8. A written promise to pay a specific amount at a specific future date.

9. A written claim against property, guaranteeing the payment of a debt.

10. (Activity)

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Answer Sheet for Test
on
CREDIT

True	False	
✓		1.
	✓	2.
✓		3.
	✓	4.
✓		5.

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Answer Sheet
for
AGRICULTURAL SALES AND SERVICE

UNIT: Business Procedures

TOPIC: Determining Selling Price

1. a. Merchandising costs
   b. Overhead
   c. Profit

2. a. Interest on investment
   b. Insurance
   c. Warehousing
   d. Taxes
   e. Office and accounting expenses

3. a. Drop in price
   b. Theft
   c. Damage

4. Fixed costs

5. Fixed expenses will increase little with increased volume; variable costs will increase more, but opportunities for total profits become greater.

6. The amount that is added to the cost to arrive at the selling price.

7. a. $3.00 b. 30% (3.00 ÷ 10.00 = 30%)

8. The gross margin is obtained by dividing the markup by the <u>selling price</u> (not the cost).

9. $3.00 ÷ $13.00 - 23+%

10. Number of times an item "turns over" per year times gross margin should equal 100.

11. Feed is consumed, requiring more frequent purchase.

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Answer Sheet for Test
on
DETERMINING SELLING PRICE

__a__ 1.

__d__ 2.

__c__ 3.

__a__ 4.

__a__ 5.

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Answer Sheet
for
AGRICULTURAL SALES AND SERVICE

UNIT: Business Procedures

TOPIC: Business Records: Ordering and Receiving Merchandise

1. Activity

2. Activity

3. To check against invoices, bills of lading and goods delivered

4. a. Merchandise received
   b. Condition of merchandise

5. a. The shipper "prepays" the freight
   b. Goods arrive "C. O. D.", with the merchant paying the freight upon delivery.

6. A form used by the carrier (railway, etc.) enumerating items being shipped

7. A statement (bill) due a company for merchandise delivered.

8. Invoices are checked for accuracy and compared to purchase orders, receiving records and bills of lading.

9. Activity

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Answer Sheet for Test
on
BUSINESS RECORDS: ORDERING AND RECEIVING MERCHANDISE

b 1.

c 2.

a 3.

c 4.

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Answer Sheet
for
AGRICULTURAL SALES AND SERVICE

UNIT: Business Procedures

TOPIC: Inventories

1. An accurate listing of the firms' merchandise on hand with its value

2. a. For periodic analysis of the business
   b. To determine age of stock on hand
   c. To indicate volume of business by items
   d. For location of losses

3. A system for making sure that adequate, but not excessive amounts of merchandise is on hand

4. An inventory kept up-to-date constantly by addition of purchases and deletion of sales

5. At the end of the firms' fiscal year and often at other times

6. a. Arranging stock
   b. Checking condition of stock
   c. Separation into departments or categories
   d. Listing values of the stock

7. a. Location of the merchandise
   b. Department to which merchandise is charged
   c. Names of persons preparing the inventory
   d. Information on age and quality of the merchandise

8. (Activity)

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Answer Sheet for Test
on
INVENTORIES

True	False	
✓		1.
	✓	2.
✓		3.
✓		4.
✓		5.

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Answer Sheet
for
AGRICULTURAL SALES AND SERVICE

UNIT: Business Procedures

TOPIC: Receiving and Storing Merchandise

1. As unloading proceeds

2. On the receiving form and in other ways used by the firm

3. By exact count or by weight

4. As soon as possible after its arrival

5. (Activity)

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Answer Sheet for Test
on
RECEIVING AND STORING MERCHANDISE

b 1.

c 2.

a 3.

c 4.

b 5.

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Answer Sheet
for
AGRICULTURAL SALES AND SERVICE

UNIT: Business Procedures

TOPIC: Stocking and Merchandise Planning

1. (Opinion question) May include past experience; weather conditions affecting farmer needs, etc.

2. a. Capital utilized unproductively ; store or warehouse space tied up.
   b. Loss of sales ; undesirable customer relations.

3. Any employee

4. (Activity)

5. (Activity)

6. (Activity-thought question)

7. (Activity)

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Answer Sheet for Test
on
STOCKING AND MERCHANDISE PLANNING

1. Capital (shelf space: o.k.)

2. Business

3. Every Employee

4. Every Employee

5. Old

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Answer Sheet
for
FERTILIZER SALES AND SERVICE

UNIT: Introduction to Fertilizers

TOPIC: Importance of Fertilizers in Modern Farming

1. a. Increase yields
   b. Increase profits
   c. Improve soils

2. Both require food for growth and development.

3. a. Air
   b. Water
   c. Soil

4. a. Erosion
   b. Harvested crops
   c. Leaching

5. a. Kind of soil
   b. Cropping sequence
   c. Farm income
   d. Soil test recommendations

6. 1945 - 234,000 tons
   1964 - 1,336,000 tons

7. 86.1 million dollars

8. Yes, a soil is limited to the element that is lowest in its soil.

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Answer Sheet for Test
on
IMPORTANCE OF FERTILIZERS IN MODERN FARMING

1. a. Addition of water
   b. Addition of organic matter
   c. Addition of fertilizers or other soil amendments

2. a. Increase yields
   b. Increase profit
   c. Improve the soil

3. They both need food for growth and development.

4. a. Erosion
   b. Harvested crops
   c. Leaching

5. a. Air
   b. Water
   c. Soil

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Answer Sheet
for
FERTILIZER SALES AND SERVICE

UNIT: Introduction to Fertilizer

TOPIC: What is Fertilizer?

1. A substance which contains one or more of the chemical plant food elements in forms that can be absorbed by plants and which promote growth.

2. Chemicals contained in fertilizer and essential to plant growth.

3. a. Nitrogen
   b. Phosphorous
   c. Potash

4. Sixteen

5. a. Nitrogen
   b. Phosphorous
   c. Potash
   d. Calcium
   e. Magnesium
   f. Sulphur
   g. Chlorine
   h. Copper
   i. Manganese
   j. Zinc

6. No

7. To be available to growing plants, plant food elements must be associated with certain other elements in the form of specific chemical compounds.

8. Nutrient-bearing chemical compounds

9. One percent of a ton or 20 lbs.

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Answer Sheet for Test
on
WHAT IS FERTILIZER?

1. Food; growth; development

2. Chemical; essential

3. Nitrogen, phosphorous, potash

4. Combined

5. Nutrient

6. Sixteen

7. One

8. Mixed

9. Nitrogen, phosphorous, potash

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Answer Sheet
for
FERTILIZER SALES AND SERVICE

UNIT: Introduction to Fertilizers

TOPIC: Forms of Fertilizers

1. a. Solids
   b. Liquids
   c. Suspensions

2. Anhydrous ammonia

3. Solid held in solution by agitation

4. Dry, solid

5. a. Dry powder
   b. Pelleted

6. Material, from decayed plants and animal matter

7. Organic matter

8. Nitrogen

9. To correct micro or minor element deficiencies.

10. More quickly and more readily available to the plant

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Answer Sheet for Test
on
FORMS OF FERTILIZER

1. a. Liquid
   b. Dry
   c. Suspension

2. Anhydrous ammonia

3. a. Pelleted
   b. Powder

4. Pelleted

5. Organic matter

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Answer Sheet
for
FERTILIZER SALES AND SERVICE

UNIT: Introduction to Fertilizers

TOPIC: How Fertilizers are Made

1. 1849, phosphate

2. Nitrogen

3. Ammonia

4. a. Anhydrous ammonia
   b. Calcium cyanamide
   c. Sodium nitrate
   d. Potassium nitrate
   e. Ammonium nitrate

5. a. Meat scraps
   b. Cottonseed meal

6. Rock phosphate

7. Florida

8. New Mexico

9. Potassium chloride or muriate of potash

10. From making and mixing other fertilizers and "stratigh" materials

11. Addition of pesticides

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Answer Sheet for Test
on
HOW FERTILIZERS ARE MADE

1. F

2. T

3. F

4. F

5. T

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Answer Sheet
for
FERTILIZER SALES AND SERVICE

UNIT: Soils and Soils Problems

TOPIC: Taking and Using Soil Samples to Determine Fertilizer Needs

1. A chemical analysis of a soil

2. a. PH (acidity or alkalinity)
   b. Available phosphate
   c. Available potash
   d. Nitrogen
   e. Available calcium
   f. Soluble salts
   g. Recommendations for correcting soil deficiencies
   h. Organic matter

3. a. Study instructions
   b. Scrape away litter on surface and take sample to depth of two to six inches
   c. Use an augar or soil probe
   d. Thoroughly mix sample
   e. Sample each field or area of different characteristics
   f. Stay out of odd places
   g. Take soil 12 or more spots in field
   h. Clean tools before using on other samples
   i. Fill out information sheet
   j. Number sample and keep record
   k. Lime or fertilize as recommended

4. Activity

5. Activity

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Answer Sheet for Test
on
TAKING AND USING SOIL SAMPLES
TO DETERMINE FERTILIZER NEEDS

1. Soil

2. Chemical

3. Test

4. Samples

5. Acidity or alkalinity

6. College or commercial

7. Phosphate, potassium, nitrogen; Recommendations

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Answer Sheet
for
FERTILIZER SALES AND SERVICE

UNIT: Soils and Soil Problems

TOPIC: Interpretation of Soil Test Results

1. a. Soil reaction (pH)
   b. Organic matter
   c. Predicted nitrogen level
   d. Available phosphorous
   e. Available potash
   f. Available calcium
   g. Soluble salts (salinity hazard)

2. a. Soil reaction (pH) - Acidity or alkaline range
   b. Organic matter -Percent or organic matter in sample
   c. Predicted nitrogen level - Possible level of nitrogen is soil
   d. Available phosphorous - Amount of phosphorous available to plants
   e. Available potash - Amount of potash available to the plant
   f. Available calcium - Amount of calcium available to the plants
   g. Salinity hazard (soluble salts) - level of salt build up that may be hazardous to plant growth

3. Yes

4. Available calcium, pH with amount of clay and amount of organic matter.

5. Pounds of actual plant food

6. Plants, like animals have better growing conditions that favor production. Some plants do better on acid soils or "Sour" soils and others do better on alkaline or "Sweet" soils.

7. Acid - 4.5 for extremely acid to 6.5 for slightly acid
   Neutral - 7.0
   Alkaline - 7.0 - slightly alkaline to 9.1 and up for very strongly alkaline

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Answer Sheet for Test
on
INTERPRETATION OF SOIL TEST RESULTS

1. a. Soil reaction or pH
   b. Available phosphorous
   c. Nitrogen level
   d. Available potash
   e. Organic matter

2. Each plant grows better in a certain pH range.

3. a. Available calcium
   b. Amount of clay
   c. Amount of organic matter
   d. pH range

4. Pounds of actual plant food per acre

5. 200 pounds of a 20% nitrogen fertilizer per acre or the equivalent.
   (20% x 200 = 40 lb.)

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Answer Sheet
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FERTILIZER SALES AND SERVICE

UNIT: Soils and Soil Problems

TOPIC: The pH Range and its Relation to Crop Production

1. The degree or scale of sourness (acid) or sweetness (alkaline) in the soil.

2. Fourteen (0 - 14)

3. Below 7.0

4. 7.0

5. Above 7.0

6. Because of losses by leaching and crop harvest of such as calcium, magnesium and potassium.

7. Flowers and shrubs

8. Yes

9. Limestone

10. a. Corn - 6.0 - 7.5
    b. Cotton - 6.0 - 8.0
    c. Bermuda grass - 5.5 - 7.5
    d. Grain sorghum - 5.5 - 7.0
    e. Peaches - 6.0 - 7.5

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Answer Sheet for Test
on
THE pH RANGE AND ITS RELATION TO CROP PRODUCTION

1. Acidity (sour)
   Alkaline (sweet)

2. Zero to fourteen

3. Acid - 0 - 7
   Alkaline - 7 - 14

4. Acid; leaching, harvest

5. Availability; pH

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Answer Sheet
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FERTILIZER SALES AND SERVICE

UNIT: Soils and Soil Problems

TOPIC: Liming of Soils

1. Limestone

2. a. Physical
   b. Chemical
   c. Biological

a. Physical - produces better soil structure, influences growth and organic matter.
b. Chemical - neutralizes soil, makes phosporous more available, decreases toxic substances and adds calcium and magnesium to the soil.
c. Biological - stimulates growth and activity of helpful soil organisms, such as bacteria and fungi.

3. Any material containing calcium or magnesium (or both) and capable of neutralizing acidity.

4. a. Ground agricultural limestone
   Ground dolomitic limestone
   b. Precipitated (builders lime) lime
   c. Hydrated lime
   d. Oyster shell

5. a. Neutralizing soil acids and toxic materials
   b. Making other nutrients available
   c. Supplying calcium and magnesium
   d. Help beneficial organisms in soil
   e. Improve physical conditions or soil
   f. Prevention of diseases

6. Sandy soils

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Answer Sheet for Test
on
LIMING SOILS

1. T

2. F

3. T

4. F

5. T

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Answer Sheet
for
FERTILIZER SALES AND SERVICE

UNIT: Soils and Soil Problems

TOPIC: Correcting Alkaline and Saline Soils

1. a. Saline - Increase the salt content of the solution in the soil.
   b. Alkali - A condition where excessive amounts of sodium have replaced calcium and magnesium in the soil.

2. a. Saline
   b. Saline - alkali
   c. Non-saline alkali

3. a. Low rainfall and high evaporation
   b. Inadequate drainage
   c. Poor irrigation practices
   d. Use of poor quality irrigation water

4. Reduces the amount of water absorbed by the roots and a direct toxic or poisonous action on plants.

5. Adequate underground drainage

6. Presence of sodium in amounts sufficient to interfere with plant growth of most crop plants.

7. Application of chemical soil amendments which either supply or release calcium.

8. a. Soluble calcium salts
   b. Low soluble calcium salts
   c. Acids or acid forming materials

9. A soil test

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Answer Sheet for Test
on
CORRECTING ALKALINE AND SALINE SOILS

1. Saline; alkali

2. a. Low rainfall - high evaporation
   b. Inadequate drainage
   c. Poor irrigation practices
   d. Using poor quality irrigation water

3. a. Reduces amount of water absorbed by roots
   b. Toxicity (poisonous) to plants

4. Chemical

5. Soil test

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Answer Sheet
for
FERTILIZER SALES AND SERVICE

UNIT: Sources of Fertilizer Nutrients

TOPIC: Nitrogen Fertilizers

1. Yes

2. Legumes

3. a. Ammonium nitrate
   b. Ammonium sulphate
   c. Ammonium phosphate
   d. Urea
   e. Sodium nitrate
   f. Potassium nitrate
   g. Nitrate of soda - potash
   h. Nitric phosphate

4. Ammonia

5. a. Anhydrous Ammonia
   b. Liquid Nitrogen solution

6. a. Animal manure
   b. Organic matter
   c. Legumes

7. Nitrate. The ammonium form, moves very little.

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Answer Sheet for Test
on
NITROGEN FERTILIZERS

1. F

2. T

3. F

4. F

5. T

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Answer Sheet
for
FERTILIZER SALES AND SERVICE

UNIT: Sources of Fertilizer Nutrients

TOPIC: Phosphorous Fertilizers

1. Rock phosphate

2. a. Phosphate rock
   b. Animal manure
   c. Organic matter
   d. Commercial fertilizers

3. a. Super phosphate
   b. Triple super phosphate
   c. Liquid phosphoric acid
   d. Ammonium phosphate
   e. Nitric phosphate

4. Ammonium phosphate

5. No, very little

6. Liquid phosphoric acid

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Answer Sheet for Test
on
PHOSPHOROUS FERTILIZERS

1. Rock phosphate

2. Super phosphate

3. Ammonium

4. Liquid phosphorous acid

5. Very little

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Answer Sheet
for
FERTILIZER SALES AND SERVICE

UNIT: Sources of Fertilizers

TOPIC: Potash Fertilizers

1. a. Potassium chloride (muriate of potash)
   b. Potassium sulphate
   c. Potassium-magnesium sulphate

2. New Mexico

3. a. Native soil potassium
   b. Animal manure
   c. Organic matter

4. a. Very little in heavy clay soils
   b. Moves with moisture in sands and sandy loams

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Answer Sheet for Test
on
POTASH FERTILIZERS

1. Burns

2. a. Potassium chloride
   b. Potassium sulphate
   c. Potassium-magnesium sulphate

3. New Mexico

4. a. Soil
   b. Organic matter
   c. Animal manure

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Answer Sheet
for
FERTILIZER SALES AND SERVICE

UNIT: Sources of Fertilizer Nutrients

TOPIC: Secondary and Trace Elements

1. a. Calcium
   b. Magnesium
   c. Sulphur

2. a. Boron
   b. Copper
   c. Iron
   d. Manganese
   e. Molybdenum
   f. Zinc
   g. Chlorine

3. Secondary Element Sources
   a. Calcium - Limestone
   b. Magnesium - Dolomitic limestone and Potassium-Magnesium Sulphate
   c. Sulphur - Natural sulphur or gypsum or sulphuric acid

4. Trace element sources supplied individuall y as
   a. Specific compound or specially mixed forms

   Manganes - Manganese sulphate
   Boron - Borax
   Molydenum - Sodium molydate

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Answer Sheet for Test
on
SECONDARY OR TRACE ELEMENTS

1. Calcium
   Magnesium
   Sulphur

2. a. Copper
   b. Iron
   c. Zinc
   d. Boron
   e. Manganese

3. a. Calcium - Limestone
   b. Sulphur - Natural sulphur
   c. Boron - Borax

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Answer Sheet
for
FERTILIZER SALES AND SERVICE

UNIT: Functions of Plant Food Elements

TOPIC: Functions of Primary Plant Foods

1. Plants use nitrogen, phosphorous and potash in large quantities.

2. Functions of nitrogen:
   a. Gives dark green color to plants
   b. Promotes rapid growth
   c. Increases yields of leaf fruit or seed
   d. Improves quality of leaf crops
   e. Increases protein content
   f. Feeds soil micro-organisms

3. Functions of phosphorous:
   a. Stimulates early root formation and growth
   b. Gives rapid and vigorous start to plants
   c. Hastens maturity
   d. Stimulates blooming and aids seed formation
   e. Gives winter hardiness to fall grains and hay crops
   f. Important to germinating seedlings

4. Functions of potash:
   a. Imparts increased vigor and disease resistance to plants
   b. Aids in protein production
   c. Produces strong stiff stalks
   d. Increases plumpness of seeds
   e. Improves quality of fruit
   f. Essential to formation of starches, sugars and oils
   g. Aids development of root crops
   h. Aids in formation of red color in fruit and leaves
   i. Stiffens stalks

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Answer Sheet for Test
on
FUNCTIONS OF PRIMARY PLANT FOODS

1. a. Nitrogen
   (1) Gives dark green color
   (2) Promotes rapid growth

   b. Phosphorous
   (1) Stimulates root growth
   (2) Hastens maturity

   c. Potash
   (1) Gives vigor and disease resistance
   (2) Stiffens stalks

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Answer Sheet
for
FERTILIZER SALES AND SERVICE

UNIT: Functions of Plant Food Elements

TOPIC: Functions of Secondary Foods

1. The plant uses less amounts of these than the primary elements.

2. Calcium
   Magnesium
   Sulphur

3. Functions of Calcium:
   a. Promotes early root formation and growth
   b. Improves general vigor and growth
   c. Facilitates improvement in soil structure
   d. Neutralizes poisons in the plant
   e. Encourages grain and seed production
   f. Increases calcium content of food and feed crops
   g. Helps correct some soil acidity problems

   Functions of Magnesium:
   a. Essential part of chlorophyll
   b. Necessary for sugar formation
   c. Helps regulate uptake of other plant foods
   d. Acts as carrier for phosphorous
   e. Promotes formation of oils and fats
   f. Helps correct some soil acidity problems

   Functions of Sulphur:
   a. Essential part of protein
   b. Helps maintain dark green color
   c. Promotes nodule formation in legumes
   d. Stimulates seed pr oduction
   e. Encourages vigorous plant growth
   f. Helps correct soil alkalinity

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Answer Sheet for Test
on
FUNCTIONS OF SECONDARY PLANT FOODS

1. Calcium
   a. Promotes early root formations and growth

2. Magnesium
   a. Helps regulate uptake of other plant foods

3. Sulphur
   a. Essential ingredient of protein

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Answer Sheet
for -
FERTILIZER SALES AND SERVICE

UNIT: Functions of Plant Food Elements

TOPIC: Functions of Micro Nutrients

1. Trace elements

2. Boron
   a. Increases yield or improves quality of fruit or vegetables
   b. Important to seed production
   c. Associated with calcium utilization and sugar transfer within plants
   d. May cause borren stalks in corn if deficient

Copper
   a. Needed to reduce wilting
   b. Seed setting is aided

Zinc
   a. Needed for chlorophyll production

Iron
   a. Essential in forming chlorophyll production

Molydenum
   a. Influences utilization of nitrogen

Manganese
   a. Accelerates germination and maturity
   b. Increases availability of calcium and magnesium and phosphorous
   c. Aids in chlorophyll production

Chlorine
   a. Affects quality of tobacco, potatoes and other crops

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Answer Sheet for Test
on
FUNCTIONS OF MICRO NUTRIENTS

1. a. Boron
   b. Zinc
   c. Manganese
   d. Copper
   e. Molydenum

2. Trace elements

3. No

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Answer Sheet
for
FERTILIZER SALES AND SERVICE

UNIT: Functions of Plant Food Elements

TOPIC: Nutrient Deficiency Signs in Plants

1. a. Acute deficiencies - Usually shows abnormalities in the plant.
   b. Hidden Hunger - Goes unseen until color indication or reduced plant yields gradually show.

2. Nitrogen
   a. Sickly, yellowish green color
   b. Slow dwarfed growth
   c. Drying or "firing" of leaves, starting at bottom of plant

   Phosphate
   a. Purplish leaves, stems and branches
   b. Slow growth and maturity
   c. Small slender stalke in corn
   d. Low yield of grain, fruit or seed

   Potash
   a. Lower leaves scorched or burned on margins and tips.
   b. Motthing, spotting, streaking or curling of leaves, starting at lower level on plant.
   c. Premamture loss of leaves and small "knotty" poorly opened bolls on cotton
   d. Poor root development and falling down, prematurly, in corn

3. Calcium
   a. Young leaves in terminal bud have a "hooked" appearance, and die back at tips and along margins.
   b. Leaves have a wrinkled appearance
   c. Young leaves, sometimes, remain folded.

   Sulphur
   a. Young leaves light green in color
   b. Short, slender stalks, yellow in color
   c. Slow, stunted growth

UNIT: Functions of Plant Food Elements
TOPIC: Nutrient Deficiency Signs in Plants
(Answer Sheet continued)

Magnesium
a. General loss of green color, starting at bottom leaves and moving up
b. Cstton leaves turn purplish-red between green veins
c. Weak stalks with long branched roots
d. Definite and sharply defined series of yellowish-green, light yellow, or even white streaks throughout entire leaf of corn
e. Leaves curve upward along margins

4. Boron
a. Cracked stem on celery
b. Brown rot of cauliflower
c. Dry rot of sugar beets
d. Heart rot of turnips
e. Yellow top of alfalfa
f. Corky cone of apples
g. Lack of seed in corn and cotton

Manganese
a. Pale green to yellow and red colors between green veins of leaves on tomatoes and other vegetables
b. "Grey speck" in oats
c. Chlorosis, or bleaching of leaves in leafy plants

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Answer Sheet for Test
on
NUTRIENT DEFICIENCY SIGNS IN PLANTS

1. Iron

2. Boron

3. Sulphur

4. Nitrogen

5. Phosphate

6. Magnesium

7. Calcium

8. Zinc

9. Nitrogen

10. Magnesium

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Answer Sheet
for
FERTILIZER SALES AND SERVICE

UNIT: Functions of Plant Food Elements

TOPIC: Plant Growth and Nutrient Uptake

1. Helps to produce better crops at lower cost

2. The leaves, flowers, roots and stems are vital parts to plant life just as hearts, lungs, and stomachs are to people. Both plants and people are made up of cells.

3. To combine or put together carbon dioxide and water by chlorophyll (green color) in the presence of light

4. Any substance which can be used as a source of energy for carrying on the life process

5. a. Carbohydrates
   b. Fats
   c. Proteins

6. The process of a gas or substance moving from an area of high concentration to area of lower concentration

7. The release of chemical energy. Occurs in the plant cell.

8. Cells need water to divide and function properly.

9. The root hair

10. a. Transpiration
    b. Bleeding
    c. Guttation

11. The same conditions that increase or decrease cell growth and activity increases or decreases the nutrients that are absorbed by plants.

12. Vascular bundles

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Answer Sheet for Test
on
PLANT GROWTH AND NUTRIENT UPTAKE

1. T
2. T
3. F
4. T
5. F
6. F
7. T
8. T
9. T
10. T

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Answer Sheet
for
FERTILIZER SALES AND SERVICE

UNIT: Functions of Primary Plant Foods

TOPIC: Plant Food Removed by Crops

1. The amount removed each year by the crop harvested

2. Plant food is lost in 3 ways other than crop harvest:
   a. Erosion or leaching
   b. Plant foods are sometimes "fixed" in soil
   c. Current fertility level is usually below that required for economic production.

3. 135 pounds of nitrogen
   53 pounds of phosphate
   40 pounds of potassium
   2 pounds of calcium
   8 pounds of magnesium
   10 pounds of Sulphur
   .1 pound of Boron
   .06 pound of copper
   .09 pound of manganese
   .15 pound of Zinc

4. 40 pounds of nitrogen
   20 pounds of phosphate
   15 pounds of potassium
   2. pounds of calcium
   4 pounds of magnesium
   2 pounds of sulphur
   .06 pounds of copper
   .11 pounds of manganese
   .32 pounds of zinc

5. 27 pounds of nitrogen
   17 pounds of phosphate
   2 pounds of potassium
   13 pounds of calcium

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Answer Sheet for Test
on
PLANT FOOD REMOVED BY CROPS

1. Plant food

2. Yield, quality and profit

3. Fixed

4. Animal

5. Replaced

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Answer Sheet
for
FERTILIZER SALES AND SERVICE

UNIT: Principles Involved in the Use of Fertilizers

TOPIC: The Economic Principles of Fertilizer Use.

1. a. Increased yield
   b. Improved quality
   c. Combination of yield and quality increase

2. Twenty-five to fifty percent

3. When the cost of the fertilizer is less than the added income from the use of fertilizer.

4. a. Labor
   b. Land
   c. Equipment
   d. Taxes
   e. Seed

5. Money invested in fertilizer may result in increased profits over and beyond fixed costs.

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Answer Sheet for Test
on
THE ECONOMIC PRINCIPLES OF FERTILIZER USE

1. a. Increased yield
   b. Improved quality

2. Twenty-five (25) to fifty (50) percent

3. When the added cost of applying the fertilizer is less than the added returns.

4. By increased yield and quality on same fixed costs.

5. Yes. Some crops respond more to the use of fertilizer.

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Answer Sheet
for
FERTILIZER SALES AND SERVICE

UNIT: Principles Involved in the Use of Fertilizers

TOPIC: Soil Factors that Affect the Response to Fertilizers

1. a. Chemical composition
   b. Organic matter.
   c. Physical condition of soil
   d. Soil reaction or pH range

2. Soils vary in characteristics and composition; a knowledge of the soil being fertilized will aid in higher profits from applying fertilizers.

3. Organic matter "opens" the soil causing the soil to take in more moisture, and feeds micro-organisms that are beneficial.

4. Soils with good tilth or condition holds more water and nutrients for the plants.

5. Yes

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Answer Sheet for Test
on
SOIL FACTORS THAT AFFECT RESPONSE TO FERTILIZERS

1. a. Chemical composition
   b. Soil condition or tilth
   c. Organic matter.
   d. Soil reaction or pH

2. Opening; holding; food

3. Organic matter

4. Nutrients

5. Composition

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Answer Sheet
for
FERTILIZER SALES AND SERVICE

UNIT: Principles Involved in the Use of Fertilizers

TOPIC: Ratios and Minimum Grades of Fertilizers

1. The minimum guarantee of plant food content in a fertilizer. The grade is expressed in percent by weight of nitrogen, phosphorous, and potash, is that order.

2. The ratio is the relationship of one nutrient to the others in the fertilizer mix.

3. A fertilizer containing all three primary plant foods.

4. Fertilizer containing one or two but not all primary plant foods.

5. No

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Answer Sheet for Test
on
RATIOS AND MINIMUM GRADES OF FERTILIZERS

1. T

2. F

3. T

4. F

5. T

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Answer Sheet
for
FERTILIZER SALES AND SERVICE

UNIT: Principles Involved in the Use of Fertilizers

TOPIC: Calculations for Recommendations

1. Consider the ratio of the nutrients recommended and use a fertilizer with the same ratio, using enough to supply the amount.

2. 200 lbs. of 20-0-0
   90 lbs. of 45-0-0
   50 lbs. of 82-0-0

3. 10-20-10-300 lbs.

4. 200 lbs. of 20-0-0 plus 135 lbs. of 0-45-0.

5. 1:2:1

6. 2:3:0

7. 6-12-6 or 10-20-10

8. 16 pounds of nitrogen

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Answer Sheet for Test
on
CALCULATIONS FOR RECOMMENDATIONS

1. a. Consider the ratio recommended
   b. Use a fertilizer with same ratio, in the amount that would supply the need.

2. 1:2:1 ratio

3. 400 lbs. of 20-0-0

4. 300 lbs. of 10-20-10

5. 9.6 pounds of N
   19.2 pounds of P
   9.6 pounds of K

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Answer Sheet
for
FERTILIZER SALES AND SERVICE

UNIT: Methods of Applying Fertilizers

TOPIC: Principles Involved in Fertilizer Placement and Use

1. a. Adequate amounts of plant nutrients, applied properly in the correct place
   b. Bad distribution lowers efficiency.
   c. Nutrients are not absorbed by plants in dry soils.
   d. Fertilizer placed too close, damages plants or seeds.
   e. Fertilizer applied on the surface is easily lost.
   f. Coarse texture soils should have less amounts applied at a time, but more frequent applications.
   g. Early stimulation of seed is important.
   h. Localized placement, near seed, is desirable.
   i. Placing fertilizer too far from seed or plants may retard them until they grow to the plant food.
   j. Some fertilizer elements may be sprayed on leaves.

2. Placing or applying of fertilizer in the proper amount in the soil where it will do the most good.

3. Some plants get too much and others not enough.

4. No

5. a. Injure roots
   b. Impair germination

6. a. Erosion
   b. Leaching

7. Yes

8. Phosphorous moves very little from placement.

9. a. Restricted contact of fertilizer with soil lessens the fixing of phosphate.
   b. Necessary plant food placed within reach of plant
   c. Fertilizer placed in band near row does not furnish nutrients to weeds growing in middle.

10. a. Zinc b. Manganese c. Copper

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Answer Sheet for Test
on
PRINCIPLES INVOLVED IN FERTILIZER
PLACEMENT AND USE

1. Application
   Amount

2. Amount
   Place
   Good

3. Plants
   Little

4. Dry

5. Injure

6. Phosphorous

7. Surface
   Leaching
   Erosion

8. Bands
   Weeds

9. Spraying

10. Type or texture

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Answer Sheet
for
FERTILIZER SALES AND SERVICE

UNIT: Methods of Applying Fertilizers

TOPIC: Common Methods of Applying Fertilizers

1. a. Dry
   (1). Powder
   (2) Granular
   b. Liquids
   c. Gas

2. a. Crop
   b. Soil
   c. Climate
   d. Date and rate of application
   e. Equipment available
   f. Kind of fertilizer

3. a. Banding along row
   b. Broadcast
   c. Deep drill
   d. Deep furrow or plow sole
   e. Drill with seed
   f. Foliar
   g. Side dressing
   h. Bedding
   i. Starter solution
   j. Top dressing
   k. Irrigation

4. a. Dry and Granular
   b. Liquid

5. a. Anhydrous Ammonia
   b. Nitrogen solutions

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Answer Sheet for Test
on
COMMON METHODS IN APPLYING FERTILIZERS

1. True
2. False
3. False
4. True
5. False
6. True
7. True
8. True
9. False
10. False

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Answer Sheet
for
FERTILIZER SALES AND SERVICE

UNIT: Methods of Applying Fertilizer

TOPIC: Time of Fertilizer Application

1. March, April, and May

2. a. It makes fertilizer more costly.
   b. Inconvenient for the manufacturer and the consumer.

3. Yes

4. a. Applying fertilizer as he has time
   b. Fall application is easier
   c. Less power needed in fall than in spring

5. Dry storage

6. a. Storage facilities are expensive
   b. More handling costs

7. Loss of nutrients by erosion or leaching is possible.

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Answer Sheet for Test
on
TIME OF FERTILIZER APPLICATION

1. March, April, and May

2. Expensive

3. Dry
   Expensive

4. Leaching
   Erosion

5. Micro-organisms

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Answer Sheet
for
FERTILIZER SALES AND SERVICE

UNIT: Methods of Applying Fertilizer

TOPIC: Fertilizer Application Equipment

1. a. Apply in proper place
   b. Distribute fertilizer evenly

2. a. Types of fertilizer materials used
   b. Various rates of application
   c. Different placement desired
   d. Areas to be fertilized

3. a. Applying fertilizer alone
   b. Applying fertilizer and seed in one application
   c. Tilling and applying fertilizer in one operation
   d. Applying fertilizer in irrigation systems
   e. Applying fertilizer by air

4. a. Hand operated machines, wheeled and without wheels
   b. Broadcasters
      1. Fill width trailers
      2. Trucks, trailers, tractors, and wagons with spreading attachments such as:
         a. Rotary fans
         b. Full width hoppers
         c. Auger spreader tubes

   c. Row distributors and drills

   d. Machines with fertilizer attachments, such as:
      1. Drills
      2. Planters
      3. Tillage equipment

   e. Liquid and gaseous fertilizer equipment
      1. Anhydrous ammonia
      2. Low pressure solutions
      3. Non-pressure solutions
      4. Foliar sprays

   f. Airborne fertilizer equipment

UNIT: Methods of Applying Fertilizer
TOPIC: Fertilizer Application Equipment
(Answer Sheet continued)

5. a. Applicator must be flexible in operation to meet the need of most fertilizer applications.
   b. Should be easily fitted and carry large load.
   c. Should be able to apply large and small amounts accurately and be easily adjusted.
   d. Should place fertilizer correctly.
   e. Should be of sturdy construction, easy to maintain and should resist corrosion.
   f. Should be easy to empty and clean.

6. a. Thoroughly clean and wash before storing
   b. Coat all moving parts with grease
   c. Inspect and maintain in good condition
   d. Store in clean dry shed

7. a. Remove grease coating with kerosene
   b. Check to be sure all parts are moving freely
   c. Check all operating adjustments
   d. Lubricate thoroughly

8. a. Wet, soggy areas
   b. Terrain where ground application is not possible

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Answer Sheet for Test
on
FERTILIZER APPLICATION EQUIPMENT

1. a. Distribute evenly
   b. Place correctly

2. a. Apply fertilizer alone
   b. Seed and apply fertilizer in one operation
   c. Tillage and fertilize in one operation
   d. Apply fertilizer in irrigation water
   e. Apply fertilizer by airplane

3. a. Hand machines
   b. Broadcasters
   c. Row distributors and drills
   d. Machines with distributors such as drills and planters
   e. Liquid and gas applicators

4. a. Thoroughly clean, and wash before storing
   b. Coat all moving parts with grease
   c. Inspect and maintain regularly
   d. Store in clean dry place

5. a. Extremely wet soggy areas
   b. Ground not possible to cover by ground equipment

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Answer Sheet
for
FERTILIZER SALES AND SERVICE

UNIT: Regulations and Control

TOPIC: Regulations Controlling Fertilizer Manufacture and Use

1. Texas Feed and Fertilizer Control Service, Texas A&M University, College Station, Texas

2. (a) Registration of brands and grades of fertilizer
   (b) Guarantee of percent of (N) Nitrogen, (P_2O_5) Phosphorous, and (K_2O) Potash
   (c) Penalty for failure to meet the guarantee

3. Mixed fertilizer and/or fertilizer materials intended for use as an ingredient or component of a mixture, designed or represented for use in promoting plant growth.

4. No

5. Any solid or non-solid compound which contains any essential plant nutrient element in a form available to plants and used primarily for promoting plant growth

6. A solid or non-solid product which results from the combination, mixture, or simultaneous application of two or more fertilizer materials.

7. Lawns, shrubbery, flowers, golf courses, parks, cemeteries, greenhouses, or nursery

8. Percent of total nitrogen phosphorous and potash guaranteed in a commercial fertilizer.

9. A lot of any commercial fertilizer which is not in a closed container at the time it passes into possession of the consumer

10. a. Name and address of the person responsible for distributing commercial fertilizer
    b. The brand and grade
    c. The guaranteed analysis listing minimum percent of plant nutrient
    d. Sources from which the plant nutrients are derived
    e. Copies of all printed material covering the sale and distribution

UNIT: Regulations and Control
TOPIC: Regulations Controlling Fertilizer Manufacture and Use
(Answer Sheet continued)

11. Set by the Control Service, at the rate of twenty-five cents (25¢) per ton of commercial fertilizer distributed in this state or a minimum inspection fee of twenty-five dollars ($25.00) per year, which ever is the greatest.

12. Yes

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Answer Sheet for Test
on
REGULATIONS CONTROLLING FERTILIZER
MANUFACTURE AND USE

1. True
2. False
3. True
4. False
5. True
6. False
7. True
8. False
9. True
10. False

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Topic Test
on
IMPORTANCE OF ACCURATE RECORDS

Student: _____ School: _____

Date: _____ Score: _____

1. An "operating statement" summarizes the _____ and _____ for a given period of time and shows the _____ or _____ for the period.

2. A "balance sheet" shows the _____ of the company at a given time.

3. Records of stocks and inventories are needed for determining the financial condition of the firm and for _____.

4. Total _____ and total _____ are always the same on a balance sheet.

5. On a balance sheet each item below would be either an "asset" or a "liability".
Which in each case?

   a. Land _____.

   b. Taxes Payable _____.

   c. Inventory _____.

   d. Cash on land _____.

   e. Accounts Payable _____.

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Topic Test
on
SALES TICKETS

Student: _____ School: _____

Date: _____ Score: _____

Check in the correct column:

T	F	
____	____	1. Sales tickets need to be numbered consecutively.
____	____	2. Once the cash register is balanced, sales tickets are no longer needed.
____	____	3. This entry would be sufficient for a sale ticket under description: "1 gal. insect poison".
____	____	4. The customer should sign "charge" tickets.
____	____	5. The best change for a $1.66 purchase when the customer presents a $10 bill would be three pennies, one 5¢ piece, one 25¢ piece and eight $1 bills.

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Topic Test
on
CREDIT

Student: _____ School: _____

Date: _____ Score: _____

True False

____ ____ 1. Productive credit is utilized to earn profits.

____ ____ 2. One source of farm credit is the Soil Conservation Service.

____ ____ 3. Checks should not be written in pencil.

____ ____ 4. A written claim against property is called a "note".

____ ____ 5. A cancelled check serves as a receipt.

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Topic Test
on
DETERMINING SELLING PRICE

Student: _____ School: _____

Date: _____ Score: _____

Multiple Choice:

_____ 1 Costs that vary little or not at all are called (a) fixed (b) standard (c) recommended (d) fair-trade costs.

_____ 2. The amount added to the cost of an article to secure the selling price is called (a) margin (b) gross margin (c) net profit (d) markup.

_____ 3. If an item costs a merchant $1.00 and retails for $1.25, the markup is what percent?
(a) 125%
(b) 20%
(c) 25%
(d) 50%

_____ 4 Markup and gross margin are (a) the same in dollars and cents (b) different in dollars and cents (c) the same in percentage (d) always 25%.

_____ 5. "Turnover" is an expression used in business for (a) the number of times per year an item is sold and replaced (b) the practice of moving stock to keep it fresh (c) the moving of feed to keep it from hardening (d) the total merchandise ordered at any one time.

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Topic Test
on
BUSINESS RECORDS: ORDERING AND RECEIVING MERCHANDISE

Student: _____ School: _____

Date: _____ Score: _____

Multiple Choice:

____ 1. A receiving record will include
a. Instructions for storage
b. Condition of merchandise
c. A catalog for future orders

____ 2. Freight charges are
a. Always
b. Never
c. Sometimes paid by the seller

____ 3. A bill of lading will list the
a. Number of packages in the shipment
b. Cost of each article
c. Suggested selling prices

____ 4. Statements of amounts due enumerating goods delivered are called:
a. Price lists
b. Bills of lading
c. Invoices

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Topic Test
on
INVENTORIES

Student _____ School: _____

Date: _____ Score: _____

True	False		
____	____	1	An inventory is an accurate record of merchandise on hand with its value.
____	____	2	Physical inventories are unnecessary if perpetual inventories are kept.
____	____	3	Inventory control helps to insure that enough goods are in the store.
____	____	4	Physical inventories are made at the end of a firms' fiscal year.
____	____	5.	Physical inventory time is a good time to rearrange stock.

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Topic Test
on
RECEIVING AND STORING MERCHANDISE

Student: _____ School: _____

Date: _____ Score: _____

Multiple Choice:

____ 1 Damage to a shipment should be noted (a) before unloading (b) as unloading proceeds (c) in the warehouse.

____ 2. Notes on damage in shipment should be (a) phoned to the supplier (b) disregarded (c) noted on the receiving form.

____ 3. "Shortages" often may be checked by (a) weight (b) asking the driver (c) comparing with last shipment.

____ 4. Merchandise delivered usually will be "signed for" by (a) the owner (b) the cashier (c) the employee receiving merchandise.

____ 5. Checks for substitutions may be made by (a) phoning the company (b) comparing to order (c) comparing to bill of lading.

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Topic Test
on
STOCKING AND MERCHANDISE PLANNING

Student: _____ School: _____

Date: _____ Score: _____

1. Merchandise ordered too early results in poor use of _____.

2. Merchandise ordered too late results in loss of _____.

3. Who should call to the attention of the owner or manager to stock getting low? _____.

4. Who should know the location of merchandise in the store? _____ _____.

5. Which should be sold first, old stock or new stock? _____.

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Topic Test
on
IMPORTANCE OF FERTILIZERS IN MODERN FARMING

Student: _____ School: _____

Date: _____ Score: _____

1. What are three ways production of most soils may be increased?

   a. _____

   b. _____

   c. _____

2. Three major advantages of fertilizing crops are:

   a. _____

   b. _____

   c. _____

3. In what way do plants resemble animals? _____

_____.

4. Plant food is lost from the soil by:

   a. _____

   b. _____

   c. _____

5. What are three sources of plant food?

   a. _____

   b. _____

   c. _____

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Topic Test
on
WHAT IS FERTILIZER?

Student: _____ School: _____

Date: _____ Score: _____

Fill in the blanks with the proper words or statements.

1. Plants must have plant_____ for _____ and _____.

2. A plant nutrient is any _____ contained in fertilizer and _____ to plant growth.

3. The three most essential plant nutrients are _____, _____, and _____.

4. Some plant food elements have to be _____ with other elements to be used by plants.

5. A "straight" fertilizer is a _____ bearing chemical compound.

6. There are _____ chemical elements considered essential to plant growth.

7. A unit of plant food is ____ percent of a ton.

8. A _____ fertilizer is a combination of needed plant food elements mixed together.

9. The three primary plant foods listed on a fertilizer label are _____, _____, and _____.

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Topic Test
on
FORMS OF FERTILIZER

Student: _____ School: _____

Date: _____ Score: _____

1. Name three common forms of fertilizer.

   a. _____

   b. _____

   c. _____

2. Which liquid fertilizer turns to a gas when applied?

   _____

3. Name two forms of dry, solid fertilizer.

   a. _____

   b. _____

4. Which form of dry fertilizer is most commonly used?

   _____

5. What is the major value of animal manure?

   _____

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Topic Test
on
HOW FERTILIZERS ARE MADE

Student: _____ School: _____

Date: _____ Score: _____

Place a T for true or F for false in the proper blank for each statement.

T F

___ ___ 1. Nitrogen was the first fertilizer produced in the United States.

___ ___ 2. Ammonia is the basic material for all nitrogen fertilizers.

___ ___ 3. Phosphate is made by mixing rock, phosphate, and sulphur.

___ ___ 4. Potash comes mostly from Texas.

___ ___ 5. Pesticides are now being added to fertilizers.

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Topic Test
on
TAKING AND USING SOIL SAMPLES
TO DETERMINE FERTILIZER NEEDS

Student: _____ School: _____

Date: _____ Score: _____

Fill in the blanks with the proper words or statements.

1. Each field prepresents a different _____ problem.

2. A soil test is a _____ analysis of the soil.

3. To correct soil problems a farmer should start with a soil _____.

4. Always take soil _____ properly for best results.

5. PH is a scale of _____ or _____ of the soil.

6. Soil testing is usually done by _____ or _____ firms.

7. Soiltests gives pH, _____, _____, _____, and _____ for correcting problems.

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Topic Test
on
INTERPRETATION OF SOIL TEST RESULTS

Student: _____ School: _____

Date: _____ Score: _____

1. Name five items of information given on a soil test report.

   a. _____.

   b. _____.

   c. _____.

   d. _____.

   e. _____.

2. How does pH or soil reaction affect crop yields?

3. Name four things that are considered together to determine the need for lime.

   a. _____

   b. _____

   c. _____

   d. _____

4. Does "plant nutrients needed per acre" mean pounds of fertilizer or pounds of actual plant food per acre.

5. If a soil test report recommended 40-0-0, how would you supply the farmers needs for fertilizer?

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Topic Test
on
THE pH RANGE AND ITS RELATION TO CROP PRODUCTION

Student: _____ School: _____

Date: _____ Score: _____

Fill in the blanks with the proper words or statements.

1. Soil reaction or pH is the range of _____ or _____ of a soil.

2. The pH scale runs from _____ to _____.

3. Sour or acid soils run from _____ to _____.

4. Southern humid soils are usually more _____ because the loss of some elements by _____ and crop _____.

5. The _____ of some nutrients is changed by the _____ range.

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Topic Test
on
LIMING SOILS

Student: _____ School: _____

Date: _____ Score: _____

Place a T for true and an F for false in the proper column before each statement.

T	F	
___	___	1. Lime is the major treatment for acid soils.
___	___	2. Lime can only neutralize acid soils.
___	___	3. Ground limestone is the most common liming material.
___	___	4. Clay soils are usually more acid than other kinds of soils.
___	___	5. Liming helps soil by physical, chemical, and biological means.

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Topic Test
on
CORRECTING ALKALINE AND SALINE SOILS

Student: _____ School: _____

Date: _____ Score: _____

Fill in the blanks with the proper word or statement.

1. The two kinds of soluble salts affecting the soil are _____ and _____.

2. The four things that usually cause soluble salts to occur are:

   a. _____.

   b. _____.

   c. _____.

   d. _____.

3. The two ways salinity affects plants are:

   a. _____.

   b. _____.

4. The usual method of reclaiming alkali soils is by _____ soil amendments.

5. The most accurate means of determining saline or alkaline problems is by a _____.

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Topic Test
on
NITROGEN FERTILIZERS

Student: _____ School: _____

Date: _____ Score: _____

Place a T for true and an F for false in proper column before each statement:

T	F	
____	____	1. Sources of nitrogen for fertilizers are few.
____	____	2. Ammonia is the base for most all nitrogen fertilizers.
____	____	3. Bacteria cannot help produce nitrogen in plants.
____	____	4. Nitrogen comes only in dry form.
____	____	5. The ammonium form of nitrogen moves with soil moisture.

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Topic Test
on
PHOSPHOROUS FERTILIZERS

Student: _____ School: _____

Date: _____ Score: _____

Fill in the blanks with correct words or statements:

1. _____ is the base for most phosphorous fertilizers.

2. _____ is the most commonly used phosphorous fertilizer,

3. _____ phosphate contains nitrogen.

4. The major liquid phosphorous fertilizer is _____ _____.

5. Phosphate moves _____ in the soil from where it is placed.

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Topic Test
on
POTASH FERTILIZERS

Student: _____ School: _____

Date: _____ Score: _____

1. What happens to pure potassium when exposed to air? _____

2. The 3 compounds that furnish most of the potash are:

   a. _____

   b. _____

   c. _____

3. The state where most postash is produced is? _____

4. Name 3 other sources of potassium.

   a. _____

   b. _____

   c. _____

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Topic Test
on
SECONDARY TRACE ELEMENTS

Student: _____ School: _____

Date: _____ Score: _____

1. Name the 3 secondary plant elements.
   a. _____
   b. _____
   c. _____

2. Name 5 micro or trace elements.
   a. _____
   b. _____
   c. _____
   d. _____
   e. _____

3. Give the source of the following elements:
   a. Calcium - _____
   b. Sulphur - _____
   c. Boron - _____

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Topic Test
on
FUNCTIONS OF PRIMARY PLANT FOODS

Students: _____ School: _____

Date: _____ Score: _____

1. Name 2 functions of each primary plant food.

   a. Nitrogen

      (1) _____

      (2) _____

   b. Phosphorous

      (1) _____

      (2) _____

   c. Potash

      (1) _____

      (2) _____

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Topic Test
on
FUNCTIONS OF SECONDARY PLANT FOODS

Student: _____ School: _____

Date: _____ Score: _____

Name the 3 secondary plant foods and give one function of each:

1. _____

   a. _____

2. _____

   a. _____

3. _____

   a. _____

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Topic Test
on
FUNCTIONS OF MICRO NUTRIENTS

Student: _____ School: _____

Date: _____ Score: _____

1. Name 5 micro nutrients.
   a. _____
   b. _____
   c. _____
   d. _____
   e. _____
2. What is the common name for micro nutrients? _____
3. Are micro nutrients very deficient in most Texas soils? _____

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Topic Test
on
NUTRIENT DEFICIENCY SIGNS IN PLANTS

Student: _____ School: _____

Date: _____ Score: _____

1. Give the nutrient beside each deficiency sign:

_____ 1. Light green band along margin of leaves.

_____ 2. Lack of seed in cotton and corn.

_____ 3. Young leaves light green in color.

_____ 4. Sickly yellowish green color.

_____ 5. Purplish leaves, stems, and branches.

_____ 6. Cotton leaves turn purple between green veins.

_____ 7. Leaves have a wrinkled appearance.

_____ 8. Rosette in pecans.

_____ 9. "Firing" or drying up of leaves, starting at bottom.

_____ 10. Sharply defined series of yellowish-green, light yellow or white streaks in leaf of corn.

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Topic Test
on
PLANT GROWTH AND NUTRITIONAL UPTAKE

Student: _____ School: _____

Date: _____ Score: _____

Place a T for True or an F for False in the proper column by each statement:

T	F	
____	____	1. Plants are like people and animals in their need for food to produce cells.
____	____	2. Food is any substance that can be used as a source of energy for carrying on the life process.
____	____	3. Photosynthesis is the combining of nitrogen and water by the chlorophyll (green color) in the presence of light.
____	____	4. Respiration is the release of chemical energy by plants.
____	____	5. The top of a plant is the chief water absorbing part of the plant.
____	____	6. Cells do not need water to divide and function.
____	____	7. Plants lose water by transpiration, bleeding and guttation.
____	____	8. Nutrient absorption is increased or decreased in some ratios as cell growth and activity.
____	____	9. One of the nutrients necessary for growth and energy is carbohydrates.
____	____	10. A plant has a system of veins to transport nutrients.

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Topic Test
on
PLANT FOOD REMOVED BY CROPS

Student: _____ School: _____

Date: _____ Score: _____

Fill in the blanks with the proper words or statements:

1. Every crop harvested carries off great quantities of _____.

2. If plant food is not replaced, _____, _____, and _____ will suffer.

3. Some plant food is _____ in the soil and is lost.

4. Some plant food is carried off by _____ products.

5. To "hold your own" in soil fertility, the same amount of plant food carried off by crops must be _____.

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Topic Test
on
THE ECONOMIC PRINCIPLES OF FERTILIZERS USE

Student: _____ School: _____

Date: _____ Score: _____

1. Profits are increased from fertilizer use by _____ and _____.

2. What percent of the production of major crops comes from fertilizer?

_____

3. When does it pay to fertilize?

_____

4. How does the use of fertilizer lower production cost?

_____

5. Does the crop involved determine the economic use of fertilizer?

_____

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Topic Test
on
SOIL FACTORS THAT AFFECT RESPONSE TO FERTILIZERS

Student: _____ School: _____

Date: _____ Score: _____

Fill in the blank with the proper word or statement.

1. Soils vary in response to fertilizer because of the following factors:

   a. _____

   b. _____

   c. _____

   d. _____

2. Organic matter improves fertilizer response by _____ the soil, _____ more moisture and furnishing _____ for micro-organisms.

3. Soil _____ _____ influences response to fertilizer by holding more moisture and nutrients and opening the structure of the soil.

4. Soil reaction or pH affects fertilizer response by affecting the availability of _____.

5. Chemical _____ of soils vary, thus causing soils to respond differently to the same fertilizer application.

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Topic Test
on
RATIOS AND MINIMUM GRADES OF FERTILIZERS

Student: _____ School: _____

Date: _____ Score: _____

Place a T for true and an F for false in the proper column beside each statement.

T F

___ ___ 1. The grade of a fertilizer is the minimum guarantee of plant food contained in a fertilizer.

___ ___ 2. The grade is expressed in pounds of pure plant food.

___ ___ 3. Ratio is the amount of one nutrient compared to another in the mixture.

___ ___ 4. A "complete" fertilizer contains all plant nutrients for a plant.

___ ___ 5. An incomplete fertilizer contains one or two primary plant foods.

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Topic Test
on
CALCULATIONS FOR RECOMMENDATIONS

Student: _____ School: _____

Date: _____ Score: _____

1. Name two ways to determine the fertilizer to buy for a given soil test recommendation.

   a. _____

   b. _____

   _____

2. Give the ratio of a 6-12-6 fertilizer.

   _____

3. How much 20-0-0 would it take to supply a soil test recommendation of 80-0-0?

   _____

4. Give the amount 10-20-10 it would take to supply a 30-60-30 recommendation.

   _____

5. How many pounds of N, P, and K are in an 80 lb. sack of 12-24-12.

   _____

   _____

   _____

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Topic Test
on
PRINCIPLES INVOLVED IN FERTILIZER PLACEMENT AND USE

Student: _____ School: _____

Date: _____ Score: _____

Fill in the blanks with the proper word or statement:

1. The method of _____ may affect the yield of a crop as much as the _____.

2. The primary aim in applying fertilizers is to get the proper _____ in the _____ where it will do the most _____.

3. Poor fertilizer distribution gives some _____ too much nutrients and others too _____.

4. When soil is _____ plant nutrients cannot be absorbed easily by the plant.

5. Fertilizer applied too close to seed or roots will _____ plants.

6. _____ moves very little from where it is placed.

7. Fertilizer placed on the _____ causes the loss of nutrients by _____ and _____.

8. Fertilizer placed in _____ near the row does not feed _____ in the middle.

9. Zinc can be applied by _____ the leaves.

10. Soil _____ affects the amount of application and frequency of application of fertilizers.

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Topic Test
on
COMMON METHODS OF APPLYING FERTILIZERS

Student: _____ School: _____

Date: _____ Score: _____

Place a T for true and an F for false in the proper column beside each statement:

T	F	
____	____	1. Fertilizers are usually applied as dry, liquid or gas.
____	____	2. Crop and equipment have nothing to do with the method of application.
____	____	3. Banding fertilizer along row, feeds weeds in the middle.
____	____	4. Foliar application is spraying on leaves.
____	____	5. Top dressing is not used on small grain or pasture.
____	____	6. Airplanes distribute dry granular fertilizer or liquid.
____	____	7. Type of soil helps to determine method of application.
____	____	8. Nitrogen solutions have aided nitrogen applications.
____	____	9. Starter solutions only help producing plants.
____	____	10. You cannot fertilize in irrigation water.

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Topic Test
on
TIME OF FERTILIZER APPLICATION

Student: _____ School: _____

Date: _____ Score: _____

Fill in the blanks with the proper word or statement:

1. Most of the fertilizer placed in the U. S. is placed during _____, _____, and _____.

2. Applying fertilizer in a few months makes it more _____.

3. Storing fertilizer requires a _____ place which is usually_____.

4. Early application of fertilizers sometimes causes more nutrient loss by _____ and _____.

5. Organic matter decomposing _____ absorb much of the nutrients, especially nitrogen, and hold it until the soil warms up.

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Topic Test
on
FERTILIZER APPLICATION EQUIPMENT

Student: _____ School: _____

Date: _____ Score: _____

1. A Fertilizer applicator should

   a. _____

   b. _____

2. Five general systems of fertilizer applications are:

   a. _____

   b. _____

   c. _____

   d. _____

   e. _____

3. Name five types of applicators for fertilizer.

   a. _____

   b. _____

   c. _____

   d. _____

   e. _____

4. Name four things to do in caring for fertilizer applicators.

   a. _____

   b. _____

Fertilizer Application Equipment
(Topic Test Continued)

c. _____

d. _____

5. List two conditions which make airplane fertilizer distribution advantageous.

a. _____

b. _____

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Topic Test
on
REGULATIONS CONTROLLING FERTILIZER MANUFACTURE AND USE

Student: _____ School: _____

Date: _____ Score: _____

Place a T for true or an F for false in the proper column beside each statement:

T	F	
____	____	1. The Texas Feed and Fertilizer Control Service controls fertilizer manufacture and use in Texas.
____	____	2. Fertilizer manufacturers do not have to guarantee analysis or grade.
____	____	3. Commercial fertilizer cannot contain animal excretions.
____	____	4. Bulk is any fertilizer sold by the ton.
____	____	5. Grade is percent of nitrogen phosphorous and potash.
____	____	6. Specialty fertilizers do not have to be labeled for special use.
____	____	7. Fertilizers may contain pesticides.
____	____	8. The fee for inspection of fertilizer manufacture is $25.00 per ton.
____	____	9. A fertilizer material is any material containing any essential plant nutrient available to plants and used for promoting plant growth.
____	____	10. All states do not penalize for lack of guaranteed anaylsis.

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VOCATIONAL AGRICULTURE

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COURSE OUTLINE

DEVELOPED BY STATE ADVISORY COMMITTEE ORNAMENTAL HORTICULTURAL OCCUPATIONS

Unit I	Introduction to Horticulture	1. Horticulture as an Industry 2. Exploring Occupational Opportunities
Unit II	Plant Growth and Classification	1. Introduction 2. Photosynthesis 3. Respiration 4. Water Absorption and Loss--Nutrient Absorption--Movement of Water and Nutrients in the Plant 5. Plant Food 6. The Plant Kingdom
Unit III	Constructing, Maintaining, and Using Structures that Aid Plant Growth	1. Types of Greenhouses 2. Size and Arrangement of Greenhouses 3. Cooling the Greenhouse (Summer and Winter) 4. Heating the Greenhouse (Space and Bench Heating) 5. Winter Protection Structures 6. Structures for Summer Heat Protection 7. Humidity and Watering 8. Ventilation 9. Lighting 10. Wiring and Electrical Controls
Unit IV	Plant Growing Media	1. Origin, Composition and Importance of the Soil 2. Soil Moisture 3. Soil Mixtures 4. Mulches and Their Use 5. Fertilizer Nutrients 6. Soil Organisms 7. Soil Sterilization 8. Growing Media Other Than Soil

Unit V	Plant Propagation	1. Introduction to Propagation 2. Propagation from Cuttings 3. Propagation by Layering 4. Propagation by Division 5. Propagation by Grafting and Budding 6. Propagation from Seed 7. Developing a Plant Breeding Vocabulary 8. Plant Selection and Fundamentals of Plant Breeding 9. Heredity 10. General Breeding Techniques
Unit VI	Nursery Plant Production	1. Transplanting Ornamental Trees and Shrubs 2. Care and Maintenance of Plants
Unit VII	Floral Crop Production	1. Introduction to Floral Crop Production 2. Growing Annuals 3. Perennials 4. Bulbs 5. Characteristics, Identification, and Use of Important Pot Plants 6. Poinsettia 7. Chrysanthemum 8. Geranium 9. Hydrangea
Unit VIII	Establishing and Caring for Lawns	1. Turf Grasses for Texas 2. Establishing a New Turf 3. Managing an Established Turf 4. Turf Problems
Unit IX	Controlling Plant Insects Plant Diseases, and Other Pests	1. Causes of Plant Diseases 2. Identifying Plant Diseases 3. Application and Safety Precautions of Horticultural Chemicals 4. Controlling Stem, Branch, and Trunk 6. Controlling Root Diseases 7. Controlling Diseases Affecting the Entire Plant

Unit IX	Controlling Plant Insects, Plant Diseases, and Other Pests (continued)	8. Controlling Lawn and Turf Diseases 9. Identifying Plant and Soil Insects and Methods of Control 10. Nematodes 11. Control of Moles, Gophers, Birds, Deer, and Ants 12. Controlling Weeds
Unit X	Operating and Maintaining Horticultural Equipment	1. Principles Used to Prevent Personal Injury and First Aid Principles 2. Selecting and Maintaining Horticultural Hand Tools 3. Maintaining Small Power Equipment 4. Operating and Maintaining Lawn Mowers Safely and Effectively 5. Operating Rotary Tillers Safely and Effectively 6. Operating Garden Tractors Safely and Effectively
Unit XI	Developing and Maintaining the Landscape	1. Introduction to Home Landscaping 2. Selecting the Site 3. Scheduling Landscape Development and Beginning Plans 4. Analyzing Problems and Determining Needs 5. Developing the Landscape Plan 6. Selecting Plants 7. Grading, Drainage and Landscape Structures
Unit XII	Merchandising Horticultural Plants and Supplies	1. Developing Personal Traits 2. Displaying 3. Advertising 4. Labeling and Pricing 5. Understanding Customers and Making Sales

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Introduction to Horticulture

TOPIC: Horticulture as an Industry

OBJECTIVE: To become aware of the importance of Horticulture and to develop an understanding of the fields of study involved

INTRODUCTION: Horticulture is an important branch of agriculture. The first definition of horticulture limited the field to cultivation of gardens. Flowers, vegetables, fruits, and ornamentals that were grown primarily in gardens soon acquired the name of "horticultural plants" in contrast to "field crops" such as corn and cotton. We now think of horticulture as the production of flowers, vegetables, fruits, and ornamentals in the garden on a large scale basis. It also includes the many services which are auxiliary to the production and marketing of horticultural crops.

REFERENCES: Required:

1. Information Sheet, "Horticulture as an Industry"

QUESTIONS or ACTIVITIES:

1. With what type of crop is the olericulturist concerned?
2. With what type of crop is the pomologist concerned?
3. What four major types of crops are included in horticulture?
4. In which group of fruits do grapes belong?
5. In which group of fruits do apples belong?
6. What caused the expansion of vegetable growing?

Information Sheet
on
HORTICULTURE AS AN INDUSTRY

There are three major fields of horticulture Floriculture is the cultivation and management of ornamental and flowering plants Landscaping has also become an important function of the floriculturist Pomology is the science and practice of fruit growing Olericulture is the production, processing and distribution of vegetable crops

Floriculture was well developed thousands of years ago by the civilizations of Asia Their beautiful gardens required much knowledge and skill A landscape designer must have a knowledge of the principles of design along with a thorough understanding of plants Plant breeding has become very popular in the floriculture field. Patience and care are needed in this tedious task of developing new and improved plants

Pomology is a very demanding field Fruit trees are under constant attack from diseases and insects The fruit producer must be able to control these pests effectively. The pomologist also has to have a thorough understanding of plant growth There is a great deal of specialization in the field of fruit growing. Many choose to work only with citrus, others concentrate on small fruits such as grapes, and still others deal with deciduous tree fruits such as apples There are countless jobs to be found in the field of pomology

Olericulture is a gigantic enterprise that is quite distinct from any other phase of plant production. The annual farm value of vegetable crops in the United States is well over a billion dollars The big expansion in the vegetable industry was due primarily to an increase in production of out-of-season vegetables in the South and West The production, processing, and marketing of this huge crop requires a great number of personnel

As we can readily see, horticulture is a giant industry. If you are interested in plant growing and are willing to work hard in gaining new knowledge, a good future awaits you.

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Introduction to Horticulture

TOPIC: Exploring Occupational Opportunities

OBJECTIVE: To develop an understanding of the requirements of some specific occupations and to determine the factors to consider in selecting an occupation.

INTRODUCTION: This lesson is designed to help you decide upon an occupation in the field of horticulture. In this lesson we will explore only five major occupations, all of which are available to cooperative part-time students in agriculture. In addition, instructional materials have been prepared for these occupations to assist you in developing into a skilled worker with potential for advancement in your chosen occupation.

In recent years the need for trained workers in these occupations has increased greatly. If you like the work and apply yourself on the job and in your studies, a world of opportunity awaits you.

REFERENCES: Required:

1. Information Sheet, "Exploring Occupational Opportunities"

Supplemental:

2. Handbook of Agricultural Occupations", Hoover

QUESTIONS or ACTIVITIES:

1. List the steps of advancement in a horticulture career.
2. If possible, what is the best way to answer self appraisal questions concerning a certain job?
3. If you wanted a horticultural job which allowed you to work both inside and outside, which would you choose?
4. Prepare a list of businesses in your community which raise or sell horticultural products.
5. Study the 18 factors to consider in selecting a job and be prepared to apply these factors in selecting your occupation.

Information Sheet
on
EXPLORING OCCUPATIONAL OPPORTUNITIES

The selection of a vocation in horticulture is similar to that of other fields Basic questions arise in the mind of the person who is trying to select a vocation These questions or factors must be dealt with before a satisfactory selection can be made The following list points up some of these questions

Factors One Should Consider in Selecting a Job

1 What is the nature of the work? What kind of jobs will I be expected to do?
2 Does the occupation require chiefly mental or physical effort? Will my health allow me to do this work?
3. Is the work inside or outside work, or both?
4. What are the working conditions? With whom will I be working?
5 What personal qualifications are required for entry into the occupation?
6. What are the educational and training requirements for the job?
7 Is there opportunity for doing a variety of jobs?
8. Will the work require considerable travel and time away from home?
9 What financial earnings can one expect?
10. Are any fringe benefits provided by the business?
11 Is there a great deal of risk involved in performing the job?
12. What security and benefits are offered in the occupation?
13. Are there opportunities for advancement and self-betterment?
14. Is the employment on a regular or seasonal basis?
15. Does one work regular hours? Eight, ten, or twelve hour day? Day or night shift?
16. Is there stability of residence or must one make frequent moves?
17 Will the job necessitate that one get along well with others or will one work pretty much alone?
18 How much personal expense is involved in clothing, transporation and meals?

Another very important question in the selection of a vocation is that of advancement. Usually a person who cannot advance in his chosen field will become unhappy and fail to do his best. This question should be investigated before choosing a vocation in the field of horticulture.

The opportunity for advancement is fairly good in this field. The following sketch demonstrates an example of the possible steps in the advancement of the horticulturist who applies himself to his work

Advancement in Horticultural Occupations

1. Laborer
2. Foreman or Supervisor
3 Assistant Manager
4. Manager or Owner

Exploring Occupational Opportunities
(Information Sheet continued)

As you can see from this example, application, education and experience can determine the speed and degree of advancement.

Probably the most important question of all is, "am I personally suited for a career in horticulture"? It can only be answered after you have investigated the field and have a good knowledge of what it is and what it offers. The answer probably lies in self appraisal.

This self appraisal can be achieved by asking yourself the following questions:

1. Do I prefer working with things?
2. Do I prefer working with facts, figures, and ideas?
3. Do I have a love for growing things?
4. Do I like to work with people?
5. What kind of work experiences have been most enjoyable to me?
6. What kind of work would I like to be doing five, ten, or fifteen years from now?
7. Will my health permit me to make the choice I want?

Probably the best way to determine the answer to these questions is by actually working on a job for a while. However, this cannot always be done. Circumstances do not always permit this.

There are other good ways to determine some answers. Your fondness for certain subjects in school, your interest in certain activities, study of the field of horticulture, talks with your teachers, guidance counselors and others may indicate interests and abilities that will help you to partially answer the questions. Such things as cooperativeness, willingness to work, dependability, willingness to assume responsibility, resourcefulness and self-reliance are all basic qualifications that you will need in ornamental horticulture as well as other occupations.

A close look at some of the jobs in horticulture will reveal many opportunities and requirements. As you look at each job try to decide if you are interested and qualified.

Job Title - Greenhouse Worker

Job Description

A greenhouse worker grows plants in an artificially heated glass or plastic greenhouse. The plants grown may be vegetables or flowers, and the work may include the propagation of trees or ornamental shrubs from seeds of cuttings. Greenhouse specialties include producing out-of-season vegetables such as tomatoes, cucumbers, or leaf lettuce, producing cut flowers or pot plants, growing bedding plants for sale, or starting plants for outdoor nursery beds. In many cases a greenhouse is a part of a nursery operation. In such cases, a worker may be performing the duties of a nursery worker as well as

Exploring Occupational Opportunities
(Information Sheet continued)

those of a greenhouse worker. An employee in the greenhouse screens, mixes, sterilizes soil, and places it in growing containers. He sows seeds, starts cuttings, and transplants seedlings and plants. He waters, feeds, weeds, thins, prunes, and sprays growing plants. He may control the greenhouse temperature and humidity. He also maintains the greenhouse structure and equipment. He should know the names and the culture of the plants with which he works.

Job Title - Nursery Worker

Job Description

A nursery worker grows seedlings and plants for landscaping, fruit farming, and forest replanting. He may work in one of several kinds of nurseries. Some nurseries specialize in producing fruit trees and small fruit transplants, some in ornamental trees and shrubs, and some in forest replanting materials. Some nurserymen operate greenhouses and produce their own seedlings and plants from cuttings. Some produce planting stock of two or more major lines of plants, trees, or shrubs.

A nursery worker prepares seedbeds, plants seedlings, weeds, cultivates, fertilizes, waters, prunes, and performs other cultural practices such as spraying and grafting. He digs, grades and packs plants for shipment. He may cut, lift, and lay sod. He transplants shrubs and trees, and in a tree nursery, gathers and processes forest tree seeds. He helps with the maintenance and repair of buildings and equipment.

A nursery employee assists customers in selecting plants for home landscaping. He also makes recommendations on maintenance to the customer and may work at a nursery where he will be required to make periodic checks on customer's lawns and to maintain the beauty of the landscape.

Job Title - Garden Center Employee

Job Description

A garden center employee performs many jobs including caring for ornamental plants, moving plants and supplies into selling areas, arranging plants and supplies for display purposes, and selling the various products handled by the garden center. A garden center may be part of a large retail store, a part of a nursery or greenhouse operation, or a retail establishment separate from any other business.

Exploring Occupational Opportunities
(Information Sheet continued)

The work of a garden center worker includes cleaning, stocking, and arranging garden supplies on shelves, counters, and in windows He cares for ornamental plants by watering, feeding, trimming, spraying, and controlling temperatures The worker unloads and unpacks supplies as they arrive from wholesalers, loads orders on trucks, makes deliveries, and loads orders into customer's cars He gives information to customers on care of plants, care of lawns, plant varieties, and merits of different garden supplies and equipment

Job Title - Assistant Groundskeeper

Job Description

An assistant groundskeeper cares for the area surrounding an industry or business, church, school, airport apartment building, private estate, cemetery, or shopping center. The employee plants and cares for lawns and ornamental plants. The work involves mowing grass, reseeding, controlling weeds, and planting and spraying ornamental plants He rakes and disposes of leaves and other refuse Year round employment is provided through maintenance and repair of walks, drives, and equipment. The work may also involve making minor repairs to buildings.

Job Title - Parks and Landscape Employee

Job Description

A parks and landscape employee performs the work necessary for proper maintenance of landscapes and park area

The work of this occupation includes mowing grass, trimming, the edges of walks and driveways, planting, pruning and caring for trees, shrubs, hedges, lawns, and flower beds; controlling insects, diseases, and weeds; and caring for the soil. The work may also include such jobs as removing trash or snow, maintenance of swimming pools, care of boating facilities, general maintenance of buildings and equipment, and repair of roadways and drives.

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Material for this information sheet was partially taken from Ornamental Horticulture for Vocational Agriculture in Alabama

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Plant Growth and Classification

TOPIC: Introduction

OBJECTIVE: To develop an understanding of the importance of studying the properties and life phenomenon exhibited by a plant.

INTRODUCTION: There are over 350,000 different kinds of plants in the world. No one person can know all of them, but he can learn the characteristics that are common to all of them. Without a knowledge of botany a plant grower is lost. If he does not know how plants grow, how can he possibly be successful in raising them?

REFERENCE: Required:
Crop Production in the South, Klingman, pp. 13-19

QUESTIONS or ACTIVITIES:

1. What is botany?
2. How many different kinds of plants are known to exist?
3. Name two carbohydrates.
4. What is the major difference between plants and animals other than the ability to move and to think?
5. What was the wrong conculsion that Van Helmont made after his experiment concerning plant growth?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Plant Growth and Classification

TOPIC: Photosynthesis

OBJECTIVE: To learn how plants produce their food.

INTRODUCTION: Van Helmont failed in his experiment to determine why plants grow. He thought that water alone was responsible for the growth. Van Helmont did not know about photosynthesis; so his conclusion was wrong.

REFERENCES: Required:
Crop Production in the South, Klingman, pp. 19-24

QUESTIONS or ACTIVITIES:

1. What does photo mean?
2. Define synthesis.
3. What is a more complete definition of photosynthesis?
4. What is a calorie?
5. What is a molecule?
6. What is the term used to describe the movement of gas or liquid from an area of high concentration to an area of low concentration?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Plant Growth and Classification

TOPIC: Respiration

OBJECTIVE: To learn about the process of respiration and to study its relation to photosynthesis.

INTRODUCTION: All cells must carry on respiration in order to stay alive. Most of us understand less about the process of respiration in the plant as compared to our knowledge of respiration in the animal. Yet the processes are very similar in the animal and plant cell.

REFERENCE: Required:
Crop Production in the South, Klingman, pp. 29-32

QUESTIONS or ACTIVITIES:

1. Define respiration.
2. What two materials are formed when food is decomposed with the addition of oxygen?
3. How much do the chemical equation for photosynthesis and respiration differ?
4. What gas do plants release at night?
5. What are the raw materials needed for respiration?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Plant Growth and Classification

TOPIC: Water Absorption and Loss--Nutrient Absorption--Movement of Water and Nutrients in the Plant

OBJECTIVE: To understand how water and nutrients are absorbed by the plant, to understand how water is lost, and to study the transportation system of the plant.

INTRODUCTION: One of the necessary functions of plants is to absorb water and nutrients from the soil. For proper management, one must understand these absorption processes and also the transporting of these materials by the plant.

REFERENCES: Required:
Crop Production in the South, Klingman pp. 32-35

QUESTIONS or ACTIVITIES:

1. What will happen to a plant if its inside pressure is greatly reduced?
2. What is the term used to describe cells that are filled tight and result in plants standing straight?
3. Explain how an over supply of fertilizer around a plant's roots affect its water absorption process.
4. What is transpiration?
5. What are nutrients?
6. What two conductive tissues make-up a vascular bundle?
7. Explain why girdling a tree causes it to die.

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Plant Growth and Classification

TOPIC: Plant Food

OBJECTIVE: To learn the different plant foods and their functions.

INTRODUCTION: A food is any substance which can be used as a source of energy for carrying on the life processes. To really understand plant growth, one must understand the basis for life --- food

REFERENCE: Required:
Crop Production in the South, Klingman, pp. 24-29

QUESTIONS or ACTIVITIES:

1. What is food?
2. What are the 3 foods used for energy and growth?
3. What elements make up carbohydrates?
4. What is the primary function of fats?
5. Where in the plant are fats most commonly found?
6. What is the process called by which hydrogen is added to oils?
7. What are the components of protein?
8. What 4 elements make up aroung 97% of the dry weight of most plants?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Plant Growth and Classification

TOPIC: The Plant Kingdom

OBJECTIVE: To become familiar with the system used to classify plants.

INTRODUCTION: People in West Texas may call a certain plant "dove weed" while an East Texas farmer may call it "croton". Names vary with localities. The only way to solve this problem was to develop a unified method of classification.

REFERENCE: Required.
Crop Production in the South, Klingman, pp 35-40

QUESTIONS or ACTIVITIES:

1. What is taxonomy?
2. What are the four divisions of plants?
3. In which division do we find most of the disease causing plants?
4. What are some examples of beneficial bacteria?
5. What plant causes smut, rust, mildew, and scab?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Constructing, Maintaining, and Using Structures that Aid Plant Growth

TOPIC: Types of Greenhouses

OBJECTIVES: To learn how greenhouses are constructed, used, and maintained.

INTRODUCTION: Greenhouse production of horticultural plants is an enormous industry. Driving a few miles across Texas, one can usually count several greenhouses that are in full operation. It is interesting to note the various shapes of these structures and the different materials used in construction.

REFERENCES: Required:
Flower and Plant Production in the Greenhouse, Nelson, pp. 19-32

QUESTIONS or ACTIVITIES:

1. What are the two most used materials for greenhouse coverings?
2. What time of year is best for repairing or replacing slipped or broken glass?
3. What properties should an ideal greenhouse plastic possess?
4. What are some of the advantages and disadvantages of polyethylene and vinyl?
5. How is the ventilation problem handled in greenhouses where there are no ventilators?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Constructing, Maintaining, and Using Structures that Aid Plant Growth

TOPIC: Size and Arrangement of Greenhouses

OBJECTIVE: To learn how to select the proper size and arrangement before constructing the greenhouse

INTRODUCTION: A careful study of greenhouse arrangement should be made before construction begins. The bench arrangement for the crops to be grown should be considered first. Then the greenhouse that fits this arrangement should be built. If these factors are done in reverse and a structure is erected before working out bench plans, many inconveniences and headaches will be the result.

REFERENCE: Required
Flower and Plant Production in the Greenhouse, Nelson, pp. 33-38

QUESTIONS or ACTIVITIES:

1. What should be considered first in deciding the size and type of greenhouse?
2. Why should boiler rooms be centrally located?
3. What are the requirements of good greenhouse benches?
4. What is the best height for pot plant benches?
5. What should be the minimum depth of cut flower benches?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT. Constructing. Maintaining. and Using Structures that Aid Plant Growth

TOPIC: Cooling the Greenhouse

OBJECTIVE To learn the different methods of cooling the greenhouse and how to use these methods most effectively

INTRODUCTION The weather in Texas during the summer months is usually very hot. This presents a problem to the greenhouse owner. A successful producer must have an effective cooling system or he may well lose every plant he owns.

REFERENCES. Required:

1 "Greenhouse Cooling", Texas Agricultural Experiment Station, MP-163

Supplemental

2 Flower and Plant Production in the Greenhouse, Nelson, pp. 44-48

QUESTIONS or ACTIVITIES:

1 What is plant respiration?
2 How many CFM should be exhausted for a greenhouse which is 40' wide and 70' long?
3. How many square feet of pad area would be needed in the above greenhouse? (nearest tenth)
4 How can debris and trash be kept out of the drip conductor and return gutter?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Constructing, Maintaining, and Using Structures that Aid Plant Growth

TOPIC: Heating the Greenhouse

OBJECTIVE: To become aware of the problems involved in heating the greenhouse and how to handle these problems

INTRODUCTION: There are two major systems of heating a greenhouse. Each system has its advantages. All factors involved should be considered before a choice is made.

REFERENCES: Required:

1 Information Sheet, "Heating the Greenhouse"
2. Flower and Plant Production in the Greenhouse, Nelson, pp. 39-44

QUESTIONS or ACTIVITIES:

1. What is the oldest and most conventional type of greenhouse heating system layout?
2. What are the two sources of heat used in this system?
3. Where are the coldest spots in a greenhouse?
4. What are the two classifications of heaters according to the type of heating unit?
5. What are the two classes of heaters based on direction of air flow?

Information Sheet
on
HEATING THE GREENHOUSE

A dependable heating system is second only in importance to the efficient design and structural soundness of a greenhouse. Any heating system employed in a greenhouse must be economical, efficient, and of sufficient size to maintain desirable greenhouse temperatures during anticipated extremes in outdoor temperatures.

An important consideration for any greenhouse operation is to operate the heating system at the lowest possible cost consistent with maintaining the temperature desired. This requires that the heating system be designed correctly for the purposes intended, that it be operated properly, and that careful and intelligent maintenance of the system be provided

GREENHOUSE HEATING DESIGN STANDARDS

The standard practice followed in the past has been to specify the design of a greenhouse heating system on the basis of a requirement to maintain a given temperature within the greenhouse at some given outdoor winter temperature. It is comparatively simple to specify such a differential.

Today the temperature required for the production of various crops grown in the greenhouse is general knowledge and is usually readily available.

Recorded temperatures in historical records in nearly every climatic area are available and will provide considerable information on the outdoor winter temperatures, including both the ext reme winter temperatures that have occurred in that particular area, and those that should be considered in regard to the type of design that is economically feasible for the greenhouse heating system.

The acceptable standard for the design of a greenhouse heating system should go beyond this basic requirement, however. A clarification of the greenhouse temperature requirements of the crop to be grown is very necessary.

Greenhouse temperature requirements for the crop should not mean the temperature prevailing in the aisle space

The common practice that now prevails in determining the temperature requirements of the crop is to measure the temperature at the point where the crops are growing. One of the requirements of a well-designed greenhouse heating system should be the provision of a uniform temperature within allowable variations throughout the plant-growing area.

These requirements are rather complex and the average greenhouse operator is usually not well enough versed in heat engineering to make sure he is going to have the type of heating system that meets his requirements. In most cases he does not have the skill, nor the time to plan such a system and he should depend upon someone well versed in this field.

Heating The Greenhouse
(Information Sheet continued)

The most logical approach to the installation of a modern, up-to-date, economical and dependable greenhouse heating system is to seek the knowledge and experience that is available from a dependable greenhouse manufacturer. Heating greenhouses is a specialized field which varies greatly from heating standards used for other type buildings.

The National Greenhouse Manufacturers Association, a newly formed organization comprised of most of the major greenhouse manufacturers in the country has recognized this need on the part of the average greenhouse operator, and has been spending considerable time, effort, and funds and utilizing the best knowledge and experience available from it's various member organizations, to establish standards of design that will insure the greenhouse owner of the proper installations to meet his particular requirements.

GREENHOUSE HEATING LAYOUTS

Pipe Coil Systems

The most conventional and the oldest type greenhouse heating system layout and the one most commonly accepted by greenhouse growers is the pipe coil system.

This system employs the use of standard pipe which carries either steam or hot water. The pipes are laid out around the greenhouse in various patterns to distribute the heat.

In recent years the use of extended surface pipe has been introduced. This pipe is commonly referred to as "finned pipe". This uses the extended surface or fins on the pipe for greater heat transfer from any given length of pipe. The pattern of behavior, however, is similar to that of plain pipe coils, which makes the layout patterns fall into the same category.

The proper layout of a pipe coil heating system is dependent upon an understanding of the basic laws of natural air movement to insure uniform temperature distribution throughout the greenhouse. Any pipe coil system supplies the heat from a concentrated heat source in the immediate area of the pipe, and depends upon convection currents of air moving past the pipe to pick up this heat and convey it to all parts of the greenhouse.

The coldest spots in the greenhouse are the gable ends and the exterior side walls, so pipe coils are suspended in these areas. The warm air emitted from the pipe coils raises and sweeps along the glass, conteracting the rapid loss of heat through the glass. This movement sets up the basic convection pattern of warm-air movement throughout the greenhouse for uniform heat distribution.

Heating The Greenhouse
(Information Sheet continued)

A finned pipe has the concentrated heat effect of several lines of bare pipe so that any restriction of air movement or reduction of temperature difference is magnified.

Unit Heater Systems

In recent years the use of unit heaters for heating greenhouses has increased considerably. Most of these unit heaters are so designed that they not only take care of the heating requirements but air movement as well.

One reason for the increase in popularity of unit heaters has without a doubt been the increasing interest in air movement within greenhouses. Many greenhouse operators are of the opinion that the movement of air in the plant zone in the greenhouse (providing that the air moves at a low velocity) has the effect of preventing the building of excess humidity within the foliage that leads to the development of certain conditions. Air movement brings in and replenishes the supply of carbon dioxide. At the present time also, there is considerable interest in installations to activate air movement and break up air stratification.

Many types of unit heaters are available. Basically they all contain some type of heating device and a fan to force the air across the heating surface and out into the area to be heated.

These heating units are classified as direct-fired or indirect-fired, dependent upon the type of the heating unit. Direct-fired units are those which contain a combustion unit right in the unit itself in which fuels such as oil or gas are burned. Then this type of unit is used for greenhouse heating, the combustion chamber should be totally enclosed and should be vented to the outside air for the products of combustion.

Indirect-fired unit heaters utilize steam or hot water circulated through coils as the heating elements.

Unit heaters are also classified according to the direction of air flow. This flow is designated as vertical blow or horizontal blow.

In vertical blow heaters the shaft is vertical and the fan blade is horizontal and the warm air is blown downward. Deflectors suitable for this purpose spread the air out in a horizontal direction in a complete circle. Normally these units are mounted up near the peak of the sidewalls. This of course is against the natural direction of warm air flow, and the distance of flow is limited. Frequently the warm air does not move down along the side walls where it is required. When this type of unit heater is installed a line or two of perimeter piping along all walls exposed to the outside should be installed to insure uniform heat distribution.

Heating The Greenhouse
(Information Sheet continued)

In narrow greenhouses coils located on the side and end walls may be sufficient to provide the uniformity needed. In wider houses, however, additional piping is required across the house.

Experience over the years has proven that pipe coils suspended overhead provide the uniform temperatures required.

The standard practice followed is to suspend the pipe coil overhead, with one line of pipe running lengthwise over each bench. The coil should be placed high enough so that the tips of the tallest plant to be grown will not come in direct contact with the pipes. The rule of thumb standard used by most greenhouse operators, is to suspend one third of the number of lines of pipe required overhead and one third of the number along each side. In general this has given a satisfactory uniform heat distribution.

An older method of installation, still preferred by many commercial growers, is to distribute the cross house piping by installing the pipe lines under the benches. Such installations keep the soil in the benches warmer, and for this reason may be desirable for those crops which require warm soil for optimum growth.

The amount of heat provided by a pipe coil depends in part upon the temperature difference between the air and the pipe surface and the rate of air movement past the pipe. These basic facts should always be kept well in mind when pipe coils are suspended along greenhouse side walls. The pipe should be suspended far enough away from the wall so that air can move up freely on both sides of the pipe. When side benches are installed in the greenhouse they should be spaced at least six inches from the wall to allow free upward movement of the warm air without "boxing" it in under the bench.

The bottom pipe of a pipe coil should be placed a minimum distance of four to six inches above the ground to permit the free flow of the cooler air in and under the coil. A pipe buried in the ground or covered with soil is practically ineffective as a heating unit.

When pipe coil heating systems are installed it is usually necessary to stack the pipes vertically to obtain the necessary number of coils. This installation makes each pipe less effective than it would be if installed separately or alone. This, of course, results in less temperature difference between the air and the pipe surface for transmitting heat. Therefore, when the pipes can be spaced as far apart as possible in the coils this reduction of heating effect can be kept at a minimum.

When finned, or extended surface pipe is installed these rules of spacing, height of pipe from the ground surface, and spacing of side benches from the walls become even more important.

Heating The Greenhouse
(Information Sheet continued)

In horizontal blow heaters the shaft is horizontal and the fan blades are in a vertical position. The air is blown out of the face of the heater in a horizontal direction. When several of these units are used in the same greenhouse they should be mounted so they are suspended overhead near the side walls of the greenhouse. The units on one side should face toward one end and those on the other side should face toward the opposite end This will establish a pattern of air movement around the greenhouse. Adjustable horizontal louvres should be installed on the face of each heater so the direction of air movement can be adjusted upward or downward to prevent direct drafts or air blasts on the plants and to provide proper warm-air distribution.

Temperature control with unit heaters in the greenhouse is normally accomplished by leaving the fans operating continually and turning the heat on and off so that there is a continuous movement of air. Whenever the fans are operated only intermittently when the fans are off the air can become stratified. This will result in conditions detrimental to good plant growth.

Automatic Control Systems

The trend toward the use of automatic controls in greenhouse operations to reduce costs and increase efficiency has led to the wide-spread adoption of automatic controls on greenhouse heating systems.

Automatic systems also perform better than manual controls since they control temperature constantly rather than intermittently.

To perform the job effectively, however; the control system must be properly designed to fit the individual heating system or they may do more harm than good. Therefore, in any installation the location of automatic valves and thermostats should be left to the discretion of a greenhouse engineer who has the competence to adjust the controls to the system being employed.

HEATING ACCESSORIES

The accessories installed are important features in properly operating and maintaining an efficient heating system.

Pipe hangers should be installed so that the proper grade can be maintained in the pipes to prevent pockets or sags that reduce the flow of steam or hot water.

Traps of the proper size and located in the correct place are essential to the efficient operation of a steam heating system.

Heating The Greenhouse
(Information Sheet continued)

Air vents must be strategically located in the system to prevent air locks.

The more extensive the heating system the more the list of accessories could be extended. When automatic controls are used the importance of proper accessories and their location increases

EFFICIENCY AND MAINTENANCE

Unless a sound, sensible and almost constant program of proper maintenance is installed as soon as a greenhouse is put into operation, all of the time and money invested in the design and the installation of an efficient greenhouse heating system may be lost. Maintenance of heating systems is an item of greenhouse operation that is most often neglected. Traps must be kept in working order, pipe hangers kept tight to prevent pipe sagging and air vents must be kept cleaned out or operating costs will increase and the heating system will become very inefficient. A sound maintenance program should be instituted in the overall greenhouse operation program and should be adhered to in a very consistent manner.

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Material for this information sheet was taken from short course mimeograph prepared by Floriculture Section, Department of Soil and Crop Science, Texas A&M University and presented by A. F. DeWerth

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Constructing, Maintaining, and Using Structures that Aid Plant Growth

TOPIC: Winter Proctection Structures

OBJECTIVE: To learn the various techniques involved in protecting plants from winter damage.

INTRODUCTION: A hard freeze can ruin a whole year's work. Plants that have been cared for and protected all year can be killed in just a short period of time by the freezing winds of winter.

REFERENCES: Required:
Basic Gardening Illustrated, pp. 72-73

QUESTIONS or ACTIVITIES:

1. What should you notice during the first couple of light frosts?
2. Why should soil be kept damp during a frost?
3. How do notcaps work?
4. How do you arrange outdoor heaters in a small orchard?
5. What are four telltale signs of a coming frost?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Constructing, Maintaining, and Using Structures that Aid Plant Growth

TOPIC: Structures for Summer Heat Protection

OBJECTIVE: To learn how to protect plants from damage by summer heat.

INTRODUCTION: The subject of shade for plants is often neglected by beginning horticulturists. Many people who are said to have a "green thumb" are excellent plant producers because they properly care for their plants during the summer months.

REFERENCE: Required:
Basic Gardening Illustrated, pp. 70-71

QUESTIONS or ACTIVITIES

1. What are the 3 main functions of shades?
2. Which direction should a permanent shade structure face in hot summer areas?
3. What are 2 good materials that can be stretched over lath frames to lean against walls to protect seedlings in flats?
4. What direction should the laths run on a sunscreen?
5. How can you stiffen the frame when making a lath screen?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT. Constructing, Maintaining, and Using Structures That Aid Plant Growth

TOPIC. Humidity and Watering

OBJECTIVE To become familiar with the effect of humidity on the development of plants and to learn how to determine water requirements

INTRODUCTION. Humidity, moisture found in the air, and the amount of soil water can greatly affect the growth of plants Overwatered plants will be stunted, yellow in color, and defective in root development The amount of humidity can reduce the food production process of the plant or cause excessive wilting.

REFERENCES
Required:
1. The Ball Red Book. George J. Ball, Inc., pp. 111-114

QUESTIONS or ACTIVITIES

1 What means of watering is best for commercial pot plant crops?
2. How are the majority of bedding plants watered?
3. What are three disadvantages of an overhead watering system in a greenhouse?
4. Explain how a Rainbird-type nozzle system operates?
5. Explain how the Skinner irrigation system operates.

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Constructing, Maintaining, and Using Structures That Aid Plant Growth

TOPIC: Ventilation

OBJECTIVE: To become familiar with the importance of proper greenhouse ventilation and to understand the methods of moving air in a greenhouse.

INTRODUCTION: Greenhouse ventilation is designed to provide a change of air to growing plants and to prevent overheating on clear days. Overheating can be disastrous or result in the production of low quality plants.

REFERENCES

Required:

1 Electrical Applications for Greenhouses, Foy Page, pp. 31-33

QUESTIONS OR ACTIVITIES:

1. Why would a greenhouse operator not use exhaust fans in cooling systems during the winter without convection tubes?
2. Describe the characteristics of a good ventilation system.
3. What is the purpose of circulating air with turbulators during the heating season?
4. How may exhaust fans in cooling systems be used during the winter months?
5. What are two advantages of using a humidistat for fan control?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Constructing, Maintaining, and Using Structures That Aid Plant Growth

TOPIC: Lighting

OBJECTIVE: To develop an understanding of how light affects plant growth, and how to control this light.

INTRODUCTION: With electric light and control of wave length, intensity, and photoperiod, it is now possible to hasten or retard growth, cause germination to begin and stop, control time of flowering, and influence tuber size. It is economically feasible to grow and control electrically certain plants.

REFERENCES:

Required:

1. Resource material for Lesson Plans in Greenhouse Management - Electrical Applications for Greenhouses, Foy Page, pp. 40-47

QUESTIONS or ACTIVITIES:

1. In regard to light, which direction do roots and stems grow?
2. What should be the maximum number of hours per day that plants should receive light?
3. What happens to chlorophyll when light is too bright?
4. Research studies have shown that plants use mainly two wave lengths of the light spectrum. What are they?
5. What does photoperiod mean?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Constructing, Maintaining, and Using Structures That Aid Plant Growth

TOPIC: Wiring and Electrical Controls

OBJECTIVE: To understand how electricity is used and controlled in a greenhouse.

INTRODUCTION: The use of single and groups of controls make electric greenhouse production and management easier and more profitable.

REFERENCES:

Required:

1. Electrical Applications for Greenhouses, Foy Page, pp. 48-65

QUESTIONS or ACTIVITIES:

1. What does U L indicate?
2. What should be the maximum number of outlets per circuit on general lighting circuits?
3. Which tables in the required reference would you use to determine the proper wire size? (Indicate your answer by listing the table numbers.)
4. How many two-horsepower motors should be put on one circuit?
5. What are the basic requirements of any well-planned wiring system?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Plant Growing Media

TOPIC: Origin, Composition, and Importance of the Soil

OBJECTIVE: To develop an understanding of how soil is formed, what it is made up of, and its importance to horticultural plants.

INTRODUCTION: From ancient times man has strived to understand more about soil. No doubt the reason for this is that man's very existence depends upon the soil. Look around you. Probably you will see that not many items in your room came from anywhere other than the soil. Even this sheet of paper you are now reading is a product of the forestry industry which depends on soil for tree growth.

Once we take time to learn how soil is formed, what it is made up of, and how it affects plants, we can do a better job of making it work for us.

REFERENCES: Required:

1. Information Sheet, "Origin, Composition, and Importance of the Soil"

Supplemental:

2. Our Land and It's Care, National Plant Food Institute, pp. 6-13
3. Home Garden Leaflet No. LA 8, Department of Floriculture and Landscape Architecture, A&M University
4. Crop Production in the South, Klingman, pp. 43-51

QUESTIONS or ACTIVITIES:

1. Name the three layers of soil.
2. What causes these three horizons to develop?
3. Which of the three layers is usually darker in color?
4. When does young soil begin to collect its plant nutrients?
5. What factors are responsible for the difference in soil colors?
6. What three components does a good soil provide to plants?
7. What are the three types of soil in regard to particle size?
8. Which is the largest of the three soil particles?
9. What governs the rate of soil development?
10. What is organic matter?

Information Sheet
on
ORIGIN, COMPOSITION, AND IMPORTANCE OF SOIL

The climate, especially rainfall and temperature, indirectly controls the rate of soil development. The climate acts slowly, taking thousands of years for the soil to reach a stage of balance with its environment.

A soil that has reached this degree of development usually has three distinct layers of horizons. As you dig downward in soil, you can notice differences in color, structure, and texture of the soil. This is especially noticeable along road cuts.

The topsoil is the first layer. It is usually richer and is of greater importance to plant growth. This layer contains most of the organic matter and is usually darker in color.

Next, we come to the subsoil. This layer does not contain as many nutrients as topsoil, but it is still important because of root development.

The third layer is the parent material and is generally less important to plant growth. It usually is below the area of heavy root growth and is seldom tilled.

These three layers are developed from weathering or wearing down of rocks. Wind, water, and ice break and crush the rocks. Eventually, a small plant begins to grow in this young soil. When the plant dies, it decays and gives the soil its first nutrients.

Other plants begin to grow and finally a rich soil is developed. Once the soil becomes productive, it provides three important components to a plant. These are fertilizer elements, air for the roots, and an adequate water supply.

You have noticed probably that there are several different soil colors. These are caused by different amounts of air being present as the soil is formed, the amount of organic matter, (decayed plant or animal matter), and the types of rocks from which the soil is formed.

You may have also noticed the different textures in soil. This is caused by the size of the soil particles. Sand is the largest and, therefore, is course to the touch. Silt and clay are the other two with clay being the smallest. It feels like flour when rubbed between the fingers.

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Plant Growing Media

TOPIC: Soil Moisture

OBJECTIVE: To understand the importance of moisture to plants and how this moisture becomes available from the soil.

INTRODUCTION: Soil moisture can be a limiting factor in plant growth. No matter how many minerals the soil contains, it will not be productive unless it holds an adequate supply of water for optimum (best) plant development. It should be kept in mind that too much moisture can be as harmful as too little. By learning more about soil moisture, one can use his knowledge to change the environment of plants in small areas such as in the horticulture industry.

REFERENCES: Required.

1. Information Sheet, "Soil Moisture"

Supplemental.

2. Soil Yearbook of Agriculture, 1957, USDA, pp. 49-60

QUESTIONS or ACTIVITIES:

1. What part of the plant takes in water from the soil?
2. The process by which water leaves the plant in the form of vapor is called what?
3. What material helps soil hold water?
4. When is water holding capacity of vital importance?
5. What affects the speed at which capillary water can move through the soil?
6. Why does it harm soil to work it when it is wet?
7. What can be added to soil to make it hold more water?
8. Why will overwatering a plant kill the root system?
9. What happens to rainfall which falls to the earth's surface?

Information Sheet
on
SOIL MOISTURE

The moisture in the soil represents an important part of the plant environment. It is common knowledge that many plants tend to wilt when lacking in water. If water is not supplied to the plants soon after the wilting point is reached, they often die. Water is used by the plant in many ways The needed water is taken from the soil by the roots. If plants are to remain healthy and grow well, water must be made constantly available to the plants The type of soil in which the plants grow has a definite influence upon the frequency of watering

Soil water is very important

1. Large amounts of water lost by plants in transpiration must be replaced. (Transpiration - loss of water in the form of vapor.)
2. Water acts as a solvent for dissolved minerals.
3. Water affects soil aeration (Movement of air through the soil.)
4. Water affects soil temperature

What happens to rain which falls to the earth's surface?

1. Runs off
2. Soaks in
3. Evaporates

Water absorption is very important to the growth of plants.

Rain water is absorbed and rapidly passes downward through a porous soil. When the upper surface of the subsoil has a slope, much of the water flowing over its surface seeps out of the hillsides in springs and quickly contributes to stream flow.

Why do different soils have different capacities to hold or "soak up" water? When organic matter is used up. soil packs together Thus a cloddy soil has fewer air spaces, its particles do not cling together in granules, and the lack of organic matter means that it weighs more than an equal volume of crumbly soil from a well-managed plot

A crumbly soil can take in water faster than a cloddy one, and it can hold more water. The thoroughly decomposed soil organic matter (humus) in a crumbly soil, can hold lots of water. Organic matter acts as a sponge in holding water In addition, to the water held by the organic matter itself, is the water held in the pores between the soil particles and between the soil granules Hundreds of very fine soil particles are glued together by the organic matter to form granules or crumbs.

The increased water-holding capacity of soils high in organic matter under natural conditions makes a big difference in the intake of water This is extremely important during droughty seasons

Soil Moisture
(Information Sheet continued)

Moisture moves through the soil in all directions even against gravity by capillary movement This movement is caused by the attraction water molecules have for each other as well as the attraction between water molecules and soil particles Water molecules cling together and form droplets in the air or on a greasy surface where there is nothing to interfere But when a drop of water falls on soil particles, it spreads out as a thin film over the soil particles, because the attraction between the soil particles and the water molecules themselves Water that moves through the soil in this way is known as capillary water.

How far and how fast capillary water will move in a soil depends on the size of the soil particles and the condition of the soil. If the spaces around the soil particles are large, the attraction between the water molecules and the soil particles will not be enough to overcome the weight of the water and it will not rise too much The movement that does take place however, will be rapid because there is little friction This is true in sandy soils.

In fine-textured soils, the particles are closer together and the attraction between soil and water is greater Water may be expected to rise more slowly, but higher in soils of fine texture

Under field conditions, moisture moves from wetter soil to drier soil. The difference is not always great, therefore, capillary water moves slowly and not far Even so, even moisture moves a short distance to the roots of growing plants to make it an important plant-soil relationship

Much soil moisture can be lost when capillary water moves to the surface and evaporates.

All living cells carry on respiration Roots are made of living cells. In order for respiration to occur, oxygen must be present Oxygen is normally formed in the air occupying the pore space of soils having good aeration As water fills the pore space of these soils, however, the air is forced out (no two things can occupy the same space at the same time) and consequently, the supply of oxygen in the soil is lost This means that root cells die and the root system decays away

Some principles of understanding of soil-water relationships for the horticulture service worker:

1. Many soils cannot be worked when wet except at the expense of desirable soil structure. This is more true for heavy clay-like soils, and is less important for sandy soils. Structure is the arrangement of the soil particles
2. Plants can be easily overwatered or underwatered. Sandy soils require more frequent waterings than heavy clay soils especially during periods of prolonged sunny days.
3. If soils do not have desirable moisture-holding capacities, they should be modified to make them more desirable

Soil Moisture
(Information Sheet continued)

4 It is more critical to overwater plants growing in heavy soils during periods of prolonged cloudy weather than it is to overwater plants growing in light soils, during this type of weather condition. Soil type and the amount of sunlight affect plant-watering practices.
5. Loose, porous soils having a good structure soak up and hold more water than hard, compact soils. This has an important influence on plant-watering practices.
6. Overwatering causes decreased aeration and subsequent root decay and death of the plant.
7. Underwatering causes wilting, dehydration, and subsequent death of the plant.

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Material for this information sheet was taken from Ornamental Horticulture for Vocational Agriculture in Alabama, pp. 79-81.

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Plant Growing Media

TOPIC: Soil Mixtures

OBJECTIVE: To learn some of the most widely used soil mixtures and to become familiar with the methods used to produce soil mixes for growing horticultural plants.

INTRODUCTION: Not all plants grow best in the same type of soil mixture. Water-holding capacity, aeration, and drainage of the soil often determines a plant's value. By studying the different types of soil and how to increase their productivity, we can grow healthier and more profitable plants.

REFERENCES: Required:

1. Information Sheet, "Soil Mixtures"

Supplemental:

2. Plant Propagation, Hartman & Kester, Prentice Hall, N. J., 1959, pp 26-30

QUESTIONS or ACTIVITIES:

1. What are the advantages of mixing organic matter and other soil "lightening" materials with loam soils?
2. Name the characteristics of an ideal soil mix.
3. Why is soil screened before mixing?
4. What equipment is required for large scale mixing operations?
5. What would be a good mixture for general container-grown nursery stock?

Information Sheet
on
SOIL MIXTURES

The Significance of Soil Mixtures

1 Loam soils by themselves are generally unsatisfactory for growing plants for various reasons
   a Often "heavy"
   b Often poorly aerated
   c Often tend to become sticky after watering
   d Often have a low moisture-holding capacity
   e Often tend to shrink upon drying
2. Advantages of incorporating organic matter and soil "lightening" materials with loam soils include
   a Better aeration
   b Greater ease of working
   c. Better drainage
   d Better moisture-holding capacity

Some Typical Soil Mixtures:

1 For potting rooted cuttings and young seedlings:
   1 or 2 parts sand
   1 part loam soil
   1 part peat moss (or leaf mold)
2. For general container grown nursery stocks:
   1 part sand
   2 parts loam soil
   1 part peat moss or leaf mold
   1/2 part dried or well-rotted manure
3 For plants which do best under acid soil conditions:
   2 parts sand
   2 parts loam soil
   2 parts peat moss
   1 part leaf mold
   1/2 dried or well-rotted manure
4. The University of California (U. C.) mix
   50% sand
   50% peat moss
   Fertilizer additives (a or b)
   a If the mix is to be stored for an indefinite period before using. This furnishes a moderate supply of available nitrogen, but the plants will soon require supplemental feeding To each cubic yard of the mix add:
      4 oz. potassium nitrate
      4 oz potassium sulfate
      2-1/2 lb. single superphosphate
      7-1/2 lb. dolomite lime
      2-1/4 lb. calcium carbonate lime

Soil Mixtures
(Information Sheet continued)

b if the mix is to be planted within one week of preparation, This furnishes available nitrogen as well as moderate nitrogen reserve. For each cubic yard of the mix add
2-1/2 lb horn and hoof or blood meal (13% nitrogen)
4 oz potassium nitrate
4 oz potassium sulfate
2-1/2 lb single superphosphate
7-1/2 lb dolomite lime
2-1/2 lb calcium carbonate lime

5 In making the U. C. mix for:
a Bedding plants and nursery container-grown stocks use --75% sand, --25% peat moss
b Potted plants use --50% sand, --50% peat moss
This mixture, including the fertilizer, can be safely sterilized by steam or chemicals without resulting in the subsequent harmful effects to the plants that often occurs when other soil mixes are sterilized.

The Ideal Soil Mix has These Characteristics

a Uniformity
b Freedom from disease
c. Low soluble salts
d Good drainage
e. Good moisture retention
f. No shrinkage
g Ease of preparation and storage
h. Complete availability

Equipment Used in preparing Soil Mixtures Includes

1 Soil screen (may be a powered rotary screen)
2 Soil shredder (either gas or electric powered)
3 Wheel barrow
4 Scoop shovel
5. Cement mixer
6. Water hose

Steps in Preparing Soil Mixture:

1 Screen the soil to make it uniform and to eliminate large particles.
2 Slightly moisten extremely dry materials (especially peat)
3 Mix smaller quantities by putting the ingredients in a pile in layers, and turn the pile with a shovel until uniformity of the mixture is attained.
4 For large scale mixing operations, use a power driven cement mixer or shredder.
5 Prepare the mixture at least one day in advance of use so that the moisture will tend to become equalized throughout the mixture. The soil mixture should be slightly moist at the time of use so that it forms a ball when squeezed in the hand at the time of use.

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Material for this information sheet was taken from Ornamental Horticulture for Vocational Agriculture in Alabama, pp. 81-84.

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT. Plant Growing Media

TOPIC Mulches and Their Use

OBJECTIVE To learn more about the kinds of mulches and how they are used. Also, to learn some common mulches and how to apply them.

INTRODUCTION. There are many places in the landscape where mulches can and should be used Rose and flower beds, trees and shrubbery, and newly seeded lawn areas are good examples of where mulches are needed.

REFERENCES Required.

1. Information Sheet, "Mulches"

Supplemental

2 Soil, 1957 Yearbook of Agriculture, U. S. D. A., pp. 151-156

QUESTIONS or ACTIVITIES

1. What are two basic kinds of mulches?
2. What is the disadvantage of asphalt paper mulch?
3. What fertilizer should be added to corncob mulch?
4. When should mulches be applied to established garden plants?
5. What is the most common mulch?
6. What can be used as a mulch in areas where organic material is scarce?
7. List the effects of mulches in the soil mix.
8. What is a mulch?
9. What is the disadvantage of straw mulch?

Information Sheet
on
MULCHES AND THEIR USE

The landscape or greenhouse worker needs to know how to use mulching materials. What kinds of materials are used as mulches? Which kinds of materials make the best mulches? What are mulches used for? How deep should mulches be applied? When should mulches be applied? A mulch is any material applied to the surface of a soil primarily to conserve moisture, maintain a uniform temperature, and to help control weeds

Effects of mulches in soil mix

Dilutes the soil and usually increases root growth
Promotes soil granulation
Improves and stabilizes structure (surface mulch)
Affects soil pH slightly
Adds some fertilizer materials
Leads to nitrogen deficiency in cases where carbonaceous materials are added
Serves as food to micro-organisms
Introduces weed seeds in the soil in some cases

Two basic kinds of mulches

Inorganic or processed
Organic

Inorganic or processed mulch material

1. Aluminum Foil - Used to some extent in vegetable planting. Research work shows that growth of plants is increased markedly.
2. Asphalt - A light spray is used commonly by landscape contractors to hold soil in place on steep banks.
3. Asphalt Paper - May be used but hard to keep in place. Can become unsightly.
4. Crushed Stone - Gravel Chips - Pebbles - This is a common mulch in areas where organic mulch is scarce. Good in plantings for effect. May be colored to blend in with the features or the home, patio or landscape.

Black Polyethylene - Becoming a popular mulch especially in areas which are not part of the foundation planting. This mulch is used in commercial vegetable plantings.

Organic Mulch Material

1. Crushed Corncobs - Excellent mulch material. May be colored for use in landscape plantings. Usually quite inexpensive. Additional nitrogen should be applied.
2. Corncobs (whole) - Used to limited extent in farm gardens where the material is available. Can be used in utility gardens where appearance is not the main objective.
3. Lawn Clippings - This material is used to a limited extent. It should be applied loosely because it mats. Heat must be produced during decomposition.
4. Leafmold - Obtained from compositing fallen leaves in the fall of the year. This partially decomposes by the spring. Good mulch but hard to apply evenly and is not particularly neat looking.

Mulches and Their Use
(Information Sheet continued)

5. Leaves - Used rather extensively in areas with many trees. The most inexpensive material available.
6. Peanut Hulls - Can be obtained in some garden centers or in areas where peanuts are processed. This is an excellent mulch and usually quite attractive.
7. Peat Moss - This is probably the most common mulch. It is quite rich looking when used correctly. The cost of this material is usually prohibited when large areas are mulched.
8. Sawdust - Very commonly used in areas where readily available. Nitrogen deficiency is almost certain if fertilizer is not applied regularly. Reports of toxic materials have not been substantiated by experiment stations.
9. Shredded Bark - In recent years, this material has become a popular item in garden stores. The material makes an excellent mulch and is very attractive in landscape plantings. Shredded bark lasts as long or somewhat longer than peat moss and adds valuable organic matter to the soil.
10. Straw - Used for winter protection and as a summer mulch. This material is highly inflammable so should not be used where a cigarette could be carelessly flipped into the material.
11. Wood Chips or Wood Shavings - In recent years this material has become available in large quantities. Wood chips decompose slowly and may be the cause of nitrogen deficiency if additional fertilizer is not applied.

When to Apply Mulch:

The time to apply mulch to the garden on established plants is in mid-spring when the soil has warmed up sufficiently for active root growth. If it is applied before this time, the mulch will keep the ground too cool and root growth may be slow. If you are applying mulch to newly planted material, do so after the plants are put into place and watered in well. If you are planting material in the late summer or early fall, apply the mulch immediately after watering so that the soil temperature will be kept warmer in the cool nights of autumn. It is important that there is sufficient root growth in fall planted stock so that the material does not heave due to freezing and thawing during the winter months.

How Deep to Apply Mulch:

For best results, the mulch should be at least 2-3" deep over the whole area during spring, summer, and early fall. Tender plants which need winter protection may require an additional 1-2" during the winter months around the crown or base of the plant. In the spring this additional material should be fanned out away from the stems or crowns of the plants before additional material is added for summer mulching.

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Material for this information sheet was taken from Ornamental Horticulture for Vocational Agriculture in Alabama, pp. 84-86.

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Plant Growing Media

TOPIC: Fertilizer Nutrients

OBJECTIVE: To learn about the fertilizer requirements of plants, the function of different minerals, and how to apply these minerals.

INTRODUCTION: Many of the materials used for mulching require an addition of fertilizer to reduce the chance of nitrogen deficiency or starvation of the growing plant material. Whodchips, sawdust, crushed corncobs and shredded bark need additions of nitrogenous fertilizers. A report from the U S D A suggests that 1/2-1lb. of ammonium nitrate or ammonium sulfate be added to each bushel of mulch material added to the plants. Remember, without the proper amounts of fertilizer, a lot of hard work can go to waste. Plants can not thrive with an improper balance of nutrients.

REFERENCES: Required.

1. Information Sheet, "Fertilizer Nutrients."

Supplemental:

1. Crop Production in the South, pp. 65-77
2. Soils and How to Improve Them. Texas Agricultural Extension Service Bulletin B-189

QUESTIONS or ACTIVITIES:

1. What are the three primary elements?
2. What primary element gives the dark green color to plants?
3. What primary element is missing when leaves become mottled, spotted, streaked, and curled?
4. What are three sure ways of mis-using fertilizer?
5. When is the best time to fertilize a lawn?
6. What are the three nutrients obtained mostly from air and water?
7. What are the two lime elements?

Information Sheet
on
FERTILIZER NUTRIENTS

NUTRIENTS USED BY PLANTS

Large Amounts Needed		Rather Small Amounts Needed	
Nutrients Obtained Mostly From Air & Water	Nutrients Obtained From Soil	Nutrients Obtained From Soil	
Carbon Hydrogen Oxygen	Nitrogen Phosphorus Potassium Calcium Magnesium Sulfur Hydrogen Oxygen	Iron Manganese Boron Copper	Zinc Chlorine Molybdenum

SOME CONVENIENT NUTRIENT GROUPINGS

Grouping	Nutrients
Primary Elements	Nitrogen Phosphorus Potassium (Potash)
Secondary Elements	Calcium Magnesium Sulfur
Fertilizer Elements	Nitrogen Phosphorus Potassium (Potash)
Lime Elements	Calcium Magnesium
Trace Elements or Micro-nutrients	Iron Copper Zinc Boron Chlorine Manganese Molybdenum

Fertilizer Nutrients
(Information Sheet continued)

HOW PLANT NUTRIENTS AFFECT PLANTS

Nutrient & Chemical Symbol	Form in Which Available to Plants	Role in Plant Growth	Deficiency Symptoms
Nitrogen(N)	NH_4^+	Gives dark green color to plants	A sickly yellowish green color
	NO_2^-	Induces rapid growth. Improves quality of leaf crops.	A distinctly slow and dwarfed growth
	NO_3^-	Increases protein content of food and feed crops. A constituent of all proteins. (Note, an over abundance of nitrogen leads to rank vegetative growth and tends to retard the date of plant maturity.)	Drying up or firing of leaves which starts at the bottom of the plants and proceed upward. The firing starts at top of the bottom leaves and proceed down the center along the mid-rib.
Phosphorus (P)	PO_4^- HPO_4^- $H_2PO_4^-$	Stimulates easy root formation and growth. Gives a rapid and vigorous start to plants. Hastens maturity. Stimulates blooming and aids in seed formation. Essential to the transformation of insoluble carbohydrates to soluble carbohydrates a constituent of all proteins.	Purplish leaves, stems, and branches. Slow growth and maturity.
Potassium (K)	K^+	Imparts increased vigor and disease resistance to plants. Increases plumpness of grain and seed. Essential to the formation and transfer of starches, sugars, and oils. Imparts winter hardiness.	Mottling, spotting, streaking or curling of leaves. Leaves are scorched or burned on the margins and tips. Firing starts at tip of leaf and proceeds down.

Fertilizer Nutrients
(Information Sheet continued)

Nutrient & Chemical Symbol	Form in Which Available to Plants	Role in Plant Growth	Deficiency Symptoms
Calcium (Ca)	Ca^{++}	Promotes early root formation and growth. Improves general plant vigor. Influences the intake of other plant nutrients.	Young leaves in terminal bud become hooked in appearance and then die at the tips and along the margins. Leaves have a wrinkled appearance. In cases the young leaves remain folded. There is a light green band along the margin of the leaves. Roots are short and much branched.
Magnesium (Mg)	Mg^{++}	A component of the chlorophyll molecule. Essential to the formation of fats, aids in the transport of phosphorous from older or younger parts of the plant. Essential to fruit production. Influences uptake of other plant nutrients. Plays a role in the translocation of starch.	A general loss of green color which starts in the bottom leaves and later moves up the stalk. The veins of the leaf remain green. The plant stem is slender and weak with long branched roots. Leaves are mottled or chlorotic with dead spots. The leaf tips are turned or cupped upwards.
Sulfur (S)	$SO_4^{=}$ $SO_3^{=}$	Essential to the formation of proteins. Essential to all divisions and fruit development. Promotes root growth. Stimulates seed production. Encourages more vigorous plant growth.	The young plant leaves are light green in color and have even lighter veins. The stalks are short and slender. Plant growth is slow and stunted. Fruit is immature and light green in color.

Fertilizer Nutrients
(Information Sheet continued)

Nutrient & Chemical Symbol	Form in Which Available to Plants	Role in Plant Growth	Deficiency Symptoms
Boron(B)	$BO_3^=$	A deficiency of this nutrient is associated with a decreased rate of water absorption and translocation of sugars in plants	The young leaves of the terminal bud become light green at the base, with final breakdown here. In later growth the leaves become twisted and the stalk finally dries back to the terminal bud.
Iron(Fe)	Fe^{++} Fe^{+++}	Essential to chlorophyll production acts as an electron carrier in enzyme systems which bring about oxidation reduction reactions in plants. Essential to the synthesis of proteins contained in chloroplasts.	The young leaves are chlorotic with the principal veins remaining green. The stalks are short and slender.
Zinc(Zn)	Zn^{++}	Zinc is believed to be concerned with the formation of some growth hormones and in reproduction processes of certain plants. The element also functions in enzyme systems which are necessary for important reactions in plant metabolism.	Generalized leaf spots which rapidly enlarge involving areas between veins and eventually involving secondary and even primary veins. The leaves are thick and the stalks have shortened internodes.

Fertilizer Nutrients
(Information Sheet continued)

Nutrient & Chemical Symbol	Form in Which Available to Plants	Role in Plant Growth	Deficiency Symptoms
Manganese(Mn)	Mn++	This element functions in enzyme systems which are necessary for important reactions in plant metabolism. The element is also essential for certain nitrogen transformations in plants.	Spots of dead tissue are scattered over the leaf. The smallest veins tend to remain green producing a checkered effect.
Molybdenum (Mo)	Mo_4	Acts as an electron carrier in enzyme systems which bring about oxidation reduction reactions in plants. Oxidation reduction reactions are essential to plant development and reproduction and do not take place in the absence of micro-nutrients. The element is also essential to certain nitrogen transformations in plants	

If plant nutrient elements are to be available to plants, three basic conditions must be met:

1. The nutrient must be in a chemical form that the plant root can absorb.
2. The nutrient must be in a position where it can be absorbed by the plant root.
3. The nutruent must occur in the soil in proper proportions.

Soil fertility then, does not depend only upon the supply of nutrients in the soil, but upon the form in which the nutrients are found.

Some fertilizers harm seeds and foliage if the material is placed in direct contact with them. Inorganic fertilizers harm plant foliage more than organic fertilizers. Often organic fertilizers are called non-burning fertilizers.

Fertilizer Nutrients
(Information Sheet continued)

If you are to avoid harming seeds and foliage with fertilizers:

DO NOT

1. Apply dry fertilizers (particularly inorganic fertilizers when the foliage is wet).
2. Plant seeds directly on a band or layer of fertilizer.
3. Spill the container of fertilizer contents and fail to remove the material from the foliage by scattering or leaching. (Many times lawn spreaders are filled on the lawn and spillage is not properly cared for. It is best to fill the spreader on the sidewalk.)

DO

1. Fertilize just before a rain. (Lawns for example)
2. Place the fertilizer below and to the side of the seed.
3. Mix fertilizer materials thoroughly in the soil before planting.

Fertilizers can be applied to the soils of the greenhouse or the landscape as:

1. Liquid fertilizers
   a. Hozon proportioners or fertilizer injectors (foliar or base application)
   b. Applied in water solution with a sprinkling can (foliar application)
   c. Applied as a water solution around the base of the plant
2. Dry fertilizers
   a. Broadcast over the soil surface by means of a spreader.
   b. Broadcast over the soil surface by hand (for small quantities). This is not the most accurate method for applying fertilizers, however.
   c. Deep drilling
   d. Side dressing
   e. Banding along the row

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Material for this information sheet was taken from Ornamental Horticulture for Vocational Agriculture in Alabama, pp. 86-92.

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Plant Growing Media

TOPIC: Soil Organisms

OBJECTIVE: To learn some of the major soil organisms, their importance, and their effect on soils.

INTRODUCTION: Soils are composed of broken and weathered rocks, organic matter, water, and air. This material serves as a home for many kinds of plant and animal life. These plants and animals are both large and small in size. Some of these plants and animals are even so small that a microscope must be used to see them. Even though these organisms are small, they play a vital role in the health of our plants.

REFERENCES: Required:

1. Information Sheet, "Soil Organisms"

Supplemental:

2. Soil, 1957 Yearbook of Agriculture, U. S. D. A.

QUESTIONS or ACTIVITIES:

1. Name three small forms of plant life that are found in the soil.
2. How much of the soil consists of organisms?
3. What damage to plants can a nematode cause?
4. What harm to a plant may fungus cause?
5. In what way do bacteria help supply the plant with fertilizer nutrients?

Information Sheet
on
SOIL ORGANISMS

Small plant life in the soil may be bacteria fungi, or algae. The small animals in the soil include one-celled animals, and tiny, round worms called nematodes. The larger animals in the soil include worms, ants, snails, spiders, and insects. Some of these animals, especially the earthworms, help to make the soil better by burrowing through the soil, mixing it and making it possible for water and air to move easily through the soil. Also, some of the organisms in the soil are able to take nitrogen from the air and change it into a form that plant roots can absorb. Other organisms in the soil are not so helpful and actually do harm to plants by eating parts of the plant and causing various plant diseases.

Soil organisms make up about 1/1000 of the weight of an acre foot of soil. The living things in the soil use soil minerals for living activities. The minerals available to the plant then, are those that remain after the soil organisms have consumed a certain quantity for their life processes

THE SIGNIFICANCE OF SOIL ORGANISMS

Organism	Major Activity	Beneficial to Plant Growth	Harmful to Plant Growth
Earthworm	Mixes soil. Increases the availability of plant nutrients. (Especially nitrogen) Increases aeration. Promotes drainage.	X	
Nematode	Penetrates plant tissue, especially roots, and causes extensive damage.		X Only about 50 of the thousands of nematodes known are harmful to plants.
Algae	Aid bacteria and fungi in the decomposition of plant tissue, in making nutrients available to plants, and in the synthesis of humus.	X	

Soil Organisms
(Information Sheet continued)

Organism	Major Activity	Beneficial to Plant Growth	Harmful to Plant Growth	
Fungi	Decompose organic residues. Promotes the formation of humus. Causes many plant diseases.	X	X	
Actinomycetes	Decompose organic matter releasing plant nutrients, especially nitrogen. Causes plant disease.	X	X	
Bacteria	Decomposes organic matter releasing plant nutrients; convert nitrogen from the air into a form available to plants (only certain bacteria are able to do this). Cause many plant diseases.	X	X	

The soil organisms which are beneficial to plant growth can be encouraged by adding organic matter, lime, and moisture to the soil.

The soil organisms harmful to plants need to be controlled. It has been estimated that the yearly loss in farm crops in the United States is five billion dollars. The cost of pesticides and required application of these expenditures is used to control harmful soil organisms.

Basically, there are three ways to control soil organisms which are harmful to seeds and plants:

1. Soil sterilization with steam
2. Soil fumigation or drenching with chemicals
3. Seed treatment

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Material for this information sheet was taken from Ornamental Horticulture for Vocational Agriculture in Alabama, pp. 92-94.

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Plant Growing Media

TOPIC: Soil Sterilization

OBJECTIVE To learn the advantages and disadvantages of steam sterilization (pasteurizing) and chemical treatment

INTRODUCTION: The soil organisms harmful to plants need to be controlled. It has been estimated that the yearly loss in farm crops in the United States is five billion dollars The cost of pesticides and required application equipment amounts to almost $350 million a year. A considerable amount of these expenditures are used to control harmful soil organisms

REFERENCES. Required.

1 Information Sheet, "Soil Sterilization"

Supplemental:

2 Soil, 1957 Yearbook of Agriculture, U.S.D.A., pp. 157-164

QUESTIONS or ACTIVITIES.

1. Why are soils treated?
2. What are four sources of steam
3. Why will soil that is too dry heat up slowly?
4. What is used to measure the soil temperature?
5. How can ammonia build-up in the soil affect plants?
6. What are the seven factors to consider when fumigating soil?
7. What are the three precautions to observe in using soil fumigants?
8. What is the cheapest method of sterilizing soil?

Information Sheet
on
SOIL STERILIZATION

This control measure is highly effective and is widely used in the greenhouse for controlling the various soil-borne pests. Steam sterilization is also used to some extent in outdoor areas and for steaming bulk soils prior to use in growing plants.

Why are soils steamed?

1. To kill soil-borne insects
2. To kill all of the bacteria, fungi, and virus organisms that are harmful to commercial crops
3. To destroy weeds
4. To promote soil granulation

Sources of steam:

1. Existing steam boilers
2. Portable oil-fired steam boilers
3. Package steamers
4. Bricked in permanent-type boilers

Preparing the soil for steaming:

1. Add humus or organic matter.
2. Water the soil lightly. Soil that is too dry will heat up slowly because of poor heat conduction and distribution. Soil that is too wet will also heat up slowly because it requires considerable heat to heat a large quantity of water.
3. Keep the soil moist a week prior to steaming so as to encourage weed-seed germination. This will make the weeds easier to kill.
4. Rototill or otherwise loosen the soil. Be sure all soil is loosened and that all lumps are broken up.
5. If soil in raised benches is being sterilized, unroll the canvas steaming hose down the length of the bench. (Ground beds may have buried tile for steaming purposes.)
6. Cover the bench with a suitable cover. The cover may be draped over the bench, weighted down with pipe or held in place with "C" clamps.

The soil should be steamed at 180°F. for thirty minutes.

Soil Sterilization
(Information Sheet continued)

KILLING TIME FOR VARIOUS SOIL ORGANISMS WHEN USING STEAM STERILIZATION

Organism	Time to Kill	Temperature
Nematodes	Instantly	140°F.
Soil Insects	Instantly	140°F.
Soil Fungi	10 minutes	140° - 160°F.
Soil Bacteria	10 minutes	140° - 160°F.
Weed Seeds	10 minutes	140° - 160°F.
Soil Virus	30 minutes	180°F.

The soil temperature during steaming is registered on a soil thermometer.

After steaming, it is often found that there are other problems which could develop.

1. Nitrifying and other beneficial soil organisms are killed.
2. Ammonia build-up in the soil which may cause root burn.

Solving after-steaming problems:

1. Use high quality, long lasting kinds of peat such as German or Canadian sphagnum, peats or other forms of organic matter that break down slowly.
2. Avoid sterilizing in hot water.
3. Don't feed the previous crop after it shows color, and leach it during the last waterings.
4. Keep soils cultivated during critical periods to encourage air to enter the lower soil.
5. Keep soils medium dry when steaming; sterilizing wet soils encourages the build-up of ammonia.
6. Adding 4 lbs. of gypsum or 40% superphosphate per 100 sq. ft. of soil immediately after steaming seems to help tie up free ammonia.
7. Leach heavily after steaming.

Soil Sterilization
(Information Sheet continued)

Soil Fumigation

Conditions under which chemicals are most extensively used for soil pasteurization:

1. Situations in which overhead costs are so low that the time required for aeration is not expensive.
2. Situations where weeds and soil-borne insects are the main reasons for sterilizing.
3. Situations in which steam boilers are not available for sterilizing.

Chemical fumigants effective against fungi, bacteria, and nematodes are:

1. Chloropicrin (Tear Gas)
2. Methyl bromide
3. Mylone
4. Vapam or VPM
5. Vorlex
6. Trizone
7. Formaldehyde

Chemical fumigants effective against nematodes are:

1. Dichloropropene-dichloropropane mixtures
2. Ethylene di-bromide

Other fumigants include:

1. Bedrench
2. Zinophos
3. Trapex
4. Nemes
5. Brozone

Factors to consider in fumigating soil:

1. Soil temperature
2. Soil moisture
3. Organic matter content
4. Soil Texture
5. Seals needed
6. Soil type
7. Depth of application

Forms in which chemical fumigants are applied:

1. Tractor-mounted equipment which lays a plastic film and injects the fumigant under the plastic cover.
2. Liquid water-miscible materials which are metered into sprinkler irrigation systems.
3. Granules, liquids, and powders which can be worked into the soil from equipment mounted in front of a rototiller.
4. Tractor-mounted chisel-tooth injection shands can be used.
5. Materials in pressure cylinders can be released under plastic covers.
6. Hand-operated needle point injection guns can be used.

No plants should be planted into a fumigant-treated soil for a period of two to three weeks.

Precautions to be observed in using soil fumigants:

1. Avoid inhaling the material.
2. Avoid contact of the fumigant with the skin.
3. Allow sufficient time for aeration after the material is applied.

Soil Sterilization
(Information Sheet continued)

ADVANTAGES AND DISADVANTAGES OF STEAM AND CHEMICAL SOIL STERILIZATION

Treatment	Advantages	Disadvantages
Steaming	A very effective job Cost of treatment is less per acre than for chemicals ($350 - 500 per acre)	High initial cost Edges of benches and growing areas may not receive steam. After steaming, problems frequently occur.
Fumigation	Useful when a source of steam is not available Gives good control of insects, weeds, and nematodes	Cost of treatment per acre is high. Not very effective against hard-to-kill organisms. A great deal of time is required for aeration after treatment.

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Material for this information sheet was taken from Ornamental Horticulture for Vocational Agriculture in Alabama, pp. 94-98

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Plant Growing Media

TOPIC: Plant Growing Media Other Than Soil

OBJECTIVE: To become familiar with growing media other than soil, to study their merits, and to learn how to use these media in growing horticultural plants.

INTRODUCTION: Every plant grower has his own opinion on which plant growing media is best. There are several very good additives and experience is the best method of selection.

REFERENCES Required:

1. Information Sheet, "Plant Growing Media Other Than Soil"
2. "Horticulture Perlite for Texas Gardens", Bulletin TAP 256, Texas A&M Extension Service

QUESTIONS or ACTIVITIES:

1. What is the most widely used media for reproduction of plants?
2. What type of peat is most widely used in the United States?
3. How much water will sphagnum moss absorb?
4. What happens to vermiculite when heated?
5. What leaves, when in a molded state, make the best growing media?
6. What three media are probably the most readily available for use by the horticulturist in the South?
7. Why have many people witnessed failures in plant growth in a medium of sawdust?
8. What are the advantages of perlite?

Information Sheet
on
PLANT GROWING MEDIA OTHER THAN SOIL

Many different growing media may be used for rooting cuttings taken from desired plants. These may be used alone or in mixtures with soil.

SAND

Sand is probably one of the most widely used growing media in the reproduction of plants. It consists of small grain or rocks ground into a fine texture by weathering. This sand must be of a good quality and must not contain silt. The recommended sand for use in rooting cuttings is of the quartz type and should be washed. It can be the same quality sand used in masonry.

PEAT

Peat, commonly referred to as peat moss, is a material that has resulted from the decaying of the remains of thick vegetation in wet, marsh, swamp areas. It has been preserved over the years by being under water in a partially decomposed state. Peat varies widely in its state of decomposition, acidity, mineral content and origin. Light brown peat has been normally produced by a type of vegetation that results in a quite acid state. Brown to black peat is of the type that is alkaline. This is the type that is desirable and most used in the United States. It has a very high water-holding capacity and contains approximately 1% nitrogen. This nitrogen assists in the decomposition process which results after peat has been placed in use. When peat is used, it should be broken apart and moistened well before adding to the growing media or mixture.

SPHAGNUM MOSS

Commercial sphagnum moss is a material that has been produced by dehydrating certain acid-bog plants. The dehydrating results in a relatively sterile material. It is very light in weight and has a very high water-holding capacity. It has been said that it will absorb 10 to 20 times its weight in water. After dehydrating the plant materials have been shredded in order to make it more usable. This material contains such small amounts of minerals that plant growth in it for any length of time will need additional fertilizer.

VERMICULITE

This is a material that is micaceous in nature and is therefore a mineral. It is composed of thin layers that expand or explode when heated. It is heated in order to dehydrate it for use in horticultural mixtures. It is light in weight and has a very high-water-holding capacity. Expanded vermiculite should not be pressed or compacted in any way when wet. If this is done the desired porous structure of the material will be destroyed.

Plant Growing Media Other Than Soil
(Information Sheet continued)

LEAF MOLD

Certain leaves can be decayed and placed into a growing media or mixture and will serve a very good purpose Maple, oak, sycamore, and elm are among the most suitable leaves for this purpose. In preparing such a compost the layers of leaves should be alternated with thin layers of soil Small amounts of nitrogenous fertilizer should be used between the layers of leaves and soil. This nitrogen assists in the decomposition of the leaves The mixture should be protected from the weather so that leaching of the mineral elements will not result during heavy rain storms To prepare suitable leaf mold, 12 to 18 months should be allowed for proper decaying of the leaves. A disadvantage of leaf mold is that it may contain nematodes, weed seed or noxious insects and diseases. It should be sterilized before being used as a growing media for horticultural plants.

SHREDDED BARK SAWDUST AND WOOD SHAVINGS

In the South these materials are probably the most readily available for use by the horticulturist They are by-products of the lumber industry and can be obtained readily at very low cost They are usually of the hardwood or pine variety. Decomposition of these materials is slow and one should be sure that they are decomposed before using them for plant propagation Usually it is advisable to add nitrogenous fertilizer to these materials during the decaying process.

USING SAWDUST

Sawdust may be used to improve the physical conditions of soils and as a mulch. As a mulch it insulates the soil against wide fluctuations in temperature, discourages weed growth and reduces evaporation of soil moisture. However, there is a difference of opinion as to its merit Some operators have long used this easy-to-get forest by-product in large quantity with complete success Others have had unfortunate experiences with sawdust and have discarded it as unsuitable to their needs.

Possibly a lack of understanding as to how to handle sawdust has caused some of these failures. When sawdust is incorporated with the soil--used in place of peat--it requires large quantities of nitrogenous fertilizer if the plants growing in the soil are not to suffer from nitrogen starvation The organisms in the soil which break down cellulose require appreciable amounts of nitrogen and will use up all available supplies of this element.

It has been estimated that 24 lbs. of nitrogen are required per ton of sawdust from some species of pine to bring the nitrogen content up to 1.2 to 1.5%, the values needed for decomposition without inducing nitrogen deficiency in plants. This would equal 115 lbs. of ammonium sulphate or 72 lbs of ammonium nitrate per ton of sawdust during the period of its decomposition, which may be 2 or 3 years A 4inch layer of loose dry sawdust over a space 20X30' weighs a little over a ton A bushel of sawdust (10 to 15 lbs.) requires 0.8 lbs. of ammonium sulphate or 0.5

Plant Growing Media Other Than Soil
(Information Sheet continued)

lb. of ammonium nitrate. When the sawdust is used as a mulch, nitrage fertilization is not required to the extent that it is when the material is incorporated with the soil.

Sawdust is widely employed as a plunging material in heel beds in retail sales yards, for which it has unanimous approval, despite the fact that research showed that it is very poor for this use, vastly inferior to peat. The need for frequent watering is the chief disadvantage of sawdust as a filler for nursery heel beds. Because of the rapidity with which it dries, it is necessary to soak thoroughly and often.

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Material for this information sheet was taken from Ornamental Horticulture for Vocational Agriculture in Alabama, pp. 98-100.

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Plant Propagation

TOPIC: Introduction to Propagation

OBJECTIVE: To develop an understanding of the basic types of reproduction in plants and to learn the facilities, media, soil mixtures, and containers used in plant propagation.

INTRODUCTION: Plant propagatinn is the controlled reproduction of plants in order that man can have selected plants which are of specific value to him. Today with the many new advances in science the propagation of plants has become one of the most fascinating aspects ornamental horticulture.

REFERENCES:

Required:

1. Information Sheet, "Introduction to Propagation"

Supplemental:

1. Handbook on Propagation, #24, Brooklyn Botanic Garden
2. "Plant Production", B-178, Florida
3. Plant Propagation Principles and Practices, Hartmann and Kester
4. "Controlling Environment with Plastic Structures for Plant Propagation", TAP-387, Texas Agriculture Extension Service

QUESTIONS OR ACTIVITIES:

1. What is meant by plant propagation?
2. Give two methods by which plants may be propagated.
3. Give three structures used for the reproducation of plants.
4. List three requirements of the ideal plant propagation structure.
5. Give three requirements of a good media or mixture used in propagation.
6. List five of the most common types of media.
7. What is used for chemical sterilization of soil?
8. Give three types of containers used in the propagation of plants.
9. What is the purpose of plant hormones?
10. What is a flat?

Information Sheet
on
INTRODUCTION TO PROPAGATION

Plant propagation is the controlled reproduction of plants in order that man can have selected plants which are of specific value to him.

Plants may be propagated by two methods -- sexual or asexual.

Seed reproduction in plants is basically a sexual process because it involves the union of sperm and egg cell before the seeds are formed. The seed has a supply of food sufficient for establishing a plant in a new location.

The vegetative methods of propagation such as layering, division, cutting, grafting, and budding are the asexual types of plant propagation.

There are a number of types of facilities and propagating structures for the reproduction of plants.

Many stypes of greenhouses are used; they are usually made of glass, plastic, or similar material.

The hotbed is used for propagating, but it is generally smaller and less expensive. Heat is provided by fermenting manure or electric heating cables.

Many growers use a propagating case made of plastic to start young plants. This case may have mist spray in it to control the environment.

The ideal structure for plant propagation should have the proper amount of ventilation, temperature, and shade or light.

There are several media and mixtures used in propagation. All media should be loose and of a light mixture so that the excess water will drain. It should be free from seeds, nematodes, and disease organisms.

Some common types of media are sand, peat, sphagnum moss, vermiculite, and perlite.

If soil is used, sterilization is a must. It may be treated by steam or chemicals. If chemicals are used, methyl bromide is an excellent chemical to use.

Flats are small rectangular containers used for germinating seeds or rooting cuttings. Many types of containers such as clay pots, peat pots, and plant bands are used.

Many plant propagators use a synthetic plant hormone to promote rooting of cuttings. Various methods are used in applying these root-inducing substances, but the most common is to dip the cutting in the hormone powder, which is a chemical mixed with powdered talc at suitable concentrations. Many of the rooting hormones contain a fungicide to give protection against diseases.

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Plant Propagation

TOPIC: Propagation from Cuttings

OBJECTIVE: To develop an understanding of the methods of reproducing plants from cuttings.

INTRODUCTION: Cutting is one of the most important methods of propagating ornamental plants. Many plants can be started from cuttings in a limited amount of space. This is an inexpensive, rapid, and simple method of starting plants.

Cutting may be defined as the process of propagating plants by the use of vegetative parts, which when placed under suitable conditions, will develop into complete plants.

REFERENCES:

Required:

1. Information Sheet, "Propagation from Cuttings"
2. Basic Gardening Illustrated, Sunset, pp. 17-19

Supplemental:

1. Flower and Plant Production in the Greenhouse, Nelson, pp. 113-123

QUESTIONS OR ACTIVITIES:

1. List three reasons for producing plants from cuttings.
2. When are hardwood cuttings usually made?
3. List three plants which would be considered as herbaceous.
4. When are softwood cuttings made?
5. What temperature is necessary to root cuttings?
6. List three characteristics of a good cutting.
7. What is the function of the callus growth on cuttings?
8. What are the requirements of a good rooting medium?
9. Give four types of rooting media.
10. When are cuttings ready to transplant?

Information Sheet
on
PROPAGATION FROM CUTTINGS

Producing plants from cuttings is often cheaper and faster than producing them from seed, by budding or by grafting The use of cuttings also helps maintain the characteristics of the original plant Many types and varieties of plants will not produce the same quality or type of plant from seed and must be reproduced by cuttings, budding, or grafting.

Commercial plant producers use cuttings to secure large numbers of plants faster than securing the same plants from seeds Cuttings are also used because they are easier and simpler to make than various budding or grafting operations.

Cuttings are classified and named according to the part of the plant from which they come; stem cuttings, leaf cuttings, or root cuttings.

Stem cuttings are most important and more commonly used They are made by cutting a segment or piece of a growing limb or shoot from the parent plant These cuttings are further classified or named by the type of wood or growth period from which the cuttings are made

1 Hardwood cuttings are usually made in the winter months (or dormant stage) from plants or trees which shed their leaves. Plants propagated by hardwood cuttings include Junipers and Yews.
2 Semi-hardwood cuttings are usually made from evergreen plants and are cut from newer growth on the plant after it has finished the rapid summer growth. Plants propagated by semi-hardwood cuttings include euonymus, evergreen, azaleas and holly
3 Softwood cuttings are made from new growth in spring or early summer while that part of the plant is growing rapidly Plants propagated by softwood cuttings include pyracantha, magnolia, and spirea
4 Herbaceous cuttings are made from plant materials which are soft, rapidly growing and relatively high in water content. Plants propagated by herbaceous cuttings include coleus, chrysanthemum, geranium, and carnation.

The following environmental conditions are necessary for rooting cuttings; high humidity, air temperature of 60° to 70° at night and 75° to 85° during the day. The temperature of the rooting medium should be as close to 70 to 75° as possible. Others are adequate light and a good rooting medium

After cuttings have been made and placed under environmental conditions favorable for rooting, a callus layer may develop at the basal end of the cutting. The callus serves as a protective layer which retards the development of decay on cuttings that are fairly slow to root The formation of callus and the formation of roots are independent of each other, although they often occur at the same time.

Propagation From Cuttings
(Information Sheet continued)

The plant from which cuttings are taken should be healthy and moderately vigorous. The cuttings should come from average growth from portions of the plant in full sun. The cuttings are usually three to five inches long with two or more nodes. The cuttings should be made with a sharp knife, making the basal cut at about a 45° angle just below a node. It is best to take cuttings in the early morning and keep them moist, cold and turgid (swollen) by wrapping in damp burlap or plastic bags until they are stuck in the propagating bed.

The lower 1/3 to 1/2 of the leaves should be removed from the cuttings. Dip the base of the cutting in a rooting hormone and insert in the rooting medium, spacing so that the leaves barely overlap. The depth of sticking the cuttings is generally 1/3 of their length. After the cuttings are stuck, the medium should be thoroughly watered to wash the particles closely around the base of the cuttings.

During rooting the medium must be kept uniformly moist, but never soggy. Until the cuttings begin to root, they should be kept under partial shade. After rooting, the shade should be removed for increasing periods of time until it is left off completely.

A good rooting medium is one which can be kept uniformly moist, but which also provides good drainage and aeration. Some satisfactory ones are: clean sharp sand (builders grade), vermiculite (horticultural grade), sand and peat moss mixture, equal parts of each, peat moss and perlite, equal parts of each.

The propagation box should be at least three to four inches deep. Usually they are wooden boxes or flats with slatted bottoms. Standard size nursery flats are usually about 15" wide by 22" long by 3-1/2" deep. This size is convenient to handle when filled with the rooting medium and cuttings.

To maintain the high humidity needed for rooting softwood cuttings, the top of the flat may be covered with plastic. This may be done by placing a wire or wooden frame over the flat to support the plastic 8 to 12" above the rooting medium. After the cuttings have been stuck and thoroughly watered, the flat is covered with a sheet of plastic, which should be tucked under the bottom of the flat or tacked to the sides and ends to hold it in place.

Cuttings should be properly managed after they have rooted. When the cuttings have roots 1/2 to 1" long, they are ready to transplant either into pots or directly to outdoor beds. If transplant into pots, 2-1/4 to 3" pots are used. The potting mixure should contain about 1/3 organic matter such as peat or leaf mold, and 2/3 sandy loam soil. The cuttings should be partially shaded for 7 to 14 days after the cuttings are established. By fall the cuttings will be ready to plant in the field to grow to a size suitable for landscape use. If they were rooted late in the season, they should be carried over the first winter in a covered cold frame.

Propagation From Cuttings
(Information Sheet continued)

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Material for this information sheet was partially taken from:

1. State Department of Education, Agricultural Education Service, Montgomery, Alabama. Ornamental Horticulture for Vocational Agriculture in Alabama.

2. The Center for Research and Leadership Development in Vocational And Technical Education. The Ohio State University. "Propagating Horticultural Plants"

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Plant Propagation

TOPIC: Propagation by Layering

OBJECTIVE: To develop an understanding of the different types of layering.

INTRODUCTION: Many plants can be reproduced by layering. This is the development of roots on a stem while it is still attached to the parent plant. The rooted plant is then detached or cut after it has developed roots and becomes a new plant.

REFERENCES:

Required:

1. Information Sheet, "Propagation by Layering"

Supplemental:

1. "Propagation of Ornamental Plants", B-816-(1), Agricultural Extension Service
2. Plant Propagation Principles and Practices, Hartmann and Kester
3. "Plant Propagation", B-178, Florida

QUESTIONS OR ACTIVITIES:

1. Why do we wound plants that are to be layered?
2. What type of plants can be layered in a simple way?
3. What type of plants are air layered?
4. Why do we air layer plants?
5. What materials are used in air layering plants?
6. When is the best time to air layer plants?

Information Sheet
on
PROPAGATION BY LAYERING

The production of a new plant by layering is one of the surest methods. It is commonly used to propagate plants which are difficult to root

A simple way of layering is performed by bending a branch of a plant to the ground and covering it with soil or a rooting medium, but leaving the terminal end exposed.

It is usually best to wound branches that are to be covered with soil. This helps to induce root formation Many plants such as ivy, philodendrons, blackberries, and strawberries will root by this method.

Air layering is a method used to increase many plants such as croton, hibiscus dracaena, and rubber plants Many tropical plants get "leggy" and shed their lower leaves; they cannot be sold as choice plants This is a method of securing good plants at a minimum cost.

Air layering is an excellent way to produce plants which do not come true from seed. In some cases, a layered plant can be produced in a shorter time than by other methods of propagation

One method of air layering is to select a spot just below the joint or node of the plant to be propagated. It may be necessary to remove a few leaves in order to do this. Make a slanting cut upward Be careful not to cut all the way through Take a toothpick or other small piece of wood and place it in the upper end of the slit to keep it from sealing. Then sprinkle the area which is to be propagated with a hormone. This will stimulate the root growth. Wrap a small handful of moist spahgnjm moss around this area to keep the roots moist while in formation Cover the moss with a small piece of plastic film, polyethylene, or kitchen-grade aluminum foil to seal in the moisture Tie the plastic with two pieces of garden wire or plastic tie. In a few weeks, under ideal conditions, the roots should be in formation and the stem may be cut from the parent plant and placed in a pot.

Air layering is best practiced during the spring and summer months when high temperatures and high humidity contribute toward quicker rooting.

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Plant Propagation

TOPIC: Propagation by Division

OBJECTIVE To develop an understanding of how to increase plants by division.

INTRODUCTION The propagation of plants by division is an easy and sure way of increasing plants such as chrysanthemums, daylilies, and some shrubs.

REFERENCES.

Required.

1 Information Sheet, "Propagation By Division"
2. Sunset Basic Gardening Illustrated, pp. 14-16

Supplemental.

3 Propagation of Ornamental Plants, Texas Agriculture Extension Service, pp. 816
4. Plant Propagation Principles and Practices, Hartmann and Kester, pp. 419

QUESTIONS OR ACTIVITIES

1 List four plants that can be propagated by division.
2 When is the best time to divide shrubs?
3. Why do you divide perennials?
4. When should you divide perennials?
5 How should you divide a daylily or other bulbous plants?

Information Sheet
on
PROPAGATION BY DIVISION

Division is a simple form of plant propagation. Some plants which can be propagated by division are daylilies, iris, chrysanthemums, geraniums, sanservieria, and shrubs such as primrose, jasmine and fig trees

Most of these plants can be dug and shaken free of soil. Then the clumps can be divided into units or small plants, each having roots, stems, buds, and leaves. They can be planted in containers or as individual plants where they are to grow permanently.

Plants are best divided after their season of blossoming, but with care they may be so increased at any season of the year. Larger shrubs may be divided in the same method as smaller plants, but in most cases they will have to be separated with a shovel or hatchet. They should be divided when the shrubs are dormant for best results.

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT. Plant Propagation

TOPIC Propagation by Grafting and Budding

OBJECTIVE. To develop an understanding of the methods and types of grafting and budding.

INTRODUCTION. Budding and grafting is usually performed when certain plants cannot conveniently be reproduced by cutting, layering, or division. Also, it is used when seeds do not reproduce the characteristics of the parent variety.

Experience is necessary to be successful at grafting and budding. One of the best ways is to study all you can about grafting and budding and then practice until you become skilled.

REFERENCES

Required.

1 Sunset Basic Gardening Illustrated, Lane Book Co., Menlo Par, Calif., pp 20-25

Supplemental:

1 "Propagation of Trees and Shrubs", Bulletin No. 1567. U S D A.
2 "Topworking Pecan Trees by Inlay Grafting", Brison, T A. P. - 93 - Texas Agriculture Experiment Station
3 Plant Propagation Principles and Practices, Hartmann, Hudson, and Kester, pp. 266-398

QUESTIONS OR ACTIVITIES

1. Explain the meaning of stock and scion.
2. What is the cambium layer?
3. When do you graft deciduous trees and shrubs?
4. Why should you have a sharp knife in grafting?
5. List two kinds of budding.

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Plant Propagation

TOPIC Propagation from Seed

OBJECTIVE To develop an understanding of producing plants from seeds.

INTRODUCTION The production of plants from seed is commonly used by horticulturists. Many ornamental plants are produced by planting seeds in flats or other containers using the proper cultural methods.

Producing good plants from seed requires great skill and knowledge. The grower must be able to determine the requirements for many different plants. He must know when seeds should be planted. how much space should be allowed for each type of seed how deep to plant them. and the proper cultural methods.

REFERENCES

Required

1 Information Sheet "Propagation From Seeds"

Supplemental

1 "Propagation of Ornamental Plants", B-816, Texas Agriculture Extension Service, pp 2-3
2 The Ball Red Book, pp 3-12
3 "Plant Propagation for Florida Homes", B-178, pp 34-37

QUESTIONS OR ACTIVITIES

1 Where does the average grower secure good seed?
2 What characteristics does a good growing media possess?
3 What is the proper temperature to germinate seeds?
4 What will happen when a grower attempts to germinate seeds at a cool temperature?
5 What is the best temperature to grow plants?
6 Why do you use a sterile moisture-holding material in planting seeds?
7. What information should the label on a seeded flat contain?

Information Sheet
on
PROPAGATION FROM SEEDS

There are several basic principles that the grower must observe if he is to get good germination of his seeds and thereby be successful in producing new plants. These are:

1. Use good seeds. For the average grower good seeds can be obtained from the commercial producer of seeds. These are growers who are not growing plants for the purpose of getting a flower but for the purpose of collecting and processing the seeds for sale to plant propagators.
2. The grower must always use the best of growing media for germinating the seeds. A wide variety of materials can be obtained for this purpose. The media, whatever his choice, must possess certain characteristics. It must be finely screened, porous, loose and have a good water-holding capacity. It should be sterilized and in most cases low in nutrients necessary for plant growth. These nutrients can be added after germination and after the plant begins its growth.
3. The germinator or grower must maintain the proper temperature if the seeds are to germinate properly. Different plant seeds require different temperatures, however, there are general principles that will be helpful to the grower that will apply to most plants. Most of the common plants that the retail grower will deal with require a minimum of 65° for proper seed germination. In most cases the temperature should be about 70°F. This is very important because the grower who attempts to germinate seeds at a cool temperature will find that the seed will rot before having a chance to germinate.
4. The proper moisture level must be maintained and must be kept uniform. If this is not done after the seed germinates or sprouts, the plant will die.
5. After germination occurs most species of plants grow better in a slightly lower temperature and in a cooler house. The best temperature is usually between 50 to 60°.

To sum up these general principles, you could say that if you start with good seeds, sow them in a good growing medium, keep them warm, and moist until after germination, success is most likely to occur.

Reasons For Failures In Germination

If the seed is good and there are proper amounts of heat, moisture and air, nearly all the seed will germinate. However, some factors are responsible for seeds not germinating. The more important factors are:

1. Damaged Seed - Seeds with broken seed coats, insect or rodent damage or heat damage will not germinate properly or else will fail to germinate at all.
2. Old Seed - Seeds which are more than one year old will not germinate as well as fresh seed, especially if the old seed was not stored properly.
3. Soil or Media Too Wet - Too much water keeps air (oxygen) from moving around the seed, causing it to rot before the plant can emerge.

Propagation From Seeds
(Information Sheet continued)

4 Temperatures Too Cold - When soil and/or air temperatures are low, the emerging plant develops slowly and uses up the stored food before it can manufacture its own food Cold temperatures also slow down the absorption of water needed to start the germination process

5. Hard Seed - Some plants produce seed with a tough coat which will not allow moisture to enter the seed In such cases, it is necessary to use a special process to weaken the outer seed coat This special process is called scarification , and is used to weaken the outer seed coat so that water may be absorbed to begin the process of germination

6 Disease - Many diseases which affect plants are caused by bacteria or fungi carried to the young plant by air, water, or insects These pests are present on the seed itself or are present in the soil Damping off is one of the more common diseases affecting new plants Many of these diseases can be controlled by using various seed treatments and through sterilization of the soil or media in which the seeds are planted

7 Drying Out Of Soil Or Media - It is necessary to keep the soil or media well watered after seeds are planted Care must be taken to keep the soil or media moist enough so that the seed have a continuous supply of moisture, but not so much as to encourage damping off or reduced aeration of the media

8 Planting Too Deep - Seeds which are placed too deep in the soil or media may fail to produce a plant. These seeds will use all of their stored food and energy before reaching the surface and die before they can begin to make their own food A good rule to follow is to plant seed no deeper than 3 times the smallest thickness or size of the seed Most small seeds should be planted from 1/8" to 1/4" deep with a covering of a loose moisture-holding medium

Seeding In Flats

Starting plants by seeding thickly in flats is a common practice The seed may be broadcast or planted along marked rows The seed should be placed at a depth which allows for easy emergence of the seedling If the seeds are broadcast, little covering is needed Some propagators may use a layer of a sterile moisture-holding material such as sphagnum moss as a seed bed to reduce the chances of damping off developing However, care must be taken that the sphagnum moss is not soggy wet.

A flat 2" x 4" board made to fit inside the flat or a brick can be used for firming the top of the soil In general, the smaller the seed, the less covering is needed For example, celery seed would require less covering than either bean or corn.

Small seeds are often hard to handle and plant. To help distribute the smallest seed, you can mix them with a small amount of sand or other inert material.

Propagation From Seeds
(Information Sheet continued

After the seed are planted in the bed and covered. water the seedbed gently. To prevent washout of fine and small seeds. use fine misting nozzles, sub--surface irrigation or place burlap bagging over the seedbed and soak the bed thoroughly When misting nozzles or sub-surface irrigation is used to moisten the seed and media, the usual practice is to cover the flat with a piece of glass or place the entire flat in a plastic bag to converse moisture until germination occurs After the initial watering no additional watering is usually required prior to germination

All seeded flats should be labeled The label should include the following information:

1 Name of plant or variety
2 Date seeded
3 Student's name
4 Special treatment if any

Using pot labels

1. Always start entries at the blunt end of the label.
2 Allow the lower 1/3 of the label to remain free of entries for insertion into the soil of the flat (or pot) This will permit reading of the information on the label without lifting and wiping off the label.
3 The students should be taught that the seeding job is not complete until the label containing the required information pertaining to the seeding is in place in the container.

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Material for this information sheet was taken from Ornamental Horticulture for Vocational Agriculture in Alabama, page 54, and also from "Propagating Horticultural Plants, Module No 3 Ohio State University.

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Plant Propagation

TOPIC Developing A Plant Breeding Vocabulary

OBJECTIVE To become familiar with the words used when discussing plant breeding.

INTRODUCTION It is next to impossible to understand any subject if one does not have a working knowledge of the terms involved Reading will be meaningless if you have to skip every third or fourth word because you are not familiar with it.

REFERENCE
Required
1 "Plant Breeding as a Hobby", Circular 817, University of Illinois, College of Agriculture page 32

QUESTIONS OR ACTIVITIES

1 What is the process called by which stamens or anthers are removed to prevent self-pollination?
2 What is a perfect flower?
3 What are the three parts of the female portion of a plant?
4 Where do seeds develop?
5 How are generations numbered?
6 What part of the plant bears pollen?
7 Is it possible for one plant to pollinate itself?
8 What part connects the stigma and ovary?
9 Ask your science or biology teacher to explain D. N. A. (Desoxyribonucleic acid) to you The discovery of D. N. A has revolutionized the field of plant breeding.

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Plant Propagation

TOPIC: Plant Selection and Fundamentals of Plant Breeding

OBJECTIVE: To become familiar with selection processes and to develop an understanding of pollination and fertilization.

INTRODUCTION: In order to breed plants successfully it is important to understand the principles of plant reproduction. A person does not have to be a scientist to understand and do plant breeding. Many people make a hobby of this field. Plant breeding, of course, is much more than a hobby. It is the foundation for developing new and better plants.

REFERENCES: Required

1. "Plant Breeding as a Hobby", Circular 817, University of Illinois, pp. 3-8

Supplemental:

2. Practical Plant Breeding, W. J. C. Lawrence, London, 1951

QUESTIONS or ACTIVITIES:

1. What is meant by natural selection?
2. What are the two ways in which plants reproduce?
3. In what general section of a plant are reproduction processes carried out?
4. What is the name of the total male reproduction system?
5. What are flowers called that only contain the male reproductive organs?
6. What is the major difference between pollination and fertilization?
7. Learn the parts of the perfect flower (figure 17 on page 5).

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Plant Propagation

TOPIC: Heredity

OBJECTIVE: To understand how traits are passed on from generation to generation

INTRODUCTION: The study of heredity is not only one of the most rewarding studies of man, it is one of the most interesting. Heredity, like a lot of subjects, seems complicated and dull at first, but with knowledge comes interest. Once you understand basic concepts, you will want to look further into the subject. You will find it interesting to actually try some of the plant breeding experiments suggested in your reference material.

REFERENCES

Required

1. "Plant Breeding as a Hobby", Circular 817, University of Illinois, pp 8-13

Supplemental

2 Handbook on Breeding Ornamental Plants, Brooklyn Botanic Garden, Brooklyn, N. Y., 1959

QUESTIONS or ACTIVITIES

1 If a dominant gene and a recessive gene come together, which gene will show up in the outside appearance?
2 What is usually necessary to develop new varieties?
3. How many genes does a germ cell contain?
4 Can genes be determined by looking at a plant's color?
5. What is meant by segregation as it applies to plant breeding?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Plant Propagation

TOPIC: General Breeding Techniques

OBJECTIVE: To become familiar with the equipment and techniques necessary for successful plant breeding

INTRODUCTION: Successful plant breeding is almost impossible unless the proper techniques are used. It takes only a little while longer to do the job right.

REFERENCES: Required

1 "Plant Breeding as a Hobby", Circular 817, University of Illinois, pp. 14-20

Supplemental

2 Simple, Practical Hybridizing for Beginners, D. Gourlay Thomas, John Gifford, Ltd., London, 1957

QUESTIONS or ACTIVITIES:

1. Make a list of the equipment which is useful in plant breeding.
2. When should prepollination steps generally begin?
3. At what time of day does pollinating work best? Why?
4. If you want to cross pollinate a perfect flower, what must be done to guard against self-pollination?
5. List the proper steps for labeling the seed parent after pollination

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Nursery Plant Production

TOPIC: Transplanting Ornamental Trees and Shrubs

OBJECTIVE: To develop an understanding of the major factors involved in the proper planting of ornamental trees and shrubs.

INTRODUCTION: Since trees and shrubs are an important part of landscaping, it is essential to know how and when to plant them.

Proper cultural practices will provide the desired effects after your careful selection of plants These practices include the care of the plants, preparing the soil, setting the plants, and providing proper care immediately after planting.

REFERENCES: Required:

1. Information Sheet on "Planting Ornamental Trees and Shrubs"
2. Sunset Basic Gardening Illustrated, pp. 31-32, 34-35

Supplemental:

3. Approved Practices in Beautifying the Home Grounds, Hoover, pp. 143-171

QUESTIONS or ACTIVITIES:

1. When should bareroot shrubs and trees be planted?
2. What size hole should be dug for the correct planting of shrubs and trees?
3. When planting a bareroot shrub or tree, how much of the top should be pruned?
4. What does the nursery term B&B mean?
5. What size tree usually needs guy wires?

Information Sheet
on
TRANSPLANTING ORNAMENTAL TREES AND SHRUBS

Proper planting will benefit both the plants and you. If they are worth planting, they are certainly worth the time and trouble to do it correctly. Care and attention from the very beginning will be of value.

Container grown plants and those balled and burlapped (BB) can be planted anytime. Early fall is a good time to plant as they should be well established before summer.

Bareroot plants such as pecan and fruit trees, some shrubs, and roses need to be planted as soon as they begin to arrive at the nurseries. This is usually in late fall or early winter.

The size of the hole into which the plant is to be placed is very important. It should be at least one to two feet wider and at least six inches or a foot deeper than the roots of the plant.

The soil in the bottom of the hole should be worked well and mixed with organic matter. Unless barnyard manure is well rotted, avoid using it. Do not fertilize newly set out plants, especially bareroot (BR) ones.

After the hole has been dug, you can fill it with water and allow it to soak into the surrounding soil. Place some of the soil mixed with organic matter into the bottom of the hole; set the plant on this. Fill in around the roots with more topsoil and pack well. You could water again and complete filling the hole with soil. The plant should be placed at the same level at which it was originally growing.

If the shrub was bareroot, you can prune about one-third of the top to compensate for the roots lost in digging. Generally, balled and bagged will need some pruning also, but container grown do not.

If the plant was in metal, paper, or plastic container, this should be removed before planting. If it was wrapped in burlap, this does not need to be removed. It can be loosened around the top near the base of the plant. Plants in containers may need to be watered before removing to prevent the soil from crumbling.

Newly planted trees or very tall shrubs will usually need to be staked especially if they are in a windy area. A stake can be placed on the side of the prevailing wind. This stake can be put in before planting if the plant is bareroot.

Transplanting Ornamental Trees and Shrubs
(Information Sheet continued)

If the tree is over five inches in diameter, it may need guy wires. The wooden stakes would be placed some distance from the base of the tree and driven about 18" into the ground. Wires can be used from the tree to the stakes. The wire should not be tied directly to the plant. Rubber hose protectors may be used around the wires. If the plant is not too large, plastic ties may be used.

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Nursery Plant Production

TOPIC: Care and Maintenance of Plants

OBJECTIVE: To develop an understanding of the modern methods of pruning ornamental shrubs and trees.

INTRODUCTION: Pruning of plants is the cutting off or cutting back of parts of a plant for better shape or more fruitful growth.

Trees and shrubs may need to be pruned in order to remove dead, diseased, or injured wood. Pruning may be needed to remove a branch that overlaps another or to remove foliage right after plants are transplanted in order to make up for the loss of roots.

Pruning also helps to improve the shape of the plant and makes it fit into the general pattern of the landscape.

REFERENCES: Required

1. Information Sheet on "Care and Maintenance of Plants"
2. "Modern Pruning Methods", B-997, Texas Agricultural Extension Service

QUESTIONS or ACTIVITIES:

1. What is the cardinal rule to follow in pruning ornamental plants?
2. Give three characteristics of pruning tools.
3. When can trees be pruned?
4. What two factors are important in pruning ornamental shrubs and small trees?
5. How much top growth should be removed from bareroot dug plants?
6. Why do rose plants need to be pruned?
7. When should deciduous plants be pruned?
8. When is the proper time to prune shrubs which bloom in the spring?
9. When should climbing roses be pruned?
10. Why is a rounded or pointed top hedge preferred over a flat top hedge?

Information Sheet
on
CARE AND MAINTENANCE OF PLANTS

Take stock of your yard and check on an important chore - pruning. Are your sidewalks and driveways covered by overgrown, sprawling shrubs? Are your doorways crowded and your windows hidden? Then you should do some pruning.

Pruning, the removal of surplus or undesirable parts of the plant to improve the remaining parts, reduces the leaf surface or buds that grow into leafy shoots. This diverts the plant food from root production to shoot production and increases the leaf growth

Deciduous plants, those which lose their leaves during cold weather, should be pruned between leaf drop and first spring growth. The skeleton is exposed and the plant is easier to work with After pruning, the plant should have a framework of well-shaped, uncrowded branches.

Many evergreen shrubs need annual pruning. These might include wax-leaf ligustrum, pittosporum, eleagnus, yaupon, and viburnum. They may be pruned into midsummer as they have no dormant period.

Sometimes coniferous evergreens such as arborvitaes need to be pruned to keep them within a certain size. This can be done by shearing the main branches and end branches with sharp hedge shears. Gradually clip from the outside to almost where the brown foilage begins. This foliage will turn green when the light reaches it

The average pruning is from about one-fifth to one-third of the entire shrub Many shrubs should be pruned by thinning out rather than be severe pruning If a shrub is badly out of proportion to its surroundings, you can cut it back to within a foot of the ground Fertilized, watered, and allowed to grow naturally, you will have an attractive shrub again.

Shrubs grown for formal hedges need frequent cutting to keep them closely sheared within definite dimensions. If a hedge is informal, it can be allowed to grow more or less at will; it can be controlled to some extent.

Shrubs which bloom in the spring should not be pruned until after their flowering. Severe pruning can be done then as the flowers are produced on wood grown the year before the blooms.

Pyracantha or other berry-bearing shrubs should be pruned before the blooms appear in the spring. The berries for next fall and winter will be lessened by late or severe pruning.

Care and Maintenance of Plants
(Information Sheet continued)

Rose bushes produce flowers on wood formed the same season. Therefore, the more of last year's wood you prune, the better for your rose bushes. Cut back old, non-productive canes. Remove any dead or diseased wood.

Climbing roses should be pruned after flowering. Flowers this spring will be produced on canes grown last season; they will be much greener looking and not as old appearing as the canes produced the season before. Branches which are too long may be cut back about one-third of their total length.

Use the proper tools when pruning. Be certain they are clean and sharp. Make a clean, smooth cut and leave no jagged edges, bruised bark, or stubs.

Always remove any dead, diseased, or broken branches from plants. If branches are rubbing, crowded, weak, or growing downward, they should be removed.

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Floral Crop Production

TOPIC Introduction to Floral Crop Production

OBJECTIVE To develop an understanding of the field of floriculture and to learn about sources of information on the subject.

INTRODUCTION Floral crop production in the United States is a comparatively young business which probably started during the early part of the nineteenth century in Pennsylvania At that time, Philadelphia was considered the social center of the country The need for floral arrangements for special occasions brought about the beginning of the production of floral crops. Today the production of flowers is one of America's largest industries.

REFERENCES Required
Flower and Plant Production, Nelson, pp. 3-15

QUESTIONS or ACTIVITIES

1 Why is it necessary for flowers to be produced throughout the year?
2 What are the three most widely grown cut flowers?
3. Where do most retailers of pot plants acquire their plants?
4 What is the motto of the Society of American Florists?
5 What magazine on the floriculture industry is available to the southern producer and can be obtained from Ft. Worth, Texas?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Floral Crop Production

TOPIC Growing Annuals

OBJECTIVE To develop an understanding of how to successfully grow annual plants

INTRODUCTION Annuals are temporary plants in that they grow for only one year. Beginners and professionals alike enjoy working with annuals.

REFERENCES Required
Basic Gardening Illustrated, Sunset, pp. 102-103

QUESTIONS or ACTIVITIES

1. When do most annuals bloom?
2. Which small seeded annual is simplest to grow?
3. Give three examples of large seeded annuals which are easy for beginners to grow
4. What is the general rule for watering annuals?
5. What should be done to most annuals after they are through blooming?
6. When do morning glories bloom?
7. Do hollyhocks produce blue flowers?
8. What color blooms are produced by the scarlet sage?
9. Where can the portulaca be used effectively?
10. What is one disadvantage of asters?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Floral Crop Production

TOPIC: Perennials

OBJECTIVE: To develop an understanding of how to successfully produce perennial flowering plants.

INTRODUCTION: Perennials are long-time favorites of gardeners everywhere. Unlike annuals, they continue to flower year after year. During the winter the plant goes into a period of rest called dormancy. The following season it begins growth and starts to bloom.

REFERENCES: Required
Basic Gardening Illustrated, Sunset, pp. 100-101

QUESTIONS or ACTIVITIES:

1. What is probably the best plant for a new gardener to grow?
2. What is one of the most common uses of the large mum?
3. How often should primrose clumps be divided?
4. How can one cause polyantha primroses to repeat bloom in the fall?
5. If peonies are properly planted, how often will they need dividing?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Floral Crop Production

TOPIC: Bulbs

OBJECTIVE: To develop an understanding of how to properly use bulbs in the floriculture industry.

INTRODUCTION: A bulb is an underground bud that sends down roots and has a very short stem covered with leafy scales such as lilies and onions.

It is both interesting and rewarding to plant a bulb and obtain a beautiful flowering plant

REFERENCES: Required:
Basic Gardening Illustrated, Sunset, pp. 104-107

QUESTIONS or ACTIVITIES:

1. When do tuberous begonias bloom?
2. Why should first foliage not be cut until it turns yellow?
3. What can be used to protect bulbs from soil insects and rot?
4. What is a true bulb?
5. What is a rhizome?
6. Study the terms on page 107.

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Floral Crop Production

TOPIC: Characteristics, Identification, and Use of Important Pot Plants

OBJECTIVE: To learn the characteristics, identification, and use of twenty important pot plants.

INTRODUCTION: This assignment contains an information sheet with some of the characteristics, uses, and cultural requirements of twenty plants that are grown in many greenhouses and garden centers in Texas. A student studying for a horticultural occupation should be able to identify the important pot plants and give their characteristics and uses.

REFERENCES: Required:
1. Information Sheet on "Important Pot Plants"
2. Seed catalogues

QUESTIONS or ACTIVITIES:
1. Locate pictures in catalogues and other references and study the picture as you study about each plant listed on the information sheet.
2. As you study each plant, list it on the attached form and determine its most important identifying characteristics and use.

CHARACTERISTICS AND USE OF POT PLANTS

No	Plant	Characteristics	Use
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Information Sheet
on
IMPORTANT POT PLANTS

1. AZALES --------Bright flowering plant from mid-December through May. Requires acid soil or peat moss as growing medium, ample moisture but good drainage. 60-65° temperature.

2. BEGONIA -------Grown for foliage and flowers. Grown in soil that is porous and slightly acid. Top soil should become dry before watering. Water thoroughly. In winter requires full sunlight; in spring and summer place in filtered sunlight.

   Thrive in humid air and do well in a temperature of 60-70°. Keep foliage dry.

3. BROMELIAD-----Exotic looking plant with showy spikes of blooms which may be attractive for several months. Most store an emergency supply of water within a natural vase-shaped center formed by their durable foliage in leaf base cups. They are easy to grow and do well in shade or sunny locations. The color patterns in the foliage and unusual growth habits make the Bromeliad an excellent and interesting plant for the home or office.

4. CALADIUM-------Colorful decorative foliage plant grown from tubers which are sold in grades expressed in inches of diameter.

   Plant in loose, well-drained soil. Need high humidity and ample water. 80-85° best temperature to start Caladiums.

   Require light but not full sun. Fertilize with complete plant food about once a month

   The fancy-leaved Caladiums offer a variety of form, color, and leaf patterns that few plants can match. Grow to 2 - 2-1/2'. Can be used as house plants or for outdoor planting.

5. CHENILLE ------Bright green, broad foliage. Flowers in hanging cattails up to a foot long of a deep red color. Needs semi-light and ample moisture.

6. DIEFENBACHIA--Large decorative foliage plant. Needs well-drained soil high in organic matter. Filtered light. Commonly propagated by cutting stems into sections containing one or more eyes.

Important Pot Plants
(Information Sheet continued)

7. CHRYSANTHEMUM - (Mum) - Grows best in porous, well-drained sterilized soil. Rooted cuttings should be planted as shallow as possible. They are heavy feeders and need a regular supply of fertilizer. Disease and insect control is very important. They have special requirements such as timing, pinching, lighting, and shading. Disbudding produces larger flowers.

8. COLEUS -------- Outstanding foliage plant which is tender; requires frequent pinching during growing season to produce attractive, compact plant.

Needs loose, well-drained woil with ample moisture. Requires partial shade in hot, dry areas of Texas. Occasionally threatened with aphids and mealy bugs. Easily rooted from cuttings.

9. CROTON ------ - Bright glossy leaves of many different colors on a single plant. Leaves are various shapes. Require strong sunlight to retain their color. Needs high humidity. Propagated usually by air-layering.

10. DEVIL'S IVY ---- Variegated yellow-splashed green leaves. Filtered light for best coloring. Requires high humidity, but do not keep constantly wet. If on totem, moisten for humidity. Needs rich loam soil. Feed with complete fertilizer about once a month.

11. DRACAENA ----- A versatile plant of various types. Most varieties are large and showy; most have leaves that are long and striped. Shade or filtered light. Moderately moist, but good drainage, and high temperatures.

12. FERNS --------- Various assortments usually called table ferns. All like cool, moist shady conditions. Rich compost soil and moisture, but well drained. Will provide cool greenery background for other plants.

Many varieties excellent for basket growing.

13. FICUS ---------- (RUBBER PLANT) - Commonly used as large specimen plants, so they do need space. Have glossy green foliage. Will tolerate dry air, and do well at 70 to 80°. Do not overwater.

Filtered light ideal, but will take a great deal of sun.

Propagated mostly by air-layering.

Important Pot Plants
(Information Sheet continued)

14. GERANIUM-----Dusty, green foliage, succulent stems Large clustered flowers in many colors Require plenty of sun to bloom properly Allow to become quite dry between waterings Sandy loam high in organic matter is best Temperature from 60-70° is ideal

15 GLOXINIA------Showy, velvety foliage and large bell-shaped blooms in assorted colors Light high humidity, moisture, rich, well-drained soil Water spots foliage and flowers, so avoid getting water on them They need filtered light, and proper spacing

16. HYDRANGEA----Showy broad dark green foliage Long lasting flowering plant commonly grown for Easter and Mother's Day Flowers in pink blue, or white Plant requires regular water during flowering and likes high humidity

17 PHILODENDRON-Most important tropical decorative plant family Tropical conditions best, but will tolerate dry air and low lighting in homes Needs loose, porous soil, sufficient water to keep soil moist Many varieties and types Some used on totems and are strong climbers

18. POINSETTIA----Seasonal plant most popular at Christmas Small yellow flowers surrounded by striking colorful bracts in red, pink, or white Keep warm, chills easily Requires moisture and strong light

19. SANSEVIERIA---(Snake Plant or Mother-in-law's tongue) - Among the sturdies of the foliage plants Will do well in shade areas or in sunlight Do need porous soil, adequate drainage Do not overwater

20. SCHEFFLERA---Attractive, fast growing umbrella-shaped foliage plant Glossy green foliage Filtered light Needs good drainage, and don't overwater Large plant, needs space Usually propagated from seed.

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Floral Crop Production

TOPIC: Poinsettias

OBJECTIVE: To develop an understanding of the cultural procedures in Poinsettia production

INTRODUCTION: The Poinsettia is an important blooming plant which is very popular at the Christmas season They are a native of Mexico and the tropical American countries

The beauty of Poinsettias lies in the brilliant bracts below the cluster of flowers They are now being produced as reds, whites, and pinks.

Cultural practices are more important in growing Poinsettias than most crops because they have to be timed for the Christmas season only. The day after Christmas the prices decline rapidly.

REFERENCES:

Required:

1 Flower and Plant Production in the Greenhouse, Nelson, pp 272-279

Supplemental:

1. The Ball Red Book, pp 299-310

QUESTIONS OR ACTIVITIES

1 What nutrient should be supplied if cuttings are made under a mist
2 List three poinsettia colors
3 What is the most common pest on Poinsettias?
4 What are the most common causes of leaf drop on Poinsettias?
5 What is the reason for poor root development in Poinsettias?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Floral Crop Production

TOPIC Chrysanthemums

OBJECTIVE To develop an understanding of some important cultural practices in chrysanthemum production

INTRODUCTION The Chinese began hybridizing or crossing varieties of Chrysanthemums, or mums as they are more commonly called, over 2,500 years ago. In the years since, plant breeders from many lands have done much to improve existing varieties. The Oriental growers tried to win the approval of royalty; European growers concentrated on magnificent showblooms; the American hybridizers have improved mums for florist trade

In recent years, much has been done to cause mums to flower on a year round basis. This is accomplished in greenhouses by controlling temperatures, shading, lighting, diseases and insects

REFERENCES

Required:

1. Flower and Plant Production in the Greenhouse, Nelson, pp. 237-244

QUESTIONS OR ACTIVITIES

1 What is the natural blooming season for mums?
2 What is the most persistent pest of pot mums?
3. What is the correct night temperature for raising mums?
4. What is the most popular color in mums?
5 Why is black cloth placed over mum plants?
6. How and when do you pinch mums?
7 What may happen when mums are planted 2 to 3" deep?
8. What is the proper schedule for misting of mums?
9. How long does the mum season last?
10. What should be done to the soil before planting mums?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Floral Crop Production

TOPIC Geraniums

OBJECTIVE To develop an understanding of the cultural procedures in geranium production

INTRODUCTION Few plants can equal the geranium for color, long period of bloom, and simple care They make a fine showing as a pot plant or as a bedding plant

Geraniums were once considered an old-fashioned plant; today they are one of the most popular plants for gardeners, indoors or outdoors

REFERENCES Required

1 Flowers and Plant Production in the Greenhouse, Nelson pp 256-264

Supplemental

2 The Ball Red Book, pp 247-251

QUESTIONS or ACTIVITIES

1 Why must geraniums be shipped so rapidly?
2 What is done to the plant several weeks before the cutting harvest is to start?
3 What color of geraniums is most in demand?
4 What system of watering has proved to be excellent for geraniums?
5 Give two good management activities in the sanitation program to prevent diseases from developing and spreading
6 What is the second most popular color in geraniums?
7 What is the night and day temperature preferred by geraniums?
8 How are most geraniums shipped from California?
9 In what size pot are most geraniums produced?
10 Why have geraniums not been widely grown from seed?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Floral Crop Production

TOPIC: Hydrangeas

OBJECTIVE: To develop an understanding of the cultural methods in raising hydrangeas

INTRODUCTION: The hydrangea is usually raised as an Easter and Mother's Day plant It is an excellent long lasting flowering plant for late winter and spring season

REFERENCES

Required

1. Flower and Plant Production in the Greenhouse, Nelson, pp 264-267

Supplemental

2. The Ball Red Book, pp. 259-269

QUESTIONS or ACTIVITIES:

1. What insect must be controlled on hydrangeas?
2. What will happen to hydrangeas if they are not frequently watered?
3. When are stem tip or leaf bud cuttings made?
4. For which two occasions are hydrangeas commonly shown?
5. What disease causes severe loss to hydrangea buds in storage?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Establishing and Caring for Lawns

TOPIC: Turf Grasses for Texas

OBJECTIVE: To develop an understanding of planning the lawn and the proper selection of turf grasses for Texas

INTRODUCTION: A beautiful lawn is the foundation for a pleasant home landscape. No matter how expensive the home, how beautiful the trees, shrubs, and flowers, they will not show up to the best advantage with an unattractive lawn.

A lawn is a living thing consisting of thousands of tiny living plants or grasses. Each plant needs food, water, sunshine, and soil. It is largely dependent upon you for many of these.

The lawn is a valuable part of the landscape design and should provide the proper setting for the house, trees, shrubs, and other buildings. It should be established properly in order to provide a beautiful area which will be easy to keep attractive.

REFERENCES: Required
"Home Lawns", B-203, Texas Agricultural Extension Service, pp 1-5

QUESTIONS or ACTIVITIES:

1. Give five factors to consider in the selection of a turf grass
2. List two ways turf grasses are classified
3. Give three points about bermuda as a turf grass
4. Give six points about St. Augustine grass as a turf grass
5. Why does Zoysia grass make an excellent turf?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Establishing and Caring for Lawns

TOPIC: Establishing a New Turf

OBJECTIVE: To develop an understanding of the principles in the establishment of a new turf.

INTRODUCTION: The lawn is a valuable part of the landscape design and should provide the proper setting for the house, trees, shrubs, and other buildings. It should be established properly in order to provide a beautiful area which will be easy to keep attractive.

REFERENCES: Required
"Home Lawns", B-203, Texas Agricultural Extension Service, pp. 5-7

QUESTIONS or ACTIVITIES:

1. List three distinct steps necessary in the establishment of turf.
2. List five types of organic matter which can be added to a new turf.
3. How should fertilizer applications be determined?
4. What are the factors to consider in determining whether a yard will be seeded, sprigged, or sodded?
5. Why is the frequency of watering reduced as the lawn begins to take root and grow?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Establishing and Caring for Lawns

TOPIC Managing an Established Turf

OBJECTIVE To develop an understanding of the principles and practices involved in managing an established turf

INTRODUCTION After the lawn has been properly established it is important to know the time and rate of fertilization when to water and to have a working knowledge of keeping a lawn beautiful

REFERENCES Required
"Home Lawns" B-203 Texas Agricultural Extension Service pp 8-12

QUESTIONS or ACTIVITIES

1 List four major factors involved in maintaining turf
2 Why is Nitrogen the key element in turf production?
3 Why is Phosphorous important to the lawn?
4 Explain what a lawn looks like when it has a nitrogen deficiency
5 What does a plant look like when it has a phosphorous deficiency?
6 Describe an iron deficiency in the turf
7 When should the turfed areas receive an application of complete fertilizer?
8 How may chlorosis be corrected?
9 Why are light frequent sprinklings harmful?
10 Why is the aeration of the soil in a turf important?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Establishing and Caring for Lawns

TOPIC: Turf Problems

OBJECTIVE: To develop an understanding of the problems which occasionally arise in the management of a lawn.

INTRODUCTION: Many problems may arise in the successful management of beautiful, well-kept lawns. The horticulturist should be able to identify the important lawn diseases and insects and have a working knowledge of the control of these problems.

REFERENCES: Required:

1. "Home Lawns", B-203, Texas Agricultural Extension Service, pp. 12-14.
2. "Texas Guide for Controlling Insects on Ornamental Plants", Texas Agricultural Extension Service, L-199.

Supplemental:

3. "Lawn Insects, How to Control Them", B-53, U.S.D.A.

QUESTIONS or ACTIVITIES:

1. List four problems which occasionally arise in the production of a turf.
2. What is the best way to control weeds?
3. What chemical is commonly used to control broad-leaved annual weeds in the lawn?
4. Describe the appearance of a lawn which has Brownpatch.
5. What is a good fungicide for controlling Brownpatch?
6. List eight dusts or sprays which are effective for controlling most lawn insects.
7. Why is renovation of old lawns necessary?
8. List four dusts that are recommended for the control of chiggers.
9. Give three good sprays for the chinch bug.
10. Give the mixture for controlling the Bermuda grass mite.

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Controlling Plant Insects, Plant Diseases, and Other Pests

TOPIC: Causes of Plant Diseases

OBJECTIVE: To learn what causes plant disease and to learn to recognize these diseases.

INTRODUCTION: There are probably about as many diseases as there are plants. Man must constantly strive to ward off these diseases. If all research stopped, it is possible that man would be living in a world of famine and hardship.

REFERENCES: Required:

1. "What You Should Know About Plant Diseases", B-995, Texas Agricultural Extension Service

Supplemental:

2. "Texas Guide for Controlling Insects and Diseases", L-245, Texas Agricultural Extension Service

QUESTIONS or ACTIVITIES:

1. What are the four most important causes of plant disease?
2. What is photosynthesis?
3. What is a vector?
4. What is the best approach to controlling canker disease?
5. What are fungi?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Controlling Plant Insects, Plant Diseases, and Other Pests

TOPIC: Identifying Plant Diseases

OBJECTIVE: To learn to identify plant diseases and to become familiar with the terminology used in connection with plant diseases.

INTRODUCTION: Better quality and higher yields at lower cost are possible with better disease control Diseases cost producers millions of dollars each year. A large part of this expense can be prevented by learning more about diagnosing and checking plant disorders.

REFERENCES: Required.

1 "Identifying Plant Diseases", MP-512, Texas Agricultural Extension Service.

Supplemental:

2. "What You Should Know About Plant Diseases", B-995, Texas Agricultural Extension Service.

QUESTIONS or ACTIVITIES:

1. What is the key to effective control of plant disease?
2. What is meant by blasting?
3. What is exudate?
4. What is the best way to check nematode damage?

Activity:

1. Study the terms that describe plant diseases on page 7 of reference no. 1.
2. Collect all the publications on plant diseases from your county agent.

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Controlling Plant Insects, Plant Diseases, and Other Pests

TOPIC: Application and Safety Precautions of Horticultural Chemicals

OBJECTIVE: To learn the safe use of the important horticultural chemicals and procedures for effective application.

INTRODUCTION: There are numerous methods of applying pesticides, fungicides, and other horticultural chemicals. The purpose is to completely cover the plant or pest with the proper amount of control material. The first factor to consider is the welfare of the people using the material, second is the welfare of the plants, and then the effectiveness of the material in controlling the pest or diseases.

REFERENCES: Required:
1. Flower and Plant Production, Nelson, pp. 302-311
2. Basic Gardening Illustrated, page 81

QUESTIONS or ACTIVITIES:
1. What is the first factor to consider when using chemicals?
2. What is the second factor to consider?
3. What is the third factor?
4. What is one of the most common means of applying pest or disease control materials in the greenhouse?
5. How should you store a water hose to prevent spreading of diseases?
6. What are the safety rules that should be followed when a person is working with pest control chemicals?
7. Why should a plant be completely covered with contact poisons?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Controlling Plant Insects, Plant Diseases, and Other Pests

TOPIC Controlling Leaf Diseases

OBJECTIVE To learn how to identify and control the major leaf diseases.

INTRODUCTION A customer who wishes to buy a plant is usually looking for one which has a lot of healthy leaves A plant will not sell if its leaves have wilted and turned brown This will result in decreased profits on the part of the producer.

REFERENCES

Required

1 "Texas Guide for Controlling Diseases on Ornamental Plants", MP-574 Texas Agricultural Extension Service, pp. 10-13

Supplemental

2 "What You Should Know About Plant Diseases", B-995, Texas Agricultural Extension Service

QUESTIONS or ACTIVITIES

1. How does one treat leaf scorch or scald?
2. What causes sooty mold?
3. What causes oedema?
4. What two chemicals are good for treating mosaic or leaf curl?
5. When do you spray azaleas and camellias for galls?
6. How often would one spray to control bacterial leaf spots?
7. What usually causes chlorosis?
8. What type of disease is anthracnose?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Controlling Plant Insects, Plant Diseases, and Other Pests

TOPIC: Controlling Stem, Branch, and Trunk Diseases

OBJECTIVE: To learn the major diseases that affect stems, branches, and trunks of horticultural plants and how to control these disorders.

INTRODUCTION: The stems branches, and trunks of plants are necessary for plant growth. They are the transportation system for the plant since water and food move through them. A disease affecting these systems can cause a definite decrease in plant vigor.

REFERENCES: Required:

1. "Diseases on Ornamental Plants", MP-574, Texas Agricultural Extension Service, pp. 14-16

Supplemental:

2. "What You Should Know About Plant Diseases", B-995, Texas Agricultural Extension Service

QUESTIONS or ACTIVITIES:

1. How does a person treat a plant that has gall?
2. What is the control for a dodder infestation?
3. How does moss damage a plant?
4. What part of a plant does green scurf attack?
5. What causes wood rot?
6. What is the treatment for slime flux?
7. How is mistletoe spread?
8. What causes lichens?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Controlling Plant Insects, Plant Diseases, and Other Pests

TOPIC: Controlling Root Diseases

OBJECTIVE: To learn to detect root diseases and how to control them.

INTRODUCTION: Roots are the storage organs of plants. If a disease is present in the roots of a plant, growth and vigor will be greatly affected.

REFERENCES: Required:
"Diseases on Ornamental Plants", MP-574, Texas Agricultural Extension Service, pp. 17-21

QUESTIONS or ACTIVITIES:

1. What is a good treatment for mushroom root rot?
2. What is a good treatment for crown gall and hairy rot?
3. What is the first step when planning to fumigate for mushroom root rot?
4. What is the minimum distance from live plants that it is permissible to use carbon bisulfide as a soil fumigant on mushroom root rot?
5. In what sections of Texas is southern blight most common?
6. What temperature is required for southern blight development?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Controlling Plant Insects, Plant Diseases, and Other Pests

TOPIC: Controlling Diseases Affecting the Entire Plant

OBJECTIVE To learn the causes, symptoms, and control of diseases affecting the entire plant

INTRODUCTION Many diseases are not localized in the stems, roots, or leaves, they damage the plant in all parts There are various controls for these diseases, but one must first be able to make a proper diagnosis. Never assume that because a plant shows a symptom of a known disease that you have diagnosed the disease properly. Many diseases have some common symptoms Don't make the mistake of diagnosing a plant disease without studying all symptoms of all diseases common to the particular plant

REFERENCES Required

1 "Texas Guide for Controlling Diseases on Ornamental Plants", MP-574. Texas Agricultural Extension Service, pp. 22-23

Supplemental

2 Basic Gardening Illustrated page 80

QUESTIONS or ACTIVITIES:

1 What symptoms would a chrysanthemum exhibit that had aster yellows that would not be present if it was affected by verticillium wilt?
2 What is an effective control for aster yellows?
3. What is an effective control for verticillium wilt?
4 In what section of Texas is verticillium wilt most common?
5. Who are the only people that should handle chloropicrin?
6. What is a chemical called that controls mites?
7. What are two effective treatments for botrytis blight?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Controlling Plant Insects, Plant Diseases, and Other Pests

TOPIC: Controlling Lawn and Turf Diseases

OBJECTIVE: To learn the major lawn and turf diseases and how to control them.

INTRODUCTION: It has been said that a landscape can be no better than the appearance of its lawn. A house can be made into a beautiful home by maintaining a nice green lawn. There are several diseases which can severely damage the appearance of the turf if they are not controlled.

REFERENCES: Required:
"Texas Guide for Controlling Diseases on Ornamental Plants", MP-574. Texas Agricultural Extension Service, pp. 24-26

QUESTIONS or ACTIVITIES:

1. What is the control for fairy rings or mushrooms?
2. What is the treatment for chlorosis?
3. What are the symptoms of fading out?
4. What is the treatment for slime mold?
5. What is the treatment for Piricularia leaf spot?
6. When should treatment for brownpatch be applied?
7. When should treatment for rust on bluegrass be applied?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Controlling Plant Insects, Plant Diseases, and Other Pests

TOPIC: Identifying Plant and Soil Insects and Methods of Control

OBJECTIVE: To learn how to recognize the major insects of horticultural plants. To understand the various controls for these insects.

INTRODUCTION: On any given day, a producer may walk through his plants and see numerous insects. Some of these insects and pests are taking money from his pockets by damaging his crop. A person who is depending on the proper growth and development of plants needs to know which insects are of economic importance and how to control them.

REFERENCES: Required:

1. Basic Gardening Illustrated, section to study: "Insect Pests", pp. 78-79
2. Information Sheet, "Identification of Plant Insects and Methods of Control"
3. "Texas Guide for Controlling Insects on Ornamental Plants", L-199, Texas Agricultural Extension Service (Study list of insects, descriptions, and types of damage.)

Supplemental:

4. "Texas Guide for Controlling Insects and Diseases", L-245, Texas Agricultural Extension Service

QUESTIONS or ACTIVITIES:

1. What is the difference between a snail and a slug?
2. At what time of year do grasshoppers hatch?
3. What are the best methods of controlling borers?
4. What part of the plant do grubs damage?
5. In what type of soil are nematodes most active?

Information Sheet
on
IDENTIFYING PLANTS AND SOIL INSECTS AND METHODS OF CONTROL

Eternal vigilance and timely applications of effective controls will reduce losses to a minimum Weeds in aisles or under benches are breeding places for a number of pests and cleanliness is imperative A generally overlooked area is that outside the greenhouse Weeds harbor many pests which can enter through side or top vents and open doors at the ends of the greenhouses Cleanliness and proper attention to the outside areas as well as under glass will reduce the sources of infestation

Great changes have occured in the field of insecticides and there is a wide array of materials which are useful in combating pests New materials are constantly being added and the horticulturist must keep informed as better insecticides are introduced

Aerosol bombs have radically changed certain pest-control practices Specific directions for their use cannot be given in general terms because they vary, and directions on the bombs should be followed closely Alternation in the use of materials is suggested to avoid the rapid build-up of resistant strains of pests

Resistance of mites to insecticides is believed to occur by mutation which establishes populations that survive normal effective doses This resistance is inherited and does not retrogress Purchasing plants or cuttings infested with resistant mites can lead to considerable trouble

Sprays and dusts are still used because in many instances they are just as effective as aerosols and may be cheaper for local applications Many insecticides are deadly poisons, and precautions regarding their use will be found on the container and should be followed

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Controlling Plant Insects, Plant Diseases, and Other Pests

TOPIC: Nematodes

OBJECTIVE: To develop an understanding of nematodes as a serious pest.

INTRODUCTION: When leaves of plants are wilting, drying, and falling off for no apparent reason, nematodes may be the cause. Nematodes are small, slender, worm-like parasites which cannot be readily seen by the naked eye. These pests are small, but they can completely destroy a plant.

REFERENCES. Required:

1. "What You Should Know About Plant Diseases", B-995, Texas Agricultural Extension Service, page 3, pp. 13-14
2. "Identifying Plant Diseases", MP-512, Texas Agricultural Extension Service

QUESTIONS or ACTIVITIES:

1. List the steps involved in preparing a small plant specimen as illustrated in bulletin MP-512.
2. What is the most common type of nematode?
3. What should be determined before a large amount of money is spent on nematodes?
4. Knots and galls found on plant roots do not always indicate root knot nematodes. Give at least two exceptions.
5. Name two plants that are very good hosts for root knot nematodes.

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Controlling Plant Insects, Plant Diseases, and Other Pests

TOPIC: Control of Moles, Gophers. Birds, Deer, and Ants

OBJECTIVE. To become familiar with animals and birds that are a nuisance to the producer of horticultural plants.

INTRODUCTION: Plant damage by animals and birds can become quite costly. The rural nurserymen usually have a big problem with animals, and the small town producers are plagued by flocks of birds

REFERENCES: Required.
Basic Gardening Illustrated, page 82

QUESTIONS or ACTIVITIES:

1. How can a person detect the presence of moles?
2. What are the two most effective means of destroying moles?
3. Why should traps be used with caution?
4. How do gophers and moles differ in their digging habits?
5. How do many gardeners who live in the country protect plant roots from gopher damage without using poisons or traps?
6. What birds have no friends and should be eliminated?
7. What is the best way to protect young seedlings from birds?
8. What is the best long term control for deer?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Controlling Plant Insects, Plant Diseases, and Other Pests

TOPIC: Controlling Weeds

OBJECTIVE: To learn how to get rid of weeds and to prevent their recurrence.

INTRODUCTION: Weeds grow well without proper water and fertilizer. If you add these two ingredients, they will flourish and this produces a great deal of trouble. If not controlled, they can crowd out annuals and perennials and even small shrubs. Chemical, hand, and mechanical methods of control are all effective if you start early and are persistent.

REFERENCES: Required:
Basic Gardening Illustrated, pp. 84-86

QUESTIONS or ACTIVITIES:

1. If you are planning to pull up weeds in a bed, what should you do to the soil several days before starting?
2. What has been the gardener's most useful tool for over 4,000 years?
3. What is a good device for weeding between paving blocks?
4. How does encouraging shrub growth reduce weed population?
5. After weeds have been cleared, what can be done to prevent recurrence?
6. What precaution should be taken when mixing and applying chemical solution where handling is required?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Operating and Maintaining Horticultural Equipment

TOPIC: Principles Used to Prevent Personal Injury

OBJECTIVE: To learn the techniques and principles involved in horticultural work that will prevent personal injury.

INTRODUCTION: Gardening and growing horticultural plants can be hard work. In many instances a little time spent constructing a labor saving device can save several hours of back-breaking work.

REFERENCES: Required:
Basic Gardening Illustrated, pp. 90-93

QUESTIONS or ACTIVITIES:

1. What part of the body should do the lifting when you are picking up an object from the ground?
2. What effect does one pulley have on the force when you are attempting to straighten up a tree?
3. What can be used to remove a stump if no heavy equipment is available?
4. What preparation should be made to clay soils before attempting to do a lot of digging?
5. Tell how to make a handy device for blasting post holes and planting holes.

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Operating and Maintaining Horticultural Equipment

TOPIC: Selecting and Maintaining Horticultural Hand Tools

OBJECTIVE: To learn to select the right tools for a job and to keep these tools in good repair.

INTRODUCTION: No situation is quite as distressing as trying to complete a job when the proper tools are not at hand.

REFERENCES: Required:
Basic Gardening Illustrated, pp. 88-89, 94

QUESTIONS or ACTIVITIES:

1. Why will asking different gardeners for a suggested tool list be of little value?
2. What type of shovel is effective for moving sawdust, manure, and other light materials?
3. What is the most common size of hoe?
4. How often should one sharpen a hoe if the cutting is not too hard?
5. What type of hoe is used by a pushing motion rather than a chopping motion?
6. What are the two most common shapes of lawn rakes?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Operating and Maintaining Horticultural Equipment

TOPIC: Maintaining Small Power Equipment

OBJECTIVE: To develop the ability to maintain small power equipment.

INTRODUCTION: Value of small power equipment quickly decreases if proper maintenance practices are not diligently followed. Preventing a breakdown is usually much easier than repairing one.

REFERENCES: Required:
Information Sheet, "Maintaining Small Power Equipment"

QUESTIONS or ACTIVITIES:

1. What are the two factions of preventive maintenance?
2. What should an operator of equipment do at the end of each work day?
3. Why should the fuel tank be filled at the end of the day?
4. What may be used to clean the air filter?
5. What two factors should be considered when checking a belt?

Information Sheet
on
MAINTAINING SMALL POWER EQUIPMENT

Small, engine-powered equipment quickly loses its value if it is not carefully maintained. Profitable use of the equipment depends on trouble-free operation on the job. While no equipment, no matter how well maintained, can be guaranteed not to break down on the job, "down time" can be extremely short if a careful maintenance program is followed. Human and livestock health care is of a preventative nature Equipment maintenance should be similar

Preventive maintenance can be described as consisting primarily of two things:

1. Periodic equipment inspection to discover situations which may lead to equipment breakdown.
2. Upkeep to minimize wear or to remedy potential trouble.

Regularly used equipment should always be checked by the operator. Should he notice any slight malfunction, he should correct it before further trouble develops. The operator should see that field maintenance is carried out regularly.

Usually not enough horticultural equipment is operated by a horticultural business to warrant hiring a full-time field mechanic or serviceman. The operator has the responsibility to check oil, apply grease, and perform other maintenance when needed. In some instances, this may be required every few hours. At the end of the day, the operator should make an overall check and properly service his equipment. This will make the equipment ready to use the next day or on any future date it may be needed.

A regular program of shop maintenance should be carried out on each piece of small, engine-powered equipment. Small engines have prescribed periods of operating time after which oil should be drained and replaced At that time a general check of the equipment is in order

Before beginning operation of a small, engine-powered piece of equipment, the following should be checked

1. Fuel
2. Engine oil level
3. Oil level and air filter
4. Belt tension
5. Chains, oil if necessary
6. Moving parts requiring frequent applications of grease or oil
7. Gearboxes
8. Implement adjustments

Maintaining Small Power Equipment
(Information Sheet continued)

During operation, the operator should constantly watch for any slight malfunction. Often a change in the sound of the machine when in operation will indicate the beginning of trouble. A skilled operator can tell by the sound of the machine if everything is in good working order. If equipment is used for long periods during the day, regular shutdowns for preventive maintenance practices are advisable.

When equipment has been shut down for the day, it should be carefully checked and readied for the following day's operation.

1. Fuel - Fill the fuel tank. Moisture condenses more rapidly in a partially empty tank as the air cools.
2. Oil - Check the oil level and add oil as required. The oil should be changed periodically.
3. Transmission case - Check the lubricant level, adding or changing the lubricant as necessary.
4. Oil filter - Clean and check the oil level.
5. Chains - Apply oil to chains at regular intervals. Check the condition of the links.
6. Belt condition - Check belts for excessive wear and for proper tension.
7. Moving parts - Grease all moving parts.
8. Cutting surfaces - Clean and check cutting surfaces of plows, cultivator tines, mowers for sharpness. Cover cutting surfaces with used oil or grease if the machine is to sit out in the weather or not be used over a period of time.
9. Adjustment - Check machine to be sure that all operating parts are in correct adjustment.
10. Bolts - Inspect the machine for missing and/or loose bolts.
11. Damaged or broken parts - Determine if any parts have been damaged to the extent that machine operation will be impaired. Replace these and all broken parts to insure proper operation.
12. Machine cleanliness - Clean off accumulated dust and dirt regularly.

When small, engine-powered equipment is put away for the off-season, give special care to provide the maintenance necessary to insure rapid starts the following season.

Small, engine-powered equipment is most valuable when operating properly. Proper preventative maintenance helps insure proper operation.

The following general procedure should be used. However, check the operator's manual for specific maintenance procedures which may be needed for a particular piece of equipment.

Maintaining Small Power Equipment
(Information Sheet continued)

1. Before beginning the check, disconnect spark plug wire to eliminate a possible accident.
2. Using wire brushes, scrapers, rags, and chemical de-greasers clean the entire machine. Use chemicals only outdoors.
3. Clean air filter. Rinse with gasoline or other solvent, wipe dry, and refill with oil. If the air filter has a dry element, replace with new element according to manufacturer's recommendations.
4. Check carburetor for sediment. Remove and check if necessary.
5. Re-connect spark plug wire and run engine for five minutes. Stop the engine, remove the spark plug wire, and drain the crankcase oil. Fill with new oil as recommended by the manufacturer.
6. Drain gas tank. Reconnect spark plug wire, start the engine, and run until the tank and carburetor are free of gasoline.
7. Remove spark plug and pour a teaspoonful of oil into the cylinder. Turn the flywheel to distribute oil. Replace the spark plug with a new one.
8. Adjust and/or sharpen any blades or implements.
9. Grease or oil any moving parts.
10. Wipe a light coating of oil over bare metal parts.
11. Store in a protected, dry place.

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Material for this Information Sheet was taken from Module 10, "Operating, Repairing, and Maintaining Small Power Equipment," Center for Vocational and Technical Education, The Ohio State University, Columbus, Ohio.

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Operating and Maintaining Horticultural Equipment

TOPIC: Operating and Maintaining Lawn Mowers Safely and Effectively

OBJECTIVE: To learn how to properly operate and to care for a lawn mower.

INTRODUCTION: A well mowed lawn can greatly increase the beauty of a home. There is more to operating a lawn mower than filling it with gasoline and mowing the grass.

REFERENCES: Required:

1. Basic Gardening Illustrated, page 94, "Lawn Mowing"
2. Information Sheet, "Operating and Maintaining Lawn Mowers Safely and Effectively"

QUESTIONS or ACTIVITIES:

1. What are the three general categories of power mowers?
2. What is meant by scalping a lawn?
3. What is the first step in adjusting the cutting height of a power mower?
4. A sickle bar mower consists primarily of what two parts?
5. Why should extremely long grass clippings be removed from the lawn?
6. Explain why grass leaves should never be clipped too short.

Information Sheet
on
OPERATING AND MAINTAINING LAWN MOWERS
SAFELY AND EFFECTIVELY

Power mowers can be divided into three general categories (1) reel, (2) rotary, or (3) sickle bar

Reel Mowers A reel mower is basically a common hand push mower powered by a small gasoline engine As the mower moves forward, the revolving blades slide past the bed knife and cut the grass blades

Reel mowers used on bluegrass and similar grasses have five revolving reel blades. Reel mowers used on the bent type grasses have seven or nine blades to provide a smooth, even cut on these fine-bladed grasses

Reel mowers minimize the tendency of scalping or extremely close cutting on the high spots of an uneven lawn Repeated scalping will result in a weak turf at those spots

The procedure for adjusting height of cut varies for each make of reel mowers In general, the following procedures apply

1 Disconnect the spark plug wire from the spark plug and place it in a position where it is impossible for a spark to jump an air gap to the plug, possibly causing accidental starting
2 Place mower on a perfectly flat, hard surface such as a concrete walk or solid workbench
3 Adjust the bed knife to the proper height by manipulating the height adjusting set screws or by adjusting the wheel height
4 Check to see that the adjustment procedure has not distorted the bed knife. Rotate the reel and check the clearance between reel blades and bed knife for the entire length of each of the reel blades This clearance should be uniform along the length of each blade If this cannot be achieved through adjustment, it will be necessary to utilize special equipment to grind the blades to obtain the desired clearance

Rotary Mowers Rotary mowers have a vertical shaft engine mounted on a housing which encloses a horizontally revolving blade The blade may be mounted on the engine shaft or one or more blades may be mounted on vertical jackshafts. As the mower moves forward, the blade revolves at very high speeds lifting and cutting off the grass blades Rotary mowers are generally simpler in construction than reel mowers

Scalping, or extremely close cutting of high spots on uneven turf, can easily occur through careless operation Because the rotary mower is relatively square in design, the wheels may pass over a high spot and drop into a lower area during mowing and

Operating and Maintaining Lawn Mowers Safely and Effectively
(Information Sheet continued)

cause the blade to crop near to or hit the soil surface Excessive scalping may severely damage the turf

Rotary mower adjustment varies in detail according to the make, but the following general procedures usually apply

1 Place mower on a perfectly flat, hard surface, such as the concrete walk or a solid workbench Remove spark plug wire so as to prevent the possibility of accidental starting which might result in serious injuries
2 Adjust mower blade to proper height by adjusting wheel height in relation to the housing Be sure to check the blade height and not the housing height since the blade is not level with the lower edge of the housing.
3 Adjust mower handle height to suit operator

Rotary mower blades should be sharpened regularly since a dull blade rips instead of cutting the grass Before removing the blade for sharpening, disconnect the spark plug wire The blade may be sharpened by grinding or by filing. Prior to remounting, the blade must be balanced The blade is mounted on a rod which is the same diameter as the hole in the blade Place the ends of the rod on a hard, perfectly flat surface with room for the blade to revolve freely Two short pieces of 2" x 4" hardwood would work After resting the ends of the rod on the 2 x 4's, the blade should remain level If the blade is not balanced, grind or file the heavier end until perfect balance is achieved

Individual knives mounted on a base plate should be weighed after grinding to check their balance If necessary, metal may either be ground off the back of the knife or holes may be drilled in the back of the knife to remove excess weight so that perfect balance can be achieved.

<u>Sickle Bar Mowers</u> Sickle bar mowers are used to cut overgrown turf or heavy weeds They generally do not cut neatly enough for use on home, industrial, or recreational lawns

Sickle bar mowers consist primarily of a cutter bar and knife. The knife is a narrow steel bar to which several triangular-shaped, sharp, knife sections are riveted. The knife is driven by a pitman rod through a series of guards and over numerous wear plates As the cutter bar moves forward, grass blades are cut by a scissor-like action as the knife moves rapidly back and forth over the wear plates. The sickle cutter bar is usually mounted on and powered by a garden tractor or is permanently mounted and powered by a specially designed power unit.

Operating and Maintaining Lawn Mowers Safely and Effectively
(Information Sheet continued)

Height-of-cut adjustment is not present on some sickle bar mowers. On other makes, height adjustment is made by raising or lowering a steel "foot" which rides on the ground and keeps the mower at a set level.

Correct mowing techniques greatly influence the health, vigor, and appearance of a lawn. Leaves of the grass plant are essential to producing food for plant growth. When cut off too low, the food producing section of the leaf is lost and turf vigor quickly declines. Grasses similar in height to the bluegrasses should be cut to a height of 1 1/2 to 2 inches. Low growing grasses of the creeping bent types should be mowed to a height of about 1/2 to 3/4 inches.

If the lawn is mowed frequently enough, clippings need not be removed. They filter down to the surface of the soil and act as a beneficial mulch for the turf. If the clippings are excessively long, they must be removed since they may smother the grass. Under certain conditions, some lawns develop excessive "thatch", dense mats of dead grass and clippings, at the soil surface. Under such circumstances, all clippings should be removed.

The mowing pattern should be varied each time the lawn is mowed to eliminate low spots, corrugations, and some matting. The changed lawn pattern created by changing mowing directions also enhances the overall landscape appearance.

Overlapping each opposing cut improves the lawn appearance. Mowing in the opposite direction of the previous cut and overlapping past the wheel mark of the previous cut can raise grass that may have been matted down by the wheels and permit it to be cut.

Safety should be foremost in the mind of any equipment operator. He should know his mower and its capabilities and should attempt only jobs for which the equipment is designed. Except for adjusting the carburetor, he should never place his hands in or near moving parts nor allow anyone else, especially children, to be nearby when the engine is running. When the engine is stopped for cleaning or repairs, the spark plug wire should be removed to eliminate the hazard of accidentally starting the engine. The operator of a rotary mower should be constantly on guard against running over articles such as glass or stones which could be thrown by the blades of the mower, since such debris can cause severe injury to people or pets.

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Material for this Information Sheet was partially taken from Module No. 10, "Operating, Repairing, and Maintaining Small Power Equipment," Center for Vocational and Technical Education, The Ohio State University, Columbus, Ohio.

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Operating and Maintaining Horticultural Equipment

TOPIC: Operating Rotary Tillers Safely and Effectively

OBJECTIVE: To learn the different types of tillers and how to properly operate them.

INTRODUCTION: A rotary tiller can be a handy piece of equipment. It can also be dangerous. One should exercise extreme caution in the operation of these machines. If cautions are heeded, a tiller can be used by even the inexperienced gardener to loosen soils and in preparing soil mixtures.

REFERENCES: Required:
Information Sheet, "Operating Rotary Tillers Safely and Effectively"

QUESTIONS or ACTIVITIES:

1. What are the two categories of rotary tillers?
2. Which type is used only for light work?
3. On front tine tillers, what moves the tiller forward?
4. If the front tine tiller digs too far into the ground and does not move forward, what should you do?
5. What should be done before starting any tiller?

Information Sheet
on
OPERATING ROTARY TILLERS SAFELY AND EFFECTIVELY

Rotary tillers are classified into two categories according to the arrangement of the tilling tines. Front tine tillers are those which have the tines located in front of the wheels. Rear tine tillers have the tines located behind the wheels.

Front tine tillers are generally designed for light-duty work and are often used for cultivating. In a loose soil they may do a satisfactory job of tilling to a depth of several inches. The machines usually are not heavy enough to till deeper on loose soils or to till heavy clay-packed soils with heavy vegetative cover.

Front tine tillers do not have power wheels. The rotation of the tines causes the tiller to move forward. Some control can be exerted over rate of forward motion by adjusting the depth bar. If the tiller must be held back to do a proper job of tilling, the depth bar should be lowered to cause the tines to dig deeper and slow the rate of forward speed. If the tiller digs deeply and does not move forward, determine the adjustment of the depth bar.

Rear tine rotary tillers are designed for medium to heavy work. Excellent tilling can be done to depths of about eight inches in a variety of soils having various amounts of vegetation or organic matter. This type of tiller can thoroughly mix organic matter into the soil.

Rear tine tillers have powered wheels and usually a reverse gear. Power can be transferred to either the wheels or the tines. Rate of forward speed is controlled by selection of proper gear and throttle setting.

Tilling depth on rear tine tillers is also adjusted by a depth bar which is usually located behind the tines. The bar is raised for increased tilling depth and lowered for decreased depth.

Since rear tine tillers are often used on heavy or packed soils, several points of operation should be noted. The following operational procedures should be observed:

1. Rotary till when soil moisture is correct. Use standard method of squeezing a handful of soil to determine moisture content. When the soil ball flakes and cracks, soil has the correct moisture content for tilling.
2. First run tilling depth should be no more than one to two inches. Increase depth for each additional pass.
3. Final tilling passes should be at right angles to previous ones to break down lumps further.

Operating Rotary Tillers Safely and Effectively
(Information Sheet continued)

The handling procedures for front and rear tine tillers are considerably different. Each type can pose safety hazards to careless operators Before starting any tiller, check to see that all clutches or belt tension pulleys are disengaged. The load on the engine may be great enough to prevent the engine from starting if these clutches were engaged If the engine should start while the clutch is engaged, the machine may get away from the operator and cause personal injury or property damage. Even if the engine does not start while the clutch is engaged, a sharp pull on the starting rope may upset the machine or injure the operator.

Rear tine tillers present added hazards to the operator. Power to the tiller tines should be disengaged whenever the tiller is not being used for tilling. This includes turning the machine around when moving it from one site to another.

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Material for this Information Sheet was taken from Module 10, "Operating and Maintaining Small Power Equipment," Center for Vocational and Technical Education, The Ohio State University, Columbus, Ohio.

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Operating and Maintaining Horticultural Equipment

TOPIC: Operating Garden Tractors Safely and Effectively

OBJECTIVE: To learn how to operate a garden tractor safely and effectively.

INTRODUCTION: The sale of garden tractors has increased steadily in the past few years. These tractors are used in a number of horticultural enterprises as well as by homeowners and hobby gardeners.

REFERENCES: Required:

1. Information Sheet, "Operating Garden Tractors Safely and Effectively"

Supplemental:

2. Literature from manufacturers of garden tractors

QUESTIONS or ACTIVITIES:

1. If one is planning to buy a garden tractor and a sickle bar, what should he keep in mind in regard to tractor size?
2. What is the usual horsepower range of small riding tractors?
3. Where should one attach pulled equipment to avoid tipping a tractor backwards?
4. What is the major difference between small riding type garden tractors and riding lawn mowers?
5. What are the two most widely used types of transmissions on garden tractors?

Information Sheet
on
OPERATING GARDEN TRACTORS SAFELY AND EFFECTIVELY

The small walking or riding type garden tractor is used in a number of horticultural enterprises as well as by homeowners and hobby gardeners

Walking type tractors have had the same basic design for a number of years, but moderate improvements such as rubber tires have been introduced

The basic design consists of a small gasoline engine mounted on a set of wheels attached to a pair of handles. Power is usually transmitted from the engine through a reduction gear arrangement to a jackshaft. An idler, or belt tension pulley, is mounted for the belt between the gear box and jackshaft. This provides the clutch for the tractor. The power is transmitted from the jackshaft to the wheels by a chain or belt arrangement.

Extra pulleys may be mounted on either the gearbox shaft or the jackshaft to permit the use of implements requiring power. A number of implements are available for walking tractors. Those requiring power, such as sickle bars or snow blowers, demand engines of high horsepower and tractors of heavier design. Many implements are simply pulled or pushed by the tractor and often can be used with tractors of lower horsepower and lighter weight.

Implements are attached to the walking tractor in two basic ways with minor modifications according to the various manufacturers. Implements which are pulled are attached by a vertical rod or "pin" which secures the tool to the tractor frame behind the engine. Implements which are pushed by the tractor are rigidly secured to the frame in front of and under the engine with several bolts or pins.

The following implements are available for most walking tractors:

Cultivator	Sickle bar mower	Lawn roller
Plow	Cart	Rotary roller
Disc	Seeder	Sulky
Reel mower	Fertilizer spreader	Grader blade

The tractor engine can also be used to power a number of other stationary pieces of equipment, such as a small rotary cement mixer, saw, compressor, compost or soil shredder, and others.

The walking tractor is a versatile piece of equipment which, in many horticultural enterprises, can supplement heavy equipment. Operators of small walking tractors should, however, be familiar with the equipment since too often the tractor is damaged and the operator injured where it is used for too heavy work. Quite often the walking tractor is not properly maintained since it is relatively inexpensive and possibly not used as often as larger equipment. Because regular maintenance schedules are often neglected, premature equipment failure may result.

Operating Garden Tractors Safely and Effectively
(Information Sheet continued)

Within the past decade, a small type of riding tractor has been developed. Most are scaled-down versions of the larger types. Horsepower ranges from 3 1/2 to 10. Due to the heavier weight of the machine and the added rider weight, the unit can handle somewhat heavier jobs than most walking tractors

While all small riding tractors can handle mower attachments, they are not riding mowers. Riding mowers are quite different from small garden tractors in that riding mowers are built to be used for mowing grass only. The high interest in small riding tractors by homeowners with large lots has resulted in scores of different models produced by various manufacturers.

The construction varies considerably in type as well as quality. For example, some models have automotive type clutches, some centrifugal clutches, and others a belt-pulley type clutch. Transmissions also vary considerably; some have an automotive type while others have a belt type.

The teacher should obtain a variety of manufacturers' literature giving detailed specification of the various types of tractors.

The list of equipment available for small riding tractors is the same as that listed for small walking tractors.

Since the small riding tractors are basically a small-scale, standard tractor, several similar rules of operation should be kept in mind. All pulled equipment should be attached properly below the rear axle level to avoid tipping the tractor backwards if the load is too great. Care should be taken when operating the tractor on uneven or sloping ground to avoid turning over. The operator of a walking tractor can usually move out of the way quickly in the event of an upset, but the operator of the riding tractor is in a more precarious position.

Both walking tractors and small riding tractors can be valuable tools for a horticultural business or for the homeowner with a large lot. For maximum value, however, they should be used only to the rated capacity of the unit, on jobs for which implements are available, and in situations where their use can be justified economically.

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Material for this Information Sheet was taken from "Operating, Repairing, and Maintaining Small Power Equipment," Center for Vocational and Technical Education, The Ohio State University, Columbus, Ohio.

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Developing and Maintaining the Landscape

TOPIC: Introduction to Home Landscaping

OBJECTIVE To develop an understanding of why landscaping has become important and to learn sources of information available to the beginner

INTRODUCTION: By properly landscaping a home its value can be greatly increased. The landscaping industry has grown in leaps and bounds during recent years. This growth is probably caused by the great number of people moving to the urban and suburban areas. It seems that everyone tries to have a better landscaped lawn than his neighbor. Another factor which has contributed much to the landscaping business is the greater amount of leisure time now enjoyed by American people. Many have found that working in a flower garden or watering the lawn is quite enjoyable and provides a form of relaxation which is very refreshing in this hurry-up world in which we live

REFERENCES: Required.

1. "Home Landscaping", B-980, Texas Agricultural Extension Service. pp 3-4

Supplemental:

2. Approved Practices in Beautifying the Home Grounds. Hoover

QUESTIONS or ACTIVITIES:

1. What are the three basic fields of endeavor involved in landscaping?
2. List the four main types of homeowners.
3. Why can gardens no longer be entirely naturalistic?
4. Why do landscaping plants vary so greatly from one side of Texas to the other?
5. How do some large nurseries which provide "free" landscape plans get their money back for the time and expense which they provide?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Developing and Maintaining the Landscape

TOPIC: Selecting a Site

OBJECTIVE: To develop an understanding of the considerations to make when purchasing a home.

INTRODUCTION: Many people forget about landscape design when they are shopping for a new home. After the house is purchased, the owner then looks at his landscape potential. Many times, to his dismay, the landscaping will present special problems which require considerable expense.

REFERENCES: Required:
"Home Landscaping", B-980, Texas Agricultural Extension Service, pp. 4-5

QUESTIONS or ACTIVITIES:

1. What should be the first consideration as to homesite?
2. What is meant by zoning?
3. Can most families afford to spend one-half of their annual income on a lot?
4. List some disadvantages of a corner lot.
5. List two disadvantages of sites that are too far above the street.
6. What direction should outdoor living areas face? Why?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Developing and Maintaining the Landscape

TOPIC: Scheduling Landscape Development and Beginning Plans

OBJECTIVE: To develop an understanding of how to schedule your landscape development and to learn how to begin the landscape plan.

INTRODUCTION: Successful landscapes are a result of proper scheduling and planning. Few beginners can see all of the problems which will arise in landscaping a lawn. It is wise to spend considerable time in reading materials written by specialists before drawing the plans.

REFERENCES: Required:
"Home Landscaping", B-980, Texas Agricultural Extension Service, pp 5-9

QUESTIONS or ACTIVITIES:

1. Describe a well-planned garden.
2. What are the most essential elements of the plan that should be constructed first?
3. Why are trees so important in Texas landscapes?
4. What are the purposes of hedges, screens, walls, and fences?
5. What are the two important steps involved in solving a landscape problem?
6. What is meant by "site"?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Developing and Maintaining the Landscape

TOPIC: Analyzing Problems and Determining Needs

OBJECTIVE: To develop an understanding of the specific problems which will be encountered on certain sites and to become aware of the four basic considerations which should be included in successful landscape development.

INTRODUCTION: Four basic considerations should be included in successful landscape development. These are suitability, function, economy, and beauty.

REFERENCES: Required:
"Home Landscaping", B-980, Texas Agricultural Extension Service, pp. 9-12

QUESTIONS or ACTIVITIES:

1. List the four basic considerations which should be included in successful landscape development.
2. What is the basic step in the preparation of a program?
3. What three questions should you ask yourself in regard to outdoor surroundings?
4. What are the three economies to keep in mind in the development of a homesite?
5. What two factors determine beauty?
6. Can a beginner usually obtain simplicity in a landscape design?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Developing and Maintaining the Landscape

TOPIC: Developing the Landscape Plan

OBJECTIVE: To develop an understanding of the steps involved in developing the landscape plan.

INTRODUCTION: Planning is the means of accomplishing an objective through an arrangement of steps. A properly designed and executed plan will result in a landscape of a desirable nature.

REFERENCES: Required:
"Home Landscaping", B-980, Texas Agricultural Extension Service, pp. 12-15

QUESTIONS or ACTIVITIES:

1. When should planning begin?
2. What scale is used on the sketch survey on page 13?
3. What are the four main functions that all homesites and farmsites must provide?
4. What area should occupy the largest portion of the property?
5. Around which area of the house should private areas be developed?
6. What were the two approaches to landscaping which were followed in years past?

Activity:
Study the areas in Texas where plants vary.

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Developing and Maintaining the Landscape

TOPIC: Selecting Plants

OBJECTIVE: To develop an understanding of how to select the proper plants to be used in a landscape.

INTRODUCTION: One must be very careful in selecting plants for a landscape. Otherwise, he may plant a monument to his ignorance. An example would be planting a tree that would grow high enough to damage the roof of the house.

The completed plantings are the final mark of distinction in any landscape. These are the elements that provide beauty and enrichment to the solution of the landscape problem.

REFERENCES: Required:
"Home Landscaping", B-980, Texas Agricultural Extension Service, pp. 20-26

QUESTIONS or ACTIVITIES:

1. How tall are large shrubs or small trees when they are full grown?
2. How tall do medium shrubs get?
3. How are shrubs classified that do not grow higher than three feet?
4. What is the danger involved in planting trees with deep, wide-spreading roots?
5. What type of tree is desirable for the warmer regions of Texas where year-round shade is needed?
6. What duties are required for proper lawn maintenance?
7. Give two examples of fast growing hedges that require frequent clipping.

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Developing and Maintaining the Landscape

TOPIC: Grading, Drainage, and Landscape Structures

OBJECTIVE: To develop an understanding of the grading and drainage factors and to learn how landscape structures should be constructed.

INTRODUCTION: Every homesite will require some grading to permit proper drainage. There are many factors to be considered before grading. It must be kept in mind that water directed to certain areas could cause damage to plants.

The construction of sidewalks and drives is expensive. Be sure of your planning before the concrete is poured.

REFERENCES: Required:
"Home Landscaping", B-980, Texas Agricultural Extension Service, pp 27-30

QUESTIONS or ACTIVITIES:

1. Although not the most desirable, what is the most inexpensive way of preventing water from downspouts from washing away soil?
2. Does lowering the grade around existing trees damage trees as much as filling in around them?
3. When you need to save a valuable tree, what method will least disturb the tree?
4. What is the most common mistake when constructing sidewalks?
5. What should be the minimum width of a front entrance sidewalk?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Merchandising Horticultural Plants and Supplies

TOPIC: Developing Personal Traits

OBJECTIVE: To understand how to increase sales. To develop the proper personal habits and techniques required to make a sale.

INTRODUCTION: No salesman is better than his personality. Act enthusiastic and you will be enthusiastic. Think happy thoughts and you will be cheerful. Smile, even though you don't feel like it. Before long these will become habits and your percentage of sales will increase.

REFERENCES: Required:

1. Information Sheet on "Developing Personal Traits"

Supplemental:

2. Sales Horizons, Haas and Perry

QUESTIONS or ACTIVITIES:

1. What are the three basic ingredients of a salesman?
2. What are the two best ways to learn how to sell?
3. What are two ways in which good habits pay off?
4. How does a person become a "scientific salesman"?
5. What is required for a would-be salesman to become a tough, aggressive, and effective salesman?

Information Sheet
on
DEVELOPING PERSONAL TRAITS

The three basic ingredients of salesmanship are knowledge of self, knowledge of people and knowledge of the product to be sold. A person who wants to become a salesman must learn to use each of these basic divisions to its fullest potential. Before anyone can understand others fully, he must have a good understanding of himself and how he relates to others. Then it is necessary to understand the product or service fully.

There are two basic ways of learning to sell after you have studied the basic knowledge of the product. First, and probably the best, is to apply some FFA training and learn by doing. This means learning from experience. To do this, it is necessary to gain employment in a retail store such as a feed, seed, and horticultural supply store and make direct sales to the customers.

The second way to learn to sell is to learn from others. This makes it necessary to observe very closely the methods used on you while you are having a product sold to you. Observe what the salesman says during the sale. He will get your interest by saying or doing certain things. Observe how well he knows his product. Observe his mistakes. These can be very valuable to you.

A salesman must develop a good sales attitude. This is very important. It involves knowing oneself. It means knowing if you have the "mind" for selling.

A good attitude means that the salesman recognizes his responsibility to the company. It means becoming a part of the company and growing progressively more loyal to it as time goes on.

A good attitude means proving that you are growing and coming up with new ideas for the company. This involves keeping up to date on new developments. Agricultural supplies are changing each day and a good salesman keeps up with these things.

A good attitude means good sales habits. Old habits must be changed. When the salesman learns good habits, they are his alone. No one can share them. Good habits pay off in promotions and dollars.

A good attitude means selecting the right learning methods. These methods are study, experience, and a combination of the two. Study means lessons at school or constant review of materials in the business. Experience means practice. With each successful sale, the salesman grows. When study and experience are combined, the result is a good salesman with a good attitude.

Constant analysis of the sale makes a "scientific salesman". This analysis is done by getting the facts, analyzing the facts, drawing conclusions from the facts, and applying the conclusions. This means planning and executing the sale inch by inch. It means

Developing Personal Traits
(Information Sheet continued)

reviewing the sale after it is made. It means applying what you have learned to the next sale.

A good salesman realizes that salesmanship provides a mutual benefit to himself and his customer. This makes it necessary to get the customer's viewpoint and help him get the most for his money. A good salesman speaks the customer's language. If possible, he determines the customer's needs, problems, business, and what the product will do for him. This is easily done by a salesman of agricultural products.

Developing the Right Sales Personality

In salesmanship as in any field of work the personality of the salesman is of utmost importance. His ability to sell himself will be directly related to his ability to sell a product. Even before selling himself to others he must sell himself to himself. This means being sure of what he can do. Strong sales personality enables the salesman to apply scientific training to the sale of the product.

Diligence and perseverance are necessary for a would-be salesman to become a tough, aggressive, and effective salesman.

There are several qualities that make up the sales personality. Each will be discussed briefly.

1. Sincerity - Sincerity is a quality that creates an atmosphere of confidence on the part of the customer in the salesman. Insincerity does just the opposite. Sincerity is, in the final analysis, the total of the salesman's attitude toward his work. The correct attitude causes the salesman to apply himself to his training and do his job.

2. Tact - When a salesman meets a customer the opportunity for conflict or differences of opinion is great. Tact is the quality of personality that can smooth out these conflicts and bring about the proper atmosphere for making a sale. It means that the salesman will not contradict. The injured pride of a customer will prevent him from making a purchase. If the salesman wins an argument, he will still lose.

3. Enthusiasm - This is the quality of the personality that means putting everything you have into it. It involves the whole body - the face, the voice, and the actions. To have enthusiasm, a salesman must be thoroughly familiar with the merchandise to be sold and he must appreciate

Developing Personal Traits
(Information Sheet continued)

it. The more the salesman knows about the product, the more enthusiastic he will become

4. Courtesy - One could never say too much about the importance of courtesy to the salesman. Courtesy is simply good behavior and good manners. It is the quality that gives good first impressions. Many times that good first impression makes the sale.

5. Cheerfulness - It has been said that we are what we think we are. If we think cheerful thoughts, we are cheerful. The cheerful salesman will meet his customers with a smile, whether he feels like smiling or not. Cheerfulness can be measured in important sales.

6. Initiative - This characteristic is most vital to the sales personality of the successful salesman. The alert mind of the salesman who possesses this quality will cause him to get new sales on his own and will cause him to operate without any prodding from his employer.

7. Friendliness - Many a sale has been won by the friendly salesman. His friendly personality puts the customer at ease. The feeling of the customer can be described as a certain good friendly feeling. The unfriendly salesman can be sure that his customers will never buy his products.

8. Persistence - This quality can suggest that in some cases a salesman can become obnoxious. This is not what is meant by being a persistent salesman. This quality causes a salesman to try again after failing to sell a potential customer. He does not admit defeat quickly. It simply means trying again to make a sale, using a different method.

9. Memory - A quick memory of the information involving the product is very important to the good salesman. A quick memory involving the name and other facts about the potential customer is also very important. It has been said that forgetting a person's name may mean the loss of a sale. To gain memory, the salesman will practice concentration, association, and repetition. Concentration on the facts, association of these facts to something familiar, and the repetition of these facts will cause the mind to grasp them.

Developing Personal Traits
(Information Sheet continued)

10. Application - Nothing is ever truly learned until it is put into practice. The applying of any idea to making a sale is putting that idea into practice. The only sales idea that is important is the one that works. The wise salesman will try hard to improve himself by applying what he has learned. Other attributes that help a salesman make a sale are a good vocabulary, a pleasant voice, shaking hands with the customer, and being vigorous and poised. All good salesmen are recognized as having these qualities.

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Material for this Information Sheet was taken from Ornamental Horticulture for Vocational Agriculture in Alabama, pp. 229-231.

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Merchandising Horticultural Plants and Supplies

TOPIC: Displaying

OBJECTIVE: To learn how to increase sales of horticultural plants and supplies.

INTRODUCTION: A grower may have an outstanding selection of plants and supplies; but if the public does not see these items, profits will be greatly reduced. No business will succeed without a market In most cases, the grower must create or improve his market. One of the more effective ways of increasing sales is to properly display items and create a desire on the part of the buyer.

REFERENCES: Required:
Information Sheet, "Displaying"

QUESTIONS or ACTIVITIES:

1. Where should point-of-purchase displays be placed?
2. What is the basic reason for displays?
3. What types of items are handled best in bin displays?
4. What items should be placed at eye level?
5. What are three characteristics of a good floor display?
6. What is the purpose of a sales floor window display?
7. Why should a single item not be displayed?
8. What should one consider when arranging different displays around the store?
9. What is the most practical way to display nursery stock?
10. What should be the maximum width of a display bed?

Information Sheet
on
DISPLAYING HORTICULTURAL PLANTS AND SUPPLIES

Point-of-purchase displays normally consist of tri-plane and peg board tables, special display racks, bins, display floor windows, and floor displays These must be located where they will be seen by the greatest number of customers The basic reason for displays is to put merchandise where customers can see it and serve themselves.

Special racks, tri-plane and peg board tables are excellent for displaying impulse items and other small competitive items. Much of the fast turnover merchandise is adaptable to display selling Customers like to handle the merchandise they buy; they find it interesting. These displays are easy to set up and maintain. They enable the salesman to handle a larger volume of sales.

Bin displays are more successful when used for familiar products, bulk seeds, and other seasonal items It is a good idea to put reminder items where they command the customer's attention. The items that are to be pushed should be placed on shelves at eye level.

Most businesses find floor displays are best for large items such as barrels of special fertilizer packages or for large quantities of small items in a special promotion. A floor display should be well stocked, safe, and at a convenient height.

Sales floor window displays have one definite purpose This is to stop customers and bring them into the place of business. They must be appealing and attract attention by action. This necessitates the use of special signs, background, lighting, and display cards. Window displays are most effective for whole goods or for tie-ins with advertised promotions.

Some Proven Principles of Effective Displays

In point-of-purchase display merchandising

1. Display in quantity - A single item does not attract customers. Bulk attracts attention and gives the impression of demand.

2. Use proper arrangement - Consider the traffic pattern. Locate displays where the greatest number of people will pass them. Each table and shelf should have a relation to the others Establish a "theme" for the entire area. Keep all displays well stocked; remove a few items from the cartons, and do not make the display so orderly that it will discourage the customer from picking up items.

Displaying Horticultural Plants and Supplies
(Information Sheet continued)

3. Change display frequently - As customers need change, so do displays. Many dealers establish a rule to change displays after a given number of weeks. This practice permits more items to be displayed and helps keep them current with the season. Even displays of non-seasonal items should be changed because customers do not like to see the same thing on each visit. The change takes very little time, but it improves the appearance of the department and pays off in additional sales.

4. Keep displays clean and neat - This is a problem in many businesses, but all agree that good housekeeping is necessary.

Point-of-sale display advertising takes advantage of the customer's presence in the store. Plant displays so that they will act as silent salesmen.

Displaying Plants To Be Sold

The most practical way to display nursery stock or other plants to be sold is to arrange them in beds. This should be done whether the plants are under a lathhouse for shade or whether they are in the open. The beds should be rectangular in shape and not more than eight feet wide. A walkway adjoining the bed should be at least three feet wide. The plants in the beds should all be the same type. They are arranged according to size and the balls are covered to prevent drying out.

When arranging merchandise other than plants in the sales room, use the same principles involved in displaying plants. Small displays of similar items should be arranged. The customer should have access to these displays at all times. He should be encouraged to browse. Above all, these displays should be kept neat and stocked with merchandise.

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Material for this Information Sheet was taken from Ornamental Horticulture for Vocational Agriculture in Alabama, State Department of Education.

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Merchandising Horticultural Plants and Supplies

TOPIC: Advertising

OBJECTIVE: To learn the different methods of advertising horticultural plants and supplies. Also, to learn the effective use of each method and to become aware of the importance of advertising.

INTRODUCTION: If a business is making money, it can afford to advertise. If it is losing money, it cannot afford to under advertise. This statement is often made to show the importance of advertising. It has been said that advertising is the key to sales. If customers are not motivated to buy, sales will drop and profits will decrease.

REFERENCES: Required:

1. Information Sheet, "Advertising"

Supplemental:

2. Fundamentals of Advertising, Rowse and Nolan

QUESTIONS or ACTIVITIES:

1. What is the most rewarding type of advertising?
2. In most cases, what type of advertising will take up most of the advertising budget?
3. In what section of the newspaper will advertising do the most effective job?
4. What is the most important factor in direct mail advertising?
5. What three factors should be considered in selecting a method of advertising?

Information Sheet
on
ADVERTISING

Experience has shown that most salesmen get the most out of their advertising budget through point-of-purchase advertising, outside advertising, and special promotions.

Point-of-Purchase Advertising consists of displays within the place of business. Items well displayed are half sold. Impulse buying results in millions of dollars' worth of sales annually, as the growth of supermarkets shows. Good displays remind the customer of things he wants. If properly grouped, they will often result in sales of related items. There should always be a tie-in with the various specialties and service sales programs, and seasonal items should be displayed several weeks ahead of season.

The trend in modern retailing is increasingly toward self-service merchandising on a supermarket scale. People are naturally interested in products. If it is easy for them to satisfy their curiosity, it will also be easy for them to buy. Farm businesses have always used bins, tri-plane tables, windows, counters, and peg boards to display items. Now, however, it is realized that these devices deserve to be the central theme in merchandising planning. Businesses who have tried self-service merchandising have been highly successful. Originality and ingenuity in displaying merchandise will be reflected in increased sales and profits.

Outside Advertising, in most cases, will take up the bulk of the advertising budget. It includes newspaper, radio, T. V., handbills, direct mail, and road signs. The basic problem is selecting the most effective media to use. The medium that is selected must produce noticeable results in the cash register. Don't be satisfied with anything less.

In selecting the media, consider effectiveness, cost, and coverage. The salesman must have knowledge of all media, including their advantages and limitations.

Newspaper Advertising includes both the display and classified. When you prepare display ads, make sure that the layout is attractive and that the headline will arouse interest. Usually, the most successful advertising is done in the classified section. A skillfully prepared, personalized classified ad in the newspaper will get results because classified readers are a voluntary audience. Be sure to identify the business so there is no doubt who is doing the advertising. Many equipment dealers include in all their newspaper advertising a "Special for the Week". This is a promotion in which one item is featured at a special price. This takes very little space in an ad, and the results are gratifying.

Advertising
(Information Sheet continued)

Direct Main Advertising can be directed toward a given group of prospects. The key is the mailing list. It must be up to date and broken down by specific groups interested in specific items. New names must be steadily added and old names dropped when mail pieces are returned undelivered. Salesmen should feed the list with names and addresses of new prospects and customers.

In a letter, postcard, leaflet, or sales flyer, personalize the message to the customer. Make the story as detailed as you wish because space is not a factor.

Radio and T. V. have some definite advantages. They convey fast, hard-hitting messages. T. V. is high in cost but has the advantage that a machine or plant can be demonstrated to the viewers. For both radio and T. V., the time of presentation is vitally important. It should be when a large percentage of the prospects may be listening or viewing; it should be tied into weather and news forecasts, or other home audience programs. Many businesses use spot announcements and obtain good results.

Road Signs on main roads leading to the store help in picking up transient business. Signs should be erected in a solo location and kept clean and well painted.

Many dealers have found handbills to be an effective, low-cost way to advertise promotions, and parts and service specials. A handbill must have an eye-catching layout and a timely, interesting message.

Special Promotions is an area of merchandising that is almost unlimited. Use the imagination and you will promote sales. In planning these slow-season specials, consider advertising through the newspaper, by direct mail, or with handbills. The purpose is not only to announce the special but also to use reduced pricing to get the customer to purchase immediately.

Again, these specials must be tied into promotional advertising and put on display to get attention. Even though a special event is held primarily to advertise whole goods, there is no reason why you can't advertise parts and accessories at the same time.

Plan your merchandising program so it will attract buyers. Make them come to your store. Include displays that will act as "sales clinchers". Finally, broaden your market with special promotions.

Advertising
(Information Sheet continued)

Selling Plants

We have discussed what is needed by the salesman in the way of personal knowledge of the product and his own personal ability to sell. These are just as important in selling plants as in any other field. In selling, first of all, the customers must be induced to call upon you. This is commonly called "getting traffic".

Many methods have been used to "get traffic". Advertising is one of the best ways. Of course, advertising also takes many forms. One of the best ways of advertising to sell plants is by the use of attractive well-placed signs. They should be placed along the approaches to the sales yard. These signs should be kept in good repair and the paint job should be fresh. In some cases these signs may be landscaped themselves. Remember the principle involved in the use of signs is that too much information will not be helpful.

Another practice used by salesmen in nurseries or retail rooms where plants are sold is for the salesmen to be dressed in attractive uniforms.

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Material for this Information Sheet was taken from Ornamental Horticulture for Vocational Agriculture in Alabama, pp. 236-239.

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Merchandising Horticultural Plants and Supplies

TOPIC: Labeling and Pricing

OBJECTIVE: To learn how to effectively label and price horticultural plants and supplies.

INTRODUCTION: The very best of plant growing techniques and practices will not pay off unless items are properly labeled and priced. A short time studying this phase of merchandising could pay off in larger profits to the plant and supply businessman.

REFERENCES: Required:
Information Sheet, "Labeling and Pricing"

QUESTIONS or ACTIVITIES:

1. What is the common fault of most beginners when pricing plants?
2. What costs are involved in producing plants?
3. What percent mark-up do most nurserymen use?
4. What items will not sell at a high percentage mark-up?
5. Upon what is the percentage mark-up based?

Information Sheet
on
LABELING AND PRICING

All plants should be well-labeled so that the customer can tell what it is without asking questions Tags of various shapes and sizes have been used for this These are attached to the plants or plant containers by the use of small wires When plants can be grouped together the variety and size may be identified by the use of a single sign placed in a conspicuous spot By all means, if possible, use color photographs on the labels The price of the merchandise may also be placed on these descriptive labels

When pricing plants and other merchandise for the first time, the beginner normally prices his plants too low Much of the cost of production is hidden in the production of plants, transplanting, salesman's salary, unsold stock, shrinkage in volume, and overhead These costs must be absorbed in the selling price

There is no rule to follow in pricing nursery stock but to understand the proper method of determining the mark-up on the plant will be helpful The percentage mark-up is based on the selling price not on the cost For example, if an item costs the operator 75¢ and is sold for $1 50, the mark-up would be 50% rather than 100% This common misconception has caused many retailers to sell their plants too low Normally, a mark-up of 50% on plants is too low An average mark-up used by many retailers is 66 2/3% However, high-priced merchandise will not sell at this high percentage An example of this is that a $1 00 item that costs only 30 or 40¢ will sell and a $15 00 item will not sell if it is priced at $30 or $40

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Material for this Information Sheet was taken from Ornamental Horticulture for Vocational Agriculture in Alabama page 242

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Merchandising Horticultural Plants and Supplies

TOPIC: Understanding the Customer and Making Sales

OBJECTIVE: To understand customers and to increase sales of horticultural plants and supplies.

INTRODUCTION: Without a market for the final product, no business will succeed. Beautiful plants or excellent supplies are useless if they are not sold. Production and storing cost will become so great that the business will operate at a loss if the products are not bought and paid for by the customer.

Usually the amount of sales depends upon the salesman. Everyone working in a business should understand customers and know how to make sales.

REFERENCES: Required

1. Information Sheet, "Understanding the Customer and Making Sales"

Supplemental

2. Popular Sales Techniques, Series, International Harvester Co., Chicago, Illinois

QUESTIONS or ACTIVITIES:

1. What is the first thing for a salesman to think about after losing a sale?
2. Which party should bring up the subject of financing?
3. Why do customers buy products?
4. Why should high pressure not be used in making sales?
5. What is the first problem of a salesman when dealing with a customer?

Information Sheet
on
UNDERSTANDING THE CUSTOMER AND MAKING SALES

We generally come in contact with two distinct types of customers. The first type is the customer who first has to be sold on the item or need for the product you are selling. He may be a potential buyer of a piece of equipment or a new and different type of fertilizer or a new and different service which your organization can perform for him.

The second type of a prospective customer differs from the first type in only one aspect, he has already decided he needs your type product. He may be undecided about buying your brand or buying a similar product from another salesman. In a case of this kind the customer must be sold on the superior features of your product. This can be done by pointing out a person in the area who is successfully using the product which you are selling. Seeing is believing.

The buying interests that cause customers to buy products are:

1. Owner's comfort and convenience
2. Performance
3. Safety - This implies safety of the operator and protection of the equipment or product.
4. Appearance
5. Length of life
6. Economy - This implies saving time, money, and labor.
7. Service
8. Prestige - This interest implies that a new owner is proud of his purchase.

Making the Approach to the Sale

Before a sale can be made, a plan has to be developed for getting the attention of the potential customer in point-of-purchase selling. This approach is not as difficult as it is in making a sale outside of the store. Farmers who come into your store are normally in search of a particular product; and if given the chance by a salesman with a pleasing personality, he will ask about the product he has in mind. If he comes in with no particular product in mind but just to browse, the salesman will need to make a sales approach if he hopes to make a sale.

A salesman should put first things first. His first problem is to get the attention of the customer. This is done in many ways and it is usually done at the same time the salesman is selling himself. It is not enough to say that the salesman must get a customer's attention, he must get his "favorable attention". A salesman who is friendly, alert, courteous, and has a confident approach to the customer will usually get his favorable attention immediately. However, his personality must be bolstered

Understanding the Customer and Making Sales
(Information Sheet continued)

with a reasonably conservative and well-groomed appearance. This appearance should never be underestimated in getting the attention of the customer especially in the agricultural business. It is true appearance does not make the man but it does make that part of the man that the customer sees first. Many times this forms the total impression that the customer has of the salesman.

Enthusiasm plays a definite part in making a successful approach and sale. It has been said that enthusiasm is contagious. If the salesman displays the idea that he is "sold" on the product, this enthusiasm is likely to carry over to the customer.

The first few seconds of the sale are very important. In getting the attention of the customer, the salesman has only obtained his temporary interest. During these first few seconds the salesman in some way should reach the customer by indicating what the product can do for him. If this is done, the customer's attention or interest is aroused. You are then in a good position to hold his interest long enough to present your product.

Holding the customer's attention or interest can be done in several ways. Usually the best way is by doing something. This means showing the product or demonstrating the product to him. The customer's normal reaction is to look, to listen, and, if pleased with the product and presentation, to buy.

Making and Closing a Sale

Although most salesmen would like to close every sale, it isn't possible to get that high a batting average. After losing a sale though, a salesman should become concerned about the reason he failed. Some of the reasons for his failure to close may be found in this section on the do's and don'ts of closing sales.

Be Sincere

Make certain that statements and actions are sincere when dealing with prospects. If you make factual statements during your sales presentation, your customers will have confidence in your recommendations and will be more inclined to buy.

If you believe a customer is purchasing equipment or supplies that will not perform his job satisfactorily, you are obligated to tell him so. Part of your job as a salesman is to recommend to the customer the equipment that is matched to the job. Customer satisfaction will result from sincere opinions and efforts on your part in leading him to a wise and correct buying decision. He will gain confidence in what you say only if you are sincere.

Understanding the Customer and Making Sales
(Information Sheet continued)

Don't High Pressure

People object to being pressured into buying They like to believe that they make up their own minds Closing a sale without using high pressure tactics is one of the greatest challenges of salesmanship

It is easy to fall into the habit of speaking quickly, concentrating on key points, and then attempting to force the prospect to make up his mind There is such a note of urgency in presentations of this type that the prospect feels he is being high-pressured into something he is not sure about His natural reaction is to feel that something is wrong or that he should be cautious

Most people will buy when the salesman has convinced them sufficiently that the product will fill their needs The prospect must be led to believe that the decision is entirely his own The skilled salesman implants his ideas carefully He presents his proposition in such a way as to give the impression that he is helping the prospect solve his problems

Sell When the Customer is Ready to Buy

In any favorable sales presentation, there are certain times when it is logical to obtain the order Experience indicates that there are certain times when an opportunity to close seems to present itself naturally One of these times is the point when the salesman and the prospect have reached substantial agreement and the prospect appears to be reasonably satisfied with the product At this time, a "psychological moment" exists and the salesman should ask for the order

Don't Oversell

Many salesmen have talked themselves out of an order because they continued to sell after the prospect has decided to buy Many times silence is the best tool

Certain questions or reactions will indicate that the prospect is seriously considering the proposal These indications are signals for the salesman to try to close regardless of when they occur in the sales presentation Here are some typical indications that the prospect is ready to buy

Understanding the Customer and Making Sales
(Information Sheet continued)

1. Favorable response to the reasons given for buying now.
2. Favorable attitude toward the benefits described on a special trade allowance that is about to expire.
3. When he asks, "Is this the best price you can give me?" or "Do you have a machine already set up and ready to go?" or "Can you supply this product in a large enough quantity?"

Recognizing these and similar indications and answering to the prospect's satisfaction may induce him to buy. Don't be so absorbed in the sales presentation that you miss buying signals. Remember, many a salesman has lost an order because he didn't know when to stop presenting features and ask for the order.

Be Honest About All of Your Commitments

The surest and quickest way to lose a sale is to misrepresent the facts. You can make this mistake without being conscious of doing so. For this reason, you need to have a thorough knowledge of both your product and your competitor's product so that the possibility of error or misrepresentation will be reduced to a minimum.

If you come to points in your feature-by-feature selling and the customer asks you a direct question to which you do not know the answer, don't bluff your way through. Bluffing will kill any confidence he may have in you, regardless of how superior your product may be. The proper thing to do is to be perfectly frank with your prospect. Tell him that you are not too sure about the information he is requesting, but that you will obtain it for him immediately. Make sure you answer the prospect's questions as soon as possible. The answer can skillfully be used as a reason for calling back on a customer who is offering stiff sales resistance.

Don't let a question keep you from continuing your feature-by-feature selling.

Be Persistent

Many sales have been lost because the salesman was not persistent. Sales Management magazine, March 2, 1962, in an article entitled, "Giving Up Too Quickly", states:

1. Almost half of all salesmen - 48 percent - quit cold after a single call on a prospect.
2. Another 20 percent make two calls before quitting.
3. Seven percent make three, and five percent make four calls.
4. The remaining 20 percent make five calls or more, and these are the men who get from 75 percent to 80 percent of the business.

Understanding the Customer and Making Sales
(Information Sheet continued)

This same article points out that, "Discouragement is a luxury no salesman can afford."

It is necessary to qualify each prospect and "sense" in your own mind how near you are to closing the sale. If you feel an individual is going to buy, stay with him until you sell him. Many sales are lost because the salesman quits too soon. Customers admire a salesman who has developed a degree of persistence. Persistence quite often wears down resistance. Persistent salesmen make it easier for customers to buy.

Don't Sell Price. Sell Benefits and Advantages

A dangerous practice that many salesmen fall into is trying to arouse interest by overstressing price. The weak salesman will quote price, argue price, and cut price at the drop of a hat. What he fails to realize is that many customers are interested only in a fair price and that more times than not they are more concerned with quality and service than price.

Your job is to convince your prospects of the true value of your product. People will buy the most expensive items if they are convinced that they will receive their money's worth. If you sell a high quality product that is priced higher than that of competition, take every opportunity to describe the features in a way that justifies the higher price. Sell the benefits that make your product worth its price.

Make It Easy for Prospects to Buy

There are many things you can do during the selling process that will make it easy for the prospect to buy. You should practice all of them while making a sales presentation. A few methods of making it easy for the prospect to buy are:

1. Know your product so that you are not required to secure additional information. The lack of product information may cause you to make an extra trip to see the prospect. By that time, he may be out of the mood to buy.

2. Know your prospect so that you can fill his needs and anticipate the sales resistance you think he might bring up during your sales story.

3. Offer available financing. Do not make him ask for financing arrangements. In addition, offer him a payment schedule that is possible for him to complete.

Understanding the Customer and Making Sales
(Information Sheet continued)

4. Summarize all agreements of the sale with him so that there will be no misunderstanding on the part of either you or the buyer.

5. Lead the prospect to a decision or an agreement at every opportunity. Many prospects need assistance in making a decision; you can guide them into making a decision in your favor.

6. Stay with your equipment and the prospect while demonstrating to make certain the equipment is working properly. You can answer any questions he might have while using it. It is important when making a demonstration to have the prospect operate the equipment as soon as possible. Let him operate it and he will soon feel that the equipment is his or that he would have a difficult time getting along without it.

7. Make sure that you always have order forms, finance charts, literature, and other pertinent facts that you will need to close the sale.

8. Be ready to close at any time during your sales presentation.

There are many more techniques that make it easy for the prospect to buy. Avoid statements, questions, or procedures that make it difficult for him to buy.

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Material for this Information Sheet was taken from Ornamental Horticulture for Vocational Agriculture in Alabama, pp. 231-236.

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Introduction to Horticulture

TOPIC: Horticulture as an Industry

1. Vegetables

2. Fruits

3. a. Fruits
   b. Vegetables
   c. Flowers
   d. Ornamental plants

4. Small fruits

5 The out-of-season production in the South and West.

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Introduction to Horticulture

TOPIC: Exploring Occupational Opportunities

1. a. Laborer
   b. Foreman or Supervisor
   c. Assistant Manager
   d. Manager or Owner

2. To work on the job

3. Garden center employee
   Probably others which are diversified in operation

4. This answer depends on the local situations.

5. No written answer required. Coordinator should stress the importance of the student becoming thoroughly familiar with the 18 factors to consider in selecting a job.

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Plant Growth and Classification

TOPIC: Introduction

1. Study of plants

2. Over 350,000

3. Sugars and starches

4. Plants have the ability to produce food from carbon dioxide and water.

5. Van Helmont concluded that plants produced wood almost completely from water.

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Plant Growth and Classification

TOPIC: Photosynthesis

1. Light

2. To combine or to put together

3. The combining of carbon dioxide and water by the chlorophyll of living plants in the presence of light.

4. Amount of heat required to raise the temperature of a gram of water one degree centigrade.

5. A combination of atoms

6. Diffusion

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Plant Growth and Classification

TOPIC: Respiration

1. The release of chemical energy

2. Carbon dioxide and water

3. They are just the opposite.

4. Carbon dioxide

5. Food and oxygen

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Plant Growth and Classification

TOPIC: Water Absorption and Loss--Nutrient Absorption--Movement of Nutrients and Water in the Plant

1. The plant will wilt.

2. Turgid

3. If you add too much fertilizer around the roots, water absorption is slowed down because most fertilizers, chemically speaking, are salts. This can cause the plant to wilt

4. Loss of water from the plant as a vapor

5. Elements, or groups of elements, needed for plant growth

6. Xylem, Phloem

7. If you girdle a tree properly, you remove the phloem and leave the xylem intact. In this way water and soil nutrients continue to move up to the top of the tree, but you prevent the movement of plant foods from the leaves to the roots. After six months to two years, the tree will usually have used up its stored food supply in the roots and it will die.

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Plant Growth and Classification

TOPIC: Plant Food

1 Any substance which can be used as a source of energy for carrying on the life process.

2. a Carbohydrates b Fats c. Proteins

3 a Carbon b. Hydrogen c. Oxygen

4 Energy

5. Seeds

6. Hydrogenation

7 a. Carbon
b Hydrogen
c. Oxygen
d. Nitrogen
e. Sulfur
f. Sometimes Phosphorous

8 a. Carbon
b Hydrogen
c. Oxygen
d. Nitrogen

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Plant Growth and Classification

TOPIC: The Plant Kingdom

1. Study of the classification and naming of plants

2. a. Thallus plants
   b. Mosses and liverworts
   c. Ferns and club mosses
   d. Seed plants

4. Thallus plants

5. The helpful soil organisms and the nitrogen-fixing organisms found in legume nodules.

6. Fungus

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Constructing, Maintaining, and Using Structures that Aid Plant Growth

TOPIC: Types of Greenhouses

1 Glass
Plastic

2. Fall

3. a. The clarity of glass
b. Easily installed
c. Inexpensive
d. Last for several years

4. Advantages: a Inexpensive
b. Easily installed

Disadvantages: a. Not too durable
b. Moisture collects on underside and a vibration or gust of wind makes the drops fall into the greenhouse

5 Exhaust fans

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Constructing, Maintaining, and Using Structures that Aid Plant Growth

TOPIC: Size and Arrangement of Greenhouses

1. Bench arrangement

2. So that the minimum lengths of mains and returns are needed between the greenhouses and the boilers

3. Provide nearly level but freely draining units that can be sterilized efficiently, not be recontaminated, and be the right height and width for working with the crop

4. 2-1/2 feet

5. At least 6"

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Constructing, Maintaining, and Using Structures that Aid Plant Growth

TOPIC: Cooling the Greenhouse

1. Breaking down of the foods manufactured by the plant

2. 19,600 CFM needed for this greenhouse.
(70' x 40' = 2800 sq ft. in greenhouse, 2800 x 7CFM needed per sq. ft. =19,600 CFM)

3. 130.6 sq. ft. of pad area.
(19,600 ÷ 150) 1 sq ft. of pad area needed for each 150CFM

4. Screens can be used.

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Constructing, Maintaining, and Using Structures that Aid Plant Growth

TOPIC: Heating The Greenhouse

1. Pipe coil system

2. Hot water and steam

3. Gable ends and exterior side walls

4. a. Direct-fired
   b. Indirect-fired

5. a. Vertical blow heaters
   b. Horizontal blow heaters

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Constructing, Maintaining, and Using Structures that Aid Plant Growth

TOPIC: Winter Protection Structures

1 You should notice where the frost will do the most damage by checking the pattern of nipping

2. Damp soil holds and releases more heat than dry soil.

3. Allows sun to penetrate soil in daytime and traps this heat.

4. Every side of a tree should "see" a heater.

5 a Trees are still (no wind)
b Stars out
c Temperature around 45°
d Dry windshields or windows

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Constructing, Maintaining, and Using Structures that Aid Plant Growth

TOPIC: Structures for Summer Heat Protection

1 a. Protect foliage
b Keep roots cool
c. Consume moisture

2. East

3 Cheesecloth, Saran

4. North and South

5. Nail each lath to a diagonal brace beneath.

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Constructing, Maintaining, and Using Structures That Aid Plant Growth

TOPIC: Humidity and Watering

1. Mechanical (Chapin)

2. Hand watered

3. a. All plants get watered.
   b. Personnel will get wet.
   c. May ruin colored displays.

4. This equipment mechanically rotates itself around a continuously 360° circle, so that each nozzle, with fair pressure, will adequately cover an area with a diameter of roughly 20 feet.

5. Skinner's system is a long line of pipes with nozzles drilled at regular intervals. The pipe rotates from right to left and back to right again, thus covering an area the length of the pipe and a width of 15 to 25 square feet, depending on pressure.

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Constructing, Maintaining, and Using Structures That Aid Plant Growth

TOPIC: Ventilation

1. Because of danger of damaging plants with the direct cold outside air.

2. Should produce a uniformly distributed, non-turbulent, air flow pattern without cold drafts on the plants in winter.

3. Prevents condensation and dripping of moisture.

4. May be used in winter in connection with convection tubes.

5. a. Cuts down on the problem of excessive humidity.
   b. Decreases the disease problem.

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Constructing, Maintaining, and Using Structures That Aid Plant Growth

TOPIC Lighting

1 Roots grow away from the light. Stems grow toward light.

2. 16 to 18 Hours

3 Chlorophyll is destroyed

4. a. Red bands
   b. Blue bands

5. Length of day or period in which light is present

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

1. U L means "Underwriters' Laboratories, Inc."

2. Eight

3. II, III, IV

4. One

5. a. Safe
   b. Adequate
   c. Expandable
   d. Efficient

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT. Plant Growing Media

TOPIC. Origin, Composition, and Importance of the Soil

1 Topsoil
Subsoil
Parent layer

2 Climate

3 Topsoil

4 When its first plant grows, dies, and decays

5 a Different amounts of air present when soil is formed
b Amount of organic matter present
c Types of rock from which soil is formed

6 a Fertilizer elements
b Air
c Adequate water

7. a Sand
b Silt
c Clay

8 Sand

9 Climate, especially rainfall and temperature

10. Decayed plant or animal material

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Plant Growing Media

TOPIC Soil Moisture

1 Roots

2 Transpiration

3 Organic matter

4 During droughts

5 Size of soil particles and condition of the soil

6 Structure of soil particles is damaged.

7 Organic matter

8 Air cannot get to the roots

9 Soaks in, runs off, evaporates

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Plant Growing Media

TOPIC: Soil Mixtures

1. a Better aeration
   b. Greater ease of working
   c Better drainage
   d Better moisture-holding capacity

2 a Uniformity
   b Disease free
   c Low soluble salts
   d Good drainage
   e Good moisture retention
   f No shrinkage
   g. Ease of preparation and storage
   h Complete availability

3. To make it uniform and to eliminate large particles

4 Power driven cement mixer or shredder

5 1 part sand
   2 parts loam soil
   1 part peat moss or leaf mold
   1/2 part dried or well-rotted manure

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Plant Growing Media

TOPOC Mulches and Their Use

1 a Inorganic or processed
b Organic

2 Hard to hold in place and can become unsightly

3 Nitrogen

4 Mid-spring

5 Peat moss

6 Crushed stone, gravel chips, pebbles

7 a Dilutes the soil and usually increases root growth
b Promotes soil granulation
c Improves and stabilizes soil structure
d Affects pH slightly
e Adds some fertilizer materials
f Leads to nitrogen deficiency in cases where carbonaceous materials are added
g Serves as food for micro-organisms
h Introduces weed seeds in the soil in some cases

8 Any material applied to the surface of a soil primarily to conserve moisture, maintain a uniform temperature, and to help control weeds

9 Highly inflamable

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Plant Growing Media

TOPIC Fertilizer Nutrients

1 Nitrogen
Phosphorus
Potassium (Potash)

2 Nitrogen

3 Potassium

4 a Applying dry fertilizers when leaves are wet
b Planting seeds directly on a layer of fertilizer
c Spilling fertilizer in heaps on the lawn

5 Before a rain or watering

6 a Carbon
b Hydrogen
c Oxygen

7. a Calcium
b Magnesium

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Plant Growing Media

TOPIC: Soil Organisms

1. a. Bacteria
   b. Fungi
   c. Algae

2. 1/1000 of the weight of an acre foot of soil

3. Penetrate plant tissue and cause root damage.

4. Causes a great number of diseases

5. Convert nitrogen in the air to available nitrogen for plants (only certain bacteria).

6 a Add organic matter.
   b. Add lime
   c Add moisture.

7. a. Soil sterilization with steam
   b. Soil fumigation or drenching with chemicals
   c. Seed treatment

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Plant Growing Media

TOPIC: Soil Sterilization

1. a. To kill soil-borne insects
   b. To kill harmful bacteria, fungi, and virus organisms
   c. Destroy weeds
   d. Promote soil granulation

2. a. Existing steam boilers
   b. Portable oil-fired steam boilers
   c. Package steamers
   d. Bricked in permanent type boilers

3. Because of poor heat conduction and distribution

4. Soil thermometer

5. Burns roots

6. a. Soil temperature
   b. Soil moisture
   c. Soil texture
   d. Organic matter content
   e. Seals needed
   f. Soil type
   g. Depth of application

7. a. Avoid inhaling the material.
   b. Avoid contact to the skin.
   c. Allow sufficient time for aeration after the material is applied.

8. Steam

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Plant Growing Media

TOPIC: Plant Growing Media Other Than Soil

1. Sand

2. Brown to Black

3. 10 to 20 Times its own weight

4. Expands or Explodes

5. a. Maple
   b. Oak
   c. Sycamore
   d. Elm

6. Shredded bark, sawdust, and wood shavings

7. They failed to add nitrogen.

8. a. Safe and easy to use
   b. Chemically inert
   c. Completely sterile
   d. Excellent water retention
   e. Long lasting
   f. Specially graded

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT. Plant Propagation

TOPIC: Introduction To Propagation

1. Plant propagation is the controlled reproduction of plants in order that man can have selected plants which are of specific value to him.

2. Sexual or asexual

3. Greenhouses, hotbeds, and propagating case

4. Ventilation, temperature, shade and light

5. Loose, light, free from seeds, nematodes and disease organisms

6. Sand, peat, sphagnum moss, vermiculite and perlite

7. Methyl bromide

8. Clay pots, peat pots, and plant bands

9 To promote rooting of cuttings

10. Small rectangular containers used for seed germination

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Plant Propagation

TOPIC: Propagation From Cuttings

1. Cheaper, faster, maintains the characteristics of the original plant

2. Winter months or dormant season

3. Coleus, chrysanthemum, geranium, and carnation

4. From new growth in spring or early summer

5. 60-70° at night, 75-85° during the day
   Rooting medium 70-75°

6. a. Should come from a healthy and moderately vigorous plant
   b. Should come from average growth from portions of a plant in full sun
   c. Should be 3 to 5" long with 2 or more nodes

7. Serves as a protective layer which retards the development of decay on cuttings that are fairly slow to root

8. One which can be kept uniformly moist, provide good drainage and aeration

9. a. Clean-sharp sand
   b. Vermiculite
   c. Sand and peat moss mixture, equal parts of each
   d. Peat moss and perlite, equal parts of each

10. When they are 1/2 to 1" long

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Plant Propagation

TOPIC: Propagation by Layering

1. To induce root formation

2. Ivy, philodendrons, blackberries, and strawberries

3. Plants such as crotons, hibiscus, dracaenas, and rubber plants

4. To produce plants which do not produce true from seed, also they may be produced quicker

5. Knife, toothpick or small piece of wood, growth hormone, spahgnum moss, and plastic film or aluminum foil.

6. Spring and summer months when high temperatures and high humidity contribute toward quicker rooting

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Plant Propagation

TOPIC: Propagation by Division

1. Primrose Jasmine
   Fig Trees
   Iris
   Chrysanthemums
   Sansevieria
   Geraniums

2. Dormant season

3. They get too big for their space or they become weakened due to competition.

4. Divide in autumn or early spring when plants are dormant.

5. Divide with a hand fork, knife, or hatchet, if clumps are large. Some can be soaked in water to loosen dirt from around roots. Pull apart and cut old leaves back about 1/2 and be careful with young growth.

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT. Plant Propagation

TOPIC Propagation by Grafting and Budding

1 Stock is the name for the plant on which you graft The scion is the piece of stem which is grafted to the stock and becomes the new plant.

2. It is the soft layer of tissue on a stem or root that lies between the bark and the wood.

3 Any time during the growing season
Usually it is more satisfactory if done before buds begin to swell in late winter or early spring.

4. A sharp knife makes a clean slice, thereby insuring maximum contact of cambium layers.

5 "T" budding and Patch-budding

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Plant Propagation

TOPIC: Propagation From Seed

1. From commercial producers of seeds

2. It must be finely screened, porous, loose, and have a good water-holding capacity. Also, it should be sterilized and in most cases low in nutrients.

3. In most cases 70°F.

4. The seed will rot.

5. 50-60°

6. To reduce damping off

7. a. Name of plant or variety
   b. Date seeded
   c. Student's name
   d. Special treatment, if any

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Plant Propagation

TOPIC: Developing A Plant Breeding Vocabulary

1. Emasculation

2. A flower having both stamen and pistil

3. Stigma
   Style
   Ovary

4. Ovary

5. F_1, F_2, etc.

6. Anther

7. Yes

8. Style

9. Ask the student what he has learned about D. N. A. (desoxyribonucleic acid)

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Plant Propagation

TOPIC: Plant Selection and Fundamentals of Plant Breeding

1. The process that occurs in nature whereby strong and well-adapted plants survive while weak and poorly adapted plants eventually die out.

2. Asexually and sexually

3. Flower

4. Stamen

5. Staminate flowers

6. Pollination is the transfer of pollen. Fertilization is the union of the germ cells. In other words, pollination is the trip over and fertilization is the actual joining of the male and female germ cells.

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Plant Propagation

TOPIC: Heredity

1. Dominant

2. Cross-pollination

3. One

4. No

5. When a self-pollinated plant produces plants unlike itself

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Plant Propagation

TOPIC: General Breeding Techniques

1. List of equipment:
   Magnifying glass (10 or 15 power)
   Tweezers
   Small sharp-pointed scissors
   Camel-hair brush
   Small containers or vials
   Tags
   Alcohol
   Rubber bands
   Soft wire
   Paper or cellophane bags
   Paper clips
   Notebook

2. Just before the flower opens

3. Morning, as it is cooler

4. Stamens must be removed.

5. Steps in labeling:
   Write: a. The number that you have assigned or the variety name of the seed parent.
   b. The letter X.
   c. The number or variety name of the pollen parent.
   d. The date the cross was made.
   Example on page 19 of reference

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Nursery Plant Production

TOPIC: Transplanting Ornamental Trees and Shrubs

1. As soon as they begin to arrive at the nurseries or in late fall or early winter

2. It should be at least one to two feet wider and at least six inches to a foot deeper than the roots of the plant.

3. One-third

4. Balled and burlapped

5. One which is over five inches in diameter

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Nursery Plant Production

TOPIC: Care and Maintenance of Plants

1. If you have no good reason for pruning a plant, put the tools away without using them.

2. High quality, sharp, and well adapted to the job on hand

3. At any time

4. Growth habit and blooming characteristics of the plant

5. About one-third

6. To tidy up their appearance, to control size and to improve their health, growth habits, and blooms

7. They should be pruned between leaf drop and first spring growth.

8. After they flower

9. After they flower

10. A flat top hedge is more difficult to maintain and clip and is more easily broken down by weather and other causes.

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Floral Crop Production

TOPIC: Introduction to Floral Crop Production

1. Flowers cannot be stored for long periods of time.

2. a. Chrysanthemum
   b. Rose
   c. Carnation

3. Directly from the producer

4. "Say it with flowers."

5. Southern Florist and Nurseryman

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Floral Crop Production

TOPIC: Growing Annuals

1. Summer

2. Alyssum

3. a. Marigold
   b. Nasturtium
   c. Zinnia

4. Water annuals enough to keep the roots from drying out, but do not "drown" them.

5. Pulled up and thrown away

6. Summer

7. No

8. Fiery red

9. Rock gardens, banks

10. Often subject to wilt

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Floral Crop Production

TOPIC: Perennials

1. Chrysanthemum

2. Corsages

3. Every two years

4. Cut them back after spring bloom and give them a feeding.

5. About every twenty years

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Floral Crop Production

TOPIC: Poinsettias

1. Nitrogen

2. Red, white, and pink

3. White Fly

4. Lack of nitrogen or lack of water

5. Poorly aerated soil

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Floral Crop Production

TOPIC: Chrysanthemums

1. Fall

2. Aphids

3. 60° (Some varieties need 65°.)

4. Yellow

5. To make a short day which helps regulate blooming

6. All pinches must be made into the soft growth, usually 7 days after planting.

7. A slow start, often trouble with rotting of cutting

8. They should be sprayed overhead lightly the first 3 or 4 days.

9. Entire year with proper day length control

10. Sterilized

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Floral Crop Production

TOPIC: Geraniums

1. They are poor shippers and will lose foliage.

2. Pinched

3. Red

4. Plastic tube system

5. a. Use a fungicide on cutting.
   b. Sterilize propagating materials.
   c. Use disease-free cuttings
   d. Sterilize soil.

6. Light pink

7. 60 degrees night, 65-70 degrees day

8. Air freight

9. Four inch

10. The seed for most desirable varieties has not been available.

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Floral Crop Production

TOPIC: Hydrangeas

1. Two spotted mite (red spiders)

2. Wilt severely

3. March to May

4. Easter, Mother's Day

5. Bud rot

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Establishing and Caring for Lawns

TOPIC Turf Grasses for Texas

1. Geographic location, the amount of water available for irrigation, the degree of shade present, the time and money the home owner is willing to spend for establishment, and the expected usage.

2. Warm-season and cool-season

3. a. Does not grow in shade
   b. Turns brown after frost in the fall
   c. Is more of a nuisance than other turf grasses

4. a. Is susceptible to certain diseases
   b. Is more susceptible to iron chlorosis
   c. Is attacked by insects
   d. Needs more water for survival
   e. Will not survive at as low temperatures as will Bermuda
   f. Is a broad-leaved coarse-textured plant

5. a. Is attractive and wear-resistant
   b. Is not invaded by weeds
   c. Is subject to little damage from insects and diseases

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Establishing and Caring for Lawns

TOPIC: Establishing a New Turf

1. Preparation of the soil, establishment of the grass, care and maintenance.

2. Peat, compost, gin trash, sawdust, and leaf mold.

3. Fertilizer applications should be made at rates and in combinations suggested by soil tests.

4. The type of grass used and the rapidity of cover desired.

5. In order to develop a deep root system.

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Establishing and Caring for Lawns

TOPIC: Managing an Established Turf

1. Feeding, watering, aerating, and moving

2. It produces vegetative growth and gives the plant a deep green color.

3. It stimulates development of a good root system.

4. Stunted growth of the entire plant. The leaves are relatively small, thin, and yellowish-green to yellow. They show yellow to brown color at the tip of the leaf and down to the midrib.

5. Slow growth of the entire plant, leaves are an unhealthy dark green, roots are stunted.

6. Pale, bleached leaves

7. Spring and early fall

8. Applying iron sulfate or iron chelate

9. Produce shallow, weak root systems, which does not allow efficient utilization of plant food or moisture in the soil.

10. It allows air or oxygen to get into the soil, water to move into and through the soil, and the soil to hold more water.

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Establishing and Caring for Lawns

TOPIC: Turf Problems

1. a. Weed
   b. Disease and insect control
   c. Clover in the turf
   d. Renovation of old lawns

2. By proper turf grass management

3. 2-4-D

4. Brownpatch occurs as irregularly shaped brown areas, usually circular, 4 to 48 inches in diameter. The fungus gives the grass a blue, water-soaked appearance. As the disease spreads, the dark areas turn light brown.

5. A fungicide containing PCNB

6. a. Chlordane
   b. Dieldrin
   c. D. D. T.
   d. Toxaphene
   e. Malathion
   f. Aldrin
   g. Heptachlor
   h. Lindane

7. When the old turf is run down, weedy, and in a generally undesirable condition, or when a new species is to be introduced.

8. a. Chlordane
   b. Lindane
   c. Sulfur
   d. Toxaphene

9. a. Diazinon
   b. Ethion
   c. Trithion

10. Five gallons of spray mixture per 100 square feet of lawn area.

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Controlling Plant Insects, Plant Diseases, and Other Pests

TOPIC: Causes of Plant Diseases

1. a. Fungi
   b. Bacteria
   c. Viruses
   d. Nematodes

2. The manufacture of sugars from carbon dioxide and water with the aid of sunlight and chlorophyll.

3. An agent that transmits disease-producing organisms.

4. Prevention by careful pruning.

5. Tiny, thread-like plants, commonly called molds.

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Controlling Plant Insects, Plant Diseases, and Other Pests

TOPIC: Identifying Plant Diseases

1. Proper identification.

2. Failure to produce seed or fruit.

3. Liquid discharge from diseased tissues.

4. Microscopic examination of roots.

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Controlling Plant Insects, Plant Diseases, and Other Pests

TOPIC: Application and Safety Precautions of Horticultural Chemicals

1. Welfare of the people

2. Welfare of the plant

3. Effectiveness of the material in controlling the pest or disease

4. Hydraulic sprayers

5. Hang the hose on a rack with nozzle pointing upwards

6. a. Read label precautions.
   b. Keep chemicals locked up when not in use.
   c. Keep children away while using.
   d. Don't smoke while spraying.
   e. Don't spill material on skin or clothing.
   f. Wash exposed areas of skin immediately after job is completed.
   g. Never spray when windy.
   h. Spray edible plants with great caution.

7. The chemical must touch the insect before death occurs.

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Controlling Plant Insects, Plant Diseases, and Other Pests

TOPIC: Controlling Leaf Diseases

1. Water and fertilize properly and remove dead limbs

2. Caused by fungi which live on secretions from aphids and immature stages of white fly

3. Caused by excess rain or over watering

4. a. Malathion
   b. Lindane

5. Just before buds open and after flowering

6. Two to four weeks or as needed

7 Most often caused by lack of iron

8. Fungus disease

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Controlling Plant Insects, Plant Diseases, and Other Pests

TOPIC: Controlling Stem, Branch, and Trunk Diseases

1. Prune infected portions sterilizing shears between each cut.

2. If little dodder is present, remove by hand. Destroy badly infected plants.

3. Reduces the amount of sunlight for trees

4. Twigs and limbs

5. Fungi

6. Install in the infected parts of tree to drain the excess fluid and relieve pressure.

7. By birds

8. Fungi and algae

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Controlling Plant Insects, Plant Diseases, and Other Pests

TOPIC: Controlling Root Diseases

1. Carbon bisulfide soil fumigation

2. Methyl bromide soil fumigation

3. Removing and destroying diseased roots

4. Ten (10) feet

5. East and southeast Texas

6. 75-95 degrees

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Controlling Plant Insects, Plant Diseases, and Other Pests

TOPIC: Controlling Diseases Affecting the Entire Plant

1. Symptoms exhibited by aster yellows that are not exhibited by verticillium wilt:
   a. Bushy with numerous secondary shoots
   b. Leaves may develop a slightly reddish, brownish, or purplish tinge in later stages.
   c. Flower parts may develop into leafy structures.

2. DDT

3. Chloropicrin

4. West

5. Commercial growers or trained personnel

6. Miticide

7. Zineb, CM-19

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Controlling Plant Insects, Plant Diseases, and Other Pests

TOPIC: Controlling Lawn and Turf Diseases

1. Handpick and destroy mushrooms or toadstools.

2. Iron sulfate or iron chelate

3. Irregular-shaped dead areas from a few inches to more than several feet in diameter

4. Wash off with water applied as a spray with 20 to 30# pressure.

5. Zineb, Captan

6. One to two weeks before disease usually appears and a second application after disease appears. Then apply as needed.

7. Apply chemicals as needed in early stages of disease.

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Controlling Plant Insects, Plant Diseases, and Other Pests

TOPIC: Identifying Plant and Soil Insects and Methods of Control

1. Slugs have no shells

2. Spring

3. Spray before eggs hatch and prune

4. Roots

5. Sandy soils

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Controlling Plant Insects, Plant Diseases, and Other Pests

TOPIC: Nematodes

1. a. Select a plant that is partly alive.
   b. Dig the plant instead of pulling it.
   c. Wash the soil from the roots and allow a few minutes for drying.
   d. Place the specimen in a polyethylene container and tie it securely.
   e. Fill out form D-418, available from your county extension agent.
   f. Place bag and D-418 in a box and send it to the research center.

2. Root knot nematode

3. Before spending a large amount of money for chemicals, determine if nematodes are causing a significant amount of damage to justify the expense and labor.

4. a. Crown gall
   b. Nodules from nitrogen fixation

5. Tomato, okra

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Controlling Plant Insects, Plant Diseases, and Other Pests

TOPIC: Control of Moles, Gophers, Birds, Deer, and Ants

1. By conical mounds of dirt pushed up from their main run

2. Baiting and trapping

3. Serious injury might occur to small children or dogs.

4. Gophers open their tunnels; moles do not.

5. Place chicken wire at the bottom and sides of planting holes.

6. Starlings.

7. Portable bird protectors made of scrap lumber, chicken wire, or cheesecloth.

8. Fencing

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Controlling Plant Insects, Plant Diseases, and Other Pests

TOPIC: Controlling Weeds

1. Water should be applied.

2. Hoe

3. Ice pick or screwdriver

4. Shrubs form a shade in which weeds do not thrive.

5. Apply organic mulch two to three inches deep.

6. Wear gloves.

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Operating and Maintaining Horticultural Equipment

TOPIC: Principles Used to Prevent Personal Injury

1. Legs

2. One pulley only changes direction of force.

3. Jack

4. Wet the soil 4 to 5 days before digging.

5. Hook a 1/2" pipe onto a hose and beat the bottom end into a flattened or pointed opening. This will enable you to stick the pipe down into the hole where the force of the water through the small opening will loosen the soil.

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Operating and Maintaining Horticultural Equipment

TOPIC: Selection and Maintenance of Horticultural Hand Tools

1. Tools are very personal pieces of equipment and all experienced gardeners have their favorites.

2. Scoop

3. 6"

4. Sharpen the hoe each time you take it into the garden.

5. Scuffle hoe

6. a. Fan-shaped
   b. Rectangular

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Operating and Maintaining Horticultural Equipment

TOPIC: Maintaining Small Power Equipment

1. a. Periodic equipment inspection to discover situations which may lead to equipment breakdown
   b. Upkeep to minimize wear or to remedy potential trouble

2. Make an overall check and properly service equipment.

3. Water condenses more rapidly in a partially filled tank.

4. Gasoline or other solvents

5. Tension and wear

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Operating and Maintaining Horticultural Equipment

TOPIC: Operating and Maintaining Lawn Mowers Safely and Effectively

1. a. Reel
   b. Rotary
   c. Sickle bar

2. Mowing too close

3. Disconnect the spark plug wire so that a spark cannot jump.

4. Cutter bar and knife

5. The clippings will smother the grass.

6. Leaves produce food for the plant. If leaves are cut too short, the health and vigor of the lawn will be greatly reduced.

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Operating and Maintaining Horticultural Equipment

TOPIC: Operating Rotary Tillers Safely and Effectively

1 a. Front tine
b. Rear tine

2 Front tine

3 Rotation of the tine

4. Raise the depth bar

5 Check to make sure that all clutches and belt tension pulleys are disengaged.

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Operating and Maintaining Horticultural Equipment

TOPIC: Operating Garden Tractors Safely and Effectively

1. The tractor must have enough horsepower to operate the power sickle bar.

2. 3 1/2 - 10 horsepower

3. Below the rear axle level

4. Riding lawn mowers are designed only for mowing. Small tractors are designed for several types of attachments.

5. a. Automotive
   b. Belt type

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Developing and Maintaining the Landscape

TOPIC: Introduction to Home Landscaping

1. a. Art
   b. Engineering
   c. Horticulture

2. a. Homeowners who purchase subdivision or housing development homes
   b. Families who buy new homes already designed and constructed with no specific client in mind
   c. Families who purchase a lot, have their home especially planned and constructed for them on the lot
   d. Families who now live in older homes and desire to remodel or redesign their gardens

3. They do not fit into our mechanized way of living.

4. Climate varies.

5. The cost is included in the price of plants.

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Developing and Maintaining the Landscape

TOPIC: Selecting the Site

1. General location

2. Zoning prevents businesses from moving into a residential section.

3. No.

4. a. Privacy is difficult.
   b. Require installation of additional utilities, walks, and drives.
   c. Outdoor space is limited.
   d. More noise from traffic

5. a. Drives and sidewalks are too steep.
   b. Lawn is more difficult to keep.

6. South. Sunlight can be better controlled.

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Developing and Maintaining the Landscape

TOPIC: Scheduling Landscape Development and Beginning Plans

1. A well-planned garden is one that is livable, interesting, beautiful, easy to maintain, and where relationships between outdoor and indoor areas are coordinated properly.

2. Drives and walks

3. Trees are essential for shade in Texas.

4. Provide privacy and assist in temperature control

5. a. There must be a program for site and landscape development.
   b. There must be a plan.

6. A piece of real estate which may be merely a lot or one with a home on it.

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Developing and Maintaining the Landscape

TOPIC: Analyzing Problems and Determining Needs

1. a. Suitability
   b. Function
   c. Economy
   d. Beauty

2. Deciding and analyzing specific problems of a chosen site

3. a. Do you prefer them to be beautiful and pleasant?
   b. Do you want them to make you feel comfortable?
   c. Do you care whether they fit together well and serve their purpose?

4. a. Space
   b. Garden development
   c. Maintenance

5. a. Individual taste
   b. Past environment

6. No. It is even hard for professionals.

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Developing and Maintaining the Landscape

TOPIC: Developing the Landscape Plan

1 Before the property is purchased

2 1 inch equals 10 feet

3 a Entrance
b General living area
c Work space
d Place for private living

4. General living area

5. Bedroom area

6. a Formal
b Informal

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Developing and Maintaining the Landscape

TOPIC: Selecting Plants

1. 12-25 feet

2. 6-8 feet

3. Dwarf shrubs

4. The roots may clog drain pipes.

5. Broadleaf evergreen

6. a. Watering
   b. Mowing
   c. Edging
   d. Clipping
   e. Weeding
   f. Fertilizing
   g. Controlling insects

7. a. Privets
   b. Arborvitae

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Developing and Maintaining the Landscape

TOPIC: Grading, Drainage, and Landscape Structures

1. Using splash blocks

2. No

3. Building a wall around it and leaving the grade unchanged in the immediate area.

4. Making them too narrow

5. 4 feet

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Merchandising Horticultural Plants and Supplies

TOPIC: Developing Personal Traits

1. a. Knowledge of self
   b. Knowledge of people
   c. Knowledge of product

2. a. Experience
   b. Observing others

3. a. Promotions
   b. Dollars (profits)

4. Analysis of sales

5. Diligence and perseverance

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Merchandising Horticultural Plants and Supplies

TOPIC: Displaying

1. Where they can be seen by the greatest number of people

2. To put merchandise where customers can see it and serve themselves

3. Familiar products, bulk seeds, or other seasonal items

4. Items that are to be "pushed"

5. a. Well stocked
   b. Safe
   c. At a convenient height

6. To stop the customer and bring him into the place of business

7. It does not attract customers.

8. The traffic pattern of the customers

9. In beds

10. Eight feet

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Merchandising Horticultural Plants and Supplies

TOPIC: Advertising

1. Point-of-purchase

2. Outside

3. Classified

4. Keeping the mailing list up to date

5. a. Effectiveness
   b. Cost
   c. Coverage

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Merchandising Horticultural Plants and Supplies

TOPIC: Labeling and Pricing

1. Price plants too low

2. a. Transplanting
   b. Salesman's salary
   c. Unsold stock
   d. Shrinkage in volume

3. 66 2/3 percent

4. High cost items

5. Selling price of the item

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Merchandising Horticultural Plants and Supplies

TOPIC: Understanding the Customer and Making Sales

1. Why he failed

2. The salesman

3. a. Owner's comfort and convenience
   b. Performance
   c. Safety
   d. Appearance
   e. Length of life
   f. Economy
   g. Service
   h. Prestige

4. People like to think they have made up their own minds. Also, the customer may think something is wrong with the product.

5. Getting the customer's attention

Topic Test
on
HORTICULTURE AS AN INDUSTRY

Student: _____ School: _____

Date: _____ Score: _____

Place a check under T for True or under F for False:

T	F	
_____	_____	1. Pomology is the science of producing cut flowers.
_____	_____	2. Olericulturists are concerned with vegetables.
_____	_____	3. The annual production of vegetables exceeds one billion dollars.
_____	_____	4. Apples are classed as small fruits.
_____	_____	5. Cotton is a horticultural crop.
_____	_____	6. Grapes are classed as citrus fruits.
_____	_____	7. Floriculture has developed in the past ten years.
_____	_____	8. Out-of-season production of vegetables is an important industry in the West and South.
_____	_____	9. Ornamental plants are considered as horticultural plants.
_____	_____	10. Olericulturists are not concerned with marketing vegetables. They deal only with production.

Topic Test
on
EXPLORING OCCUPATIONAL OPPORTUNITIES

Student: _____ School: _____

Date: _____ Score: _____

1. List at least 10 factors, in your own words, which one should consider in selecting an occupation.
   a. _____
   b. _____
   c. _____
   d. _____
   e. _____
   f. _____
   g. _____
   h. _____
   i. _____
   j. _____

2. List the five job titles for which descriptions were provided in the assignment.
   a. _____
   b. _____
   c. _____
   d. _____
   e. _____

Topic Test
on
INTRODUCTION

Student: _____ School: _____

Date: _____ Score: _____

Fill in the blanks:

1. _____ is the study of plants.

2. There are over _____ kinds of plants found in the world.

3. _____ and _____ are carbohydrates.

4. Van Helmont did an experiment to determine what made plants grow. His conclusion was that _____ alone produced growth.

5. Plants differ from animals in that they produce food from _____ and _____.

Topic Test
on
PHOTOSYNTHESIS

Student: _____ School: _____

Date: _____ Score: _____

Fill in the blanks:

1. _____ is the process by which liquids and gases move from an area of high concentration to an area of low concentration.

2. _____ means light.

3. All substances are made up of_____.

4. Photosynthesis requires four components. They are _____, _____, _____, and _____.

5. When atoms are combined, we call them a _____.

Topic Test
on
RESPIRATION

Student: _____ School: _____

Date: _____ Score: _____

Fill in the blanks:

1. Raw materials for respiration are _____ and _____.

2. Energy is _____ during photosynthesis.

3. Respiration _____ dry weight. (increases or decreases)

4. Plants release _____ at night. (what gas?)

5. _____ is the release of chemical energy.

Topic Test
on
WATER ABSORPTION AND LOSS--
NUTRIENT ABSORPTION--
MOVEMENT OF WATER AND NUTRIENTS IN THE PLANT

Student: _____ School: _____

Date: _____ Score: _____

Fill in the blanks:

1. _____ are elements, or groups of these elements, needed for plant growth.

2. Eash vascular bundle has two types of conductive tissues called the _____ and _____.

3. _____ occurs from plant injuries.

4. _____ is the loss of water from the plant as a vapor.

5. The principal water-absorbing structure is the _____ _____.

Topic Test
on
PLANT FOOD

Student: _____ School: _____

Date: _____ Score: _____

Fill in the blanks:

1. Examples of the carbohydrates include the sugars, starches, and _____.

2. A pound of _____ has about 2-1/4 times as much stored energy as a pound of sugar.

3. _____ is the principal part of lean meat.

4. _____, _____, _____, and _____ make up about 97% of the dry weight of most plants.

5. The "_____ elements" are those which the plant must have in order to survive.

Topic Test
on
THE PLANT KINGDOM

Student: _____ School: _____

Date: _____ Score: _____

Fill in the blanks:

1. _____ plants cause many diseases of higher plants by attacking, multiplying, and living in or on the higher plants.

2. The botanist classifies the seed-producing plants according to their _____ _____.

3. Helpful soil organisms and the nitrogen-fixing organisms found in legume nodules are examples of _____ bacteria.

4. _____ forms a green scum on ponds and lives in both fresh water and sea water.

5. The plant world has been divided into _____ divisions.

Topic Test
on
TYPES OF GREENHOUSES

Student: _____ School: _____

Date: _____ Score: _____

PART I: Fill in the blanks:

1. _____ _____ handles the ventilation problem in greenhouses with no ventilators.

2. The _____ is the season for repairing greenhouse coverings.

3. It is necessary to provide a good means of exchanging the greenhouse air with outdoor air in order to regulate the greenhouse temperature, Adjust the _____, provide air movement around the plants, and introduce new supplies of _____ and carbon dioxide.

PART II: True or False

_____ 1. Vinyl film is more durable than polyethylene.

_____ 2. The exterior of a greenhouse does not need to be painted more often than seven years.

_____ 3. Film plastic eliminates the problem of dripping water in the greenhouse.

Topic Test
on
SIZE AND ARRANGEMENT OF GREENHOUSES

Student: _____ School: _____

Date: _____ Score: _____

True or False:

_____ 1. The depth of a bench for cut flowers needs to be at least twelve inches.

_____ 2. The best height for pot plant benches is 2-1/2 feet.

_____ 3. Before the type of greenhouse is chosen and built, a careful study should be made of the best bench arrangement for the crops to be grown.

_____ 4. Wood contracts when it is wet; so boards must be fitted close together when making wooden benches.

_____ 5. One of the best bench making materials for drainage and air circulation is one inch by one inch welded wire fabric.

Topic Test
on
COOLING THE GREENHOUSE

Student: _____ School: _____

Date: _____ Score: _____

Problems:

1. If a greenhouse was 100 feet long and 40 feet wide, how many square feet would it contain? _____ (answer)

2. How many CFM would need to be exhausted for a greenhouse containing 1000 square feet? _____ (answer)

3. How many square feet of padded area will be needed in a greenhouse that requires 7500 CFM to be exhausted? _____(answer)

Work here:

Topic Test
on
HEATING THE GREENHOUSE

Student: _____ School: _____

Date: _____ Score: _____

True or False:

_____ 1. In vertical blow heaters the shaft is vertical and the fan blade is horizontal.

_____ 2. Direct-fired units are those which contain a combustion unit right in the unit itself.

_____ 3. In recent years the use of unit heaters for heating greenhouses has decreased considerably.

_____ 4. The oldest and most conventional heating system is the pipe coil.

_____ 5. The coldest spots in the greenhouse are the exterior side walls and gable ends.

Topic Test
on
WINTER PROTECTION STRUCTURES

Student: _____ School: _____

Date: _____ Score: _____

Fill in the blanks:

1. _____ gardens often have definite thermal belts and artic regions.

2. The most dangerous spots for frost damage are stretches of open ground exposed on all sides, particularly to the _____ sky.

3. Regardless of what kind of shelter you use, keep soil _____ around plants.

4. _____ soil holds and releases more heat than _____ soil.

5. _____, made of double strength glass and available in several sizes, are set side-by-side to protect large areas.

Topic Test
on
STRUCTURES FOR SUMMER HEAT PROTECTION

Student: _____ School; _____

Date: _____ Score: _____

Fill in the blanks:

1. A lath sunscreen should be placed so the laths run in a _____ and _____ direction.

2. If you like to grow _____ loving flowers such as tuberous begonias and cyclamens, you may want a permanent display structure.

3. From sunrise to _____ o'clock in the morning there is very little heat accumulation.

4. The subject of _____ in the garden is frequently ignored or misunderstood -- particularly by the beginner.

5. A structure facing an _____ direction is ideal, especially if you live in a hot summer area.

Topic Test
on
HUMIDITY AND WATERING

Student: _____ School: _____

Date: _____ Score: _____

True or False:

_____ 1. The majority of bedding plants are hand watered.

_____ 2. There is no equipment available for the purpose of watering pot plants.

_____ 3. Watering of greenhouse cut flower crops by mechanical means is a well-established, proven practice.

_____ 4. Rainbird-type nozzle systems consist of long lines of pipe with holes drilled in each end.

_____ 5. Most growers use pipe systems for watering bedding plants.

Topic Test
on
VENTILATION

Student: _____ School: _____

Date: _____ Score: _____

True or False:

_____ 1. The disadvantage of using humidistats to control fans is that the problem of excessive humidity becomes greater.

_____ 2. Thermostatically-controlled systems respond quickly to changing outdoor temperatures.

_____ 3. The thermostat controlling the first stage fans should be set several degrees above the setting of the heating thermostat.

_____ 4. Motorized roof ventilators can be controlled automatically.

_____ 5. Exhaust fans in cooling systems may be used during the winter months if a convection tube is attached.

Topic Test
on
LIGHTING

Student: _____ School: _____

Date: _____ Score: _____

True or False:

_____ 1. Certain kinds of seed require light in order to germinate.

_____ 2. Plants are classified into two groups in regard to light intensity, low-energy and high energy.

_____ 3. Long day plants require from 8 to 12 hours of light per day.

_____ 4. Research studies show that plants utilize chiefly three different wave length regions of radiant energy, the green, orange, and yellow.

_____ 5. White light is a mixture of all colors but white light of incadescent lamp is rich in red.

Topic Test
on
WIRING AND ELECTRICAL CONTROLS

Student: _____ School: _____

Date: _____ Score: _____

Fill in the blanks:

1. The basic requirements of any well-planned wiring system are that it shall be _____, _____, _____, and efficient.

2. Only the first requirement, _____, will be achieved by compliance with the National Electric Code. The others depend on careful planning.

3. General lighting circuits should have a maximum of _____ outlets per circuit.

4. Provide individual circuits for motors _____ horsepower and larger.

5. Minimum wire size for general purpose circuits should be _____ with 15 ampere protection.

Topic Test
on
ORIGIN, COMPOSITION, AND IMPORTANCE OF SOILS

Student: _____ School: _____

Date: _____ Score: _____

PART I: Fill in the blanks:

1. The largest of the soil particles is _____.

2. Decayed plants and animal material is called _____.

3. _____ and _____ determine the rate of soil formation.

4. Clay feels like _____ rubbed between the fingers.

5. The difference in texture of soils is caused by the different sizes of soil _____.

PART II: List:

1. Three (3) layers of soil from top to bottom:

   a. _____

   b. _____

   c. _____

2. Three (3) factors that are responsible for differences in soil color:

   a. _____

   b. _____

   c. _____

Topic Test
on
SOIL MOISTURE

Student: _____ School: _____

Date: _____ Score: _____

PART I: Fill in the blanks:

1. Moisture moves through the soil in all directions,even against gravity by_____ movement.

2. In _____ textured soils, the particles are closer together and the attraction between soil and water is greater.

3. Much soil moisture can be lost when capillary water moves to the surface and _____.

4. All living cells carry on _____.

5. Movement of air through the soil is called _____.

PART II: Check T for true or F for false:

T	F	
_____	_____	1. Soils should be worked while in a wet condition.
_____	_____	2. It is possible to change water-holding capacity of soil.
_____	_____	3. Underwatering causes decreased aeration.
_____	_____	4. Sandy soils require more frequent watering than heavy clay soils.
_____	_____	5. Oxygen must be present for respiration to occur.

Topic Test
on
SOIL MIXTURES

Student: _____ School: _____

Date: _____ Score: _____

Fill in the blanks:

1. _____ soils are a mixture of sand, silt, and clay.

2. _____ increases aeration of soil.

3. Loam soils become _____ after watering.

4. For large scale mixing operations, use a power driven cement mixer or _____.

5. Loam soils often _____ after drying.

List:

6. The characteristics of a good mixture:

   a. _____

   b. _____

   c. _____

   d. _____

   e. _____

   f. _____

   g. _____

   h. _____

Topic Test
on
MULCHES AND THEIR USE

Student _____ School _____

Date _____ Score _____

PART I: Fill in the blanks:

1. The most common mulch is _____.

2. The time to apply mulch to the garden on established plants is in _____.

3. Additional _____ should be applied to a crushed corncob mulch.

4. _____ may be produced during decomposition of lawn clippings.

5. A light spray of _____ may be used by contractors to hold soil in place on steep slopes.

PART II: Multiple choice.

_____ 1. The cost of this material is usually prohibited when large areas are mulched.
a. crushed corncob b. peat moss c. wood chips

_____ 2. This material should not be used in areas where a cigarette may be dropped.
a. corncobs b. asphalt c. straw

_____ 3. Any mulch should be at least this deep:
a. 1/4" - 1/2" b. 1" - 2" c. 2"-3"

Topic Test
on
FERTILIZER NUTRIENTS

Student _____ School _____

Date _____ Score _____

Fill in the blanks.

1 _____ is responsible for the dark green color in plants

2 The two lime elements are _____ and magnesium.

3 Do not apply dry fertilizer to plants when the foliage is_____.

4 Place fertilizer _____ and to the side of the seed.

5 Dry fertilizer can be _____ (how applied) over the soil surface by means of a spreader

List.

1 Three primary elements

a _____

b _____

c _____

2 Three secondary elements

a. _____

b _____

c _____

Topic Test
on
SOIL ORGANISMS

Student: _____ School: _____

Date: _____ Score: _____

Fill in the blanks:

1. _____ converts nitrogen in the air to available plant nitrogen.

2. Moisture, lime, and _____ can be added to the soil to stimulate soil organisms.

3. _____ feed on soil bacteria and contribute to organic content of the soil.

4. _____ decompose organic residues and promote formation of humus.

5. The _____ mixes soil and increases aeration. Also it promotes drainage.

List:

6. Three ways to control harmful soil organisms:

   a. _____

   b. _____

   c. _____

Topic Test
on
SOIL STERILIZATION

Student: _____ School: _____

Date: _____ Score: _____

PART I: Fill in the blanks:

1. _____ sterilization is cheaper than using chemicals.

2. Ethylene di-bromide is especially effective against _____.

3. No plants should be planted into a fumigant-treated soil for a period of _____ to _____ weeks.

4. Ammonia build-up in the soil may cause _____.

5. Nematodes are killed _____ when exposed to 140°F. steam heat.

PART II: List:

1. Reasons for sterilizing soils:

   a. _____

   b. _____

   c. _____

   d. _____

2. Three precautions to observe when using fumigants:

   a. _____.

   b. _____.

   c. _____.

Topic Test
on
PLANT GROWING MEDIA OTHER THAN SOIL

Student: _____ School: _____

Date: _____ Score: _____

Fill in the blanks:

1. _____ is the most widely used medium for reproduction of plants.

2. Sphagnum will retain _____ to _____ times its own weight in water.

3. _____ expands or explodes when heated.

4. Shredded bark, sawdust, and wood shavings are most commonly used in the _____ part of the United Stated

5. When sawdust is used, _____ must be added to the medium.

6. Brown to black peat contains approximately 1% _____.

7. _____ results from decayed remains of thick vegetation in swampy condition.

Topic Test
on
INTRODUCTION TO PROPAGATION

Student; _____ School: _____

Date: _____ Score: _____

PART I: Fill in the blanks:

1. Two methods by which plants may be propagated are _____, and _____

2. Three requirements of the ideal plant propagation structure are _____, _____, _____, and _____.

3. _____ is used for chemical sterilization of soil.

4. A good propagation media should be free of _____, _____ and _____.

5. Many types of containers are used in plant propagation such as _____, _____, and _____.

PART II: Place a check under T for true or under F for false for each of the following statements:

T	F	
____	____	1. If soil is used, sterilization is a must.
____	____	2. Many plant propagators use a plant hormone to promote rooting of seeds.
____	____	3. Seed reproduction in plants is basically a sexual process.

Topic Test
on
PROPAGATION FROM CUTTINGS

Student: _____ School _____

Date: _____ Score: _____

PART I. Place a check under T for true or under F for false for each of the following statements.

T	F	
_____	_____	1. Many types and varieties of plants will not produce the same quality and type of plant from seed and must be reproduced by cutting, budding, or grafting
_____	_____	2. Cuttings are more difficult to make than budding.
_____	_____	3. Cuttings are classified and named according to the part of the plant from which they come
_____	_____	4. Herbaceous cuttings are made from plant materials which are hard.
_____	_____	5. Low humidity is necessary for rooting cuttings.

PART II. Fill in the following blanks to make complete true statements

1. The temperature of the rooting medium should be close to _____

2. Three requirements of a good rooting medium are.

   a. _____

   b. _____

   c. _____

3. Cuttings are ready to transplant when roots are _____.

4. Softwood cuttings are made (when) _____.

5. During rooting the medium must be kept uniformly moist but never _____

Topic Test
on
PROPAGATION BY LAYERING

Student: _____ School: _____

Date: _____ Score: _____

PART I: Place a check under T for true and under F for false in each of the following statements:

T	F	
____	____	1. The production of a new plant by layering is one of the slowest methods.
____	____	2. Air layering is an excellent way to produce plants which do not come true from seed.
____	____	3. Air layering is best practiced during the spring and summer months.
____	____	4. A growth hormone may help to stimulate root growth.
____	____	5. Under ideal conditions, plants should root in a few months when they are air layered.

PART II: List:

1. List four plants which can be air layered:

   a. _____.

   b. _____.

   c. _____.

   d. _____.

Topic Test
on
PROPAGATION BY DIVISION

Student: _____ School: _____

Date: _____ Score: _____

T F

_____ _____ 1. Plants are best divided after their season of blossoming.

_____ _____ 2. Larger shrubs should be divided when they are dormant for best results.

_____ _____ 3. Each root segment or division is actually a plant in itself or is capable of becoming a new plant.

_____ _____ 4. Division is a slow way of increasing your supply of perennials.

_____ _____ 5. Deciduous and semi-deciduous perennials may be cut back to about four inches from the ground when you transplant.

Topic Test
on
PROPAGATION BY GRAFTING AND BUDDING

Student: _____ School: _____

Date: _____ Score: _____

PART I: Answer the following questions:

1. Define stock.

2. What is the cambium layer?

3. List two kinds of budding.

PART I: Place a check under T for true or under F for false for each of the following statements:

T	F	
_____	_____	1. In all grafting methods, the tight union between stock and scion must be sealed off from air with some kind of sealing agent.
_____	_____	2. Evergreens can be grafted in early spring, just before plants begin to grow actively.

Topic Test
on
PROPAGATION FROM SEEDS

Student: _____ School: _____

Date: _____ Score: _____

PART I: Place a check under T for true or under F for false for each of the following statements:

T	F	
____	____	1. There are no bargains when obtaining good seeds.
____	____	2. A good growing media for germinating seeds should be high in the nutrients necessary for plant growth.
____	____	3. The minimum temperature for seed germination is 70°F.

PART II. Fill in the following blanks to make true, complete statements:

1. Some propagators use a layer of a sterile moisture-holding material as _____.
2. A _____ can be used for firming the top of the soil.
3. To help distribute small seed, mix them with a small amount of _____.
4. The label on a seeded flat should contain:

   a. _____.

   b. _____.

   c. _____.

   d. _____.

Topic Test
on
DEVELOPING A PLANT BREEDING VOCABULARY

Student: _____ School: _____

Date: _____ Score; _____

Fill in the blanks.

1. The _____ is the part of the stamen that develops and bears pollen.

2. A _____ is a small flower in a composite flower, having stamens and a pistil.

3. A _____ is the unit that carries hereditary traits.

4. The _____ is an enlarged base of a pistil in which the seed develops.

5. A _____ is a small flower in a composite flower, having a pistil but no stamens.

Topic Test
on
PLANT SELECTION AND FUNDAMENTALS

Student: _____ School: _____

Date: _____ Score: _____

PART I: Fill in the blanks:

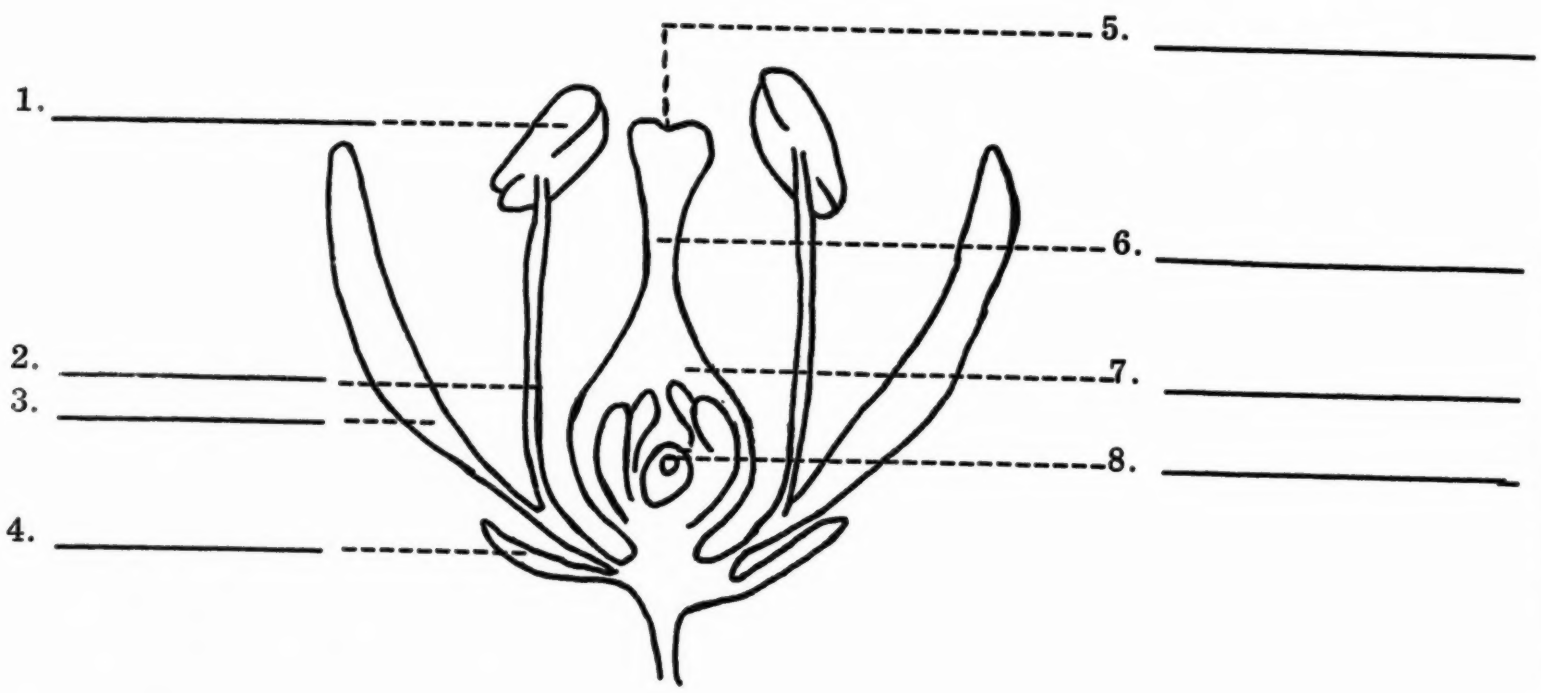
1. _____ is the transfer of pollen.

2. _____ is the union of germ cells.

3. A perfect flower contains both _____ and _____.

4. The _____ which are often green cuplike structures support the petals and the floral parts.

PART II: Label the parts of the perfect flower:



Topic Test
on
HEREDITY

Student: _____ School: _____

Date: _____ Score: _____

Fill in the blanks:

1. If a plant that is self-pollinated produces offspring identical to itself, it is said to breed _____.

2. If the first-generation offspring are not all identical to the parent plant, then it is said that _____ has occurred.

3. When the red and yellow genes come together and both are incomplete, the resulting color of the flower will be _____.

4. Hybrids are results of crosses between two_____ _____.

5. When the male and female germ cells unite in the _____, each contributes one gene for each _____.

Topic Test
on
GENERAL BREEDING TECHNIQUES

Student: _____ School: _____

Date: _____ Score: _____

Place a check under T for true or F for false for each of the following statements:

T	F	
____	____	1. Only those composite flowers containing both disc and ray florets can be self-pollinated.
____	____	2. Prepollination steps generally should begin after the flower is well opened.
____	____	3. Extremely high temperatures or moist conditions are harmful to pollen.
____	____	4. Some breeders use chicken bands for marking the parent plants.
____	____	5. Composite flowers can be easily closed with a string or soft wire.

Topic Test
on
TRANSPLANTING ORNAMENTAL TREES AND SHRUBS

Student: _____ School: _____

Date: _____ Score: _____

Fill in the blanks:

1. The hole which the plants are to be set in should be _____ wider and _____ deeper than the roots of the plant.

2. The plant should be set at the _____ _____ at which it was growing.

3. When planting a bareroot shrub or tree, _____ of the top should be pruned.

4. Trees _____ usually need guy wires.

5. The nursery term B&B means _____ and _____.

Topic Test
on
CARE AND MAINTENANCE OF PLANTS

Student: _____ School: _____

Date: _____ Score: _____

PART I: Place a check under T for true or F for false:

T	F	
____	____	1. Trees may be pruned at any time.
____	____	2. Climbing hybrid-tea roses look best when old blooms are cut off just above the second bud in the axil of a leaf.
____	____	3. Many shrubs should be pruned by thinning out rather than by severe pruning.
____	____	4. Shrubs which bloom in the spring should be pruned in the fall.
____	____	5. Climbing roses should be pruned after flowering.

PART II: Answer the following to make true complete statements:

1. Pruning ornamental shrubs and small flowering trees depends on the _____ _____ and _____ _____ of the plant.

2. When woody plants are dug without a ball of soil around the roots, they are said to be dug _____.

3. Deciduous plants should be pruned between _____ and _____ _____.

4. Many shrubs should be pruned by _____ rather than by severe pruning.

5. Pruning of plants is the cutting off or cutting back of parts of that plant for _____ or more _____.

Topic Test
on
INTRODUCTION TO FLORAL CROP PRODUCTION

Student _____ School _____

Date _____ Score _____

Fill in the blanks

1 The three most widely grown cut flowers are roses chrysanthemums, and _____

2 The cultivation and selling of flowers is known as _____

3 Many greenhouses have been located in a particular area because of the great amount of _____ during the winter or the mild climate

4 Most cut flowers are sold to the retail flower shops through wholesale _____ houses

5 The U S D A does research in many phases of floriculture at _____ Maryland

Topic Test
on
GROWING ANNUALS

Student: _____ School: _____

Date: _____ Score: _____

Place a check under T for true or F for false:

T	F	
____	____	1. Annuals grow only one year or less.
____	____	2. Morning glories bloom only in the winter.
____	____	3. Asters are resistant to wilt.
____	____	4. There are many varieties of zinnias.
____	____	5. Some annuals take only six weeks from seed to flower.
____	____	6. Annuals can be produced in flats.
____	____	7. Pansies are biennials.
____	____	8. Asters make good cut flowers.
____	____	9. Annuals do best in well-prepared soil.
____	____	10. Hollyhocks are blue in color.

Topic Test
on
PERENNIALS

Student: _____ School: _____

Date: _____ Score: _____

Fill in the blanks:

1. Primrose clumps need dividing every _____ years, after blooming season.

2. Primroses like most soils, but rich _____ is ideal.

3. The _____ is probably the best perennial for beginning gardeners.

4. Polyantha primroses will repeat bloom in fall if you _____ them back after spring bloom and give them a _____.

5. _____ is a favorite season for dividing and replanting as well as for planting newly purchased perennials.

Topic Test
on
BULBS

Student: _____ School: _____

Date: _____ Score: _____

Fill in the blanks:

1. The term _____ is one that is loosely applied to any plant that has a swollen or thickened basal portion.

2. A _____ is a creeping underground stem, often thick with stored food.

3. Bulblets grow larger each year until it is time to _____ and replant them.

4. In early spring, cool air and high humidity enables young plants to tolerate more _____.

5. In mild-winter regions, tulips will _____ if not dug.

Topic Test
on
CHARACTERISTICS, IDENTIFICATION AND USE OF IMPORTANT POT PLANTS

Student: _____ School: _____

Date: _____ Score: _____

PART I: Fill in the blanks:

1. The Azalea requires _____ or _____ as growing medium.

2. Rooted mum cuttings should be planted as _____ as possible.

3. Coleus root easily from _____.

4. The Poinsettia is a seasonal plant most popular at _____.

5. The best temperature to start Caladiums is _____.

PART II: Underline the most appropriate answer.

1. Exotic looking plant with showy spikes of blooms which may be attractive for several months. (a) Azalea (b) Bromeliad (c) Hydrangea (d) Poinsettia

2. Bright glossy leaves of many different colors on a single plant. (a) Croton (b) Azalea (c) Ficus (d) Sansevieria

3. Showy, velvety foliage plant with large bell-shaped blooms in assorted colors. (a) Geranium (b) Caladium (c) Gloxinia (d) Begonia

4. Flowers in hanging cattails up to a foot long of a deep red color. (a) Ferns (b) Hydrangea (c) Croton (d) Chenille

5. Most important tropical decorative plant family. (a) Philodendron (b) Dracaena (c) Devil's Ivy (d) Schefflera

Topic Test
on
POINSETTIAS

Student: _____ School: _____

Date: _____ Score: _____

TRUE or FALSE:

_____ 1. Poinsettia cuttings should be rooted under mist if possible.

_____ 2. Poinsettias should be staked.

_____ 3. Poinsettias are very sensitive to light, and great care needs to be taken not to light them accidentially.

_____ 4. The market acceptance for Poinsettias is excellent at Christmas.

_____ 5. The most common cause of lack of roots is poorly aerated soil.

Topic Test
on
CHRYSANTHEMUMS

Student: _____ School: _____

Date: _____ Score: _____

PART I: True or False:

_____ 1. The most popular color mum is yellow

_____ 2. The ideal night temperature for mum is 95°

_____ 3. The pot mum grower can keep diseases under control by using disease-free stock and doing a good job of sterilizing potting soil and handling equipment.

_____ 4. The grasshopper is the most persistent insect on mums.

PART II: Fill in the blanks:

1. The method of propagation for mums is by _____

2. The most persistent pests on mums are _____

3. Mums naturally bloom in the _____

4. The _____ began hybridizing varieties of mums more than 2,500 years ago.

Topic Test
on
GERANIUMS

Student: _____ School: _____

Date: _____ Score: _____

PART I: Place a check in the blank under T for true or F for false:

T	F	
____	____	1. Geraniums are not commonly grown from seed because the seed of the most desirable varieties are not available.
____	____	2. Geraniums are notoriously poor shippers.
____	____	3. Never pinch geraniums.
____	____	4. Blue is the color of geraniums most in demand.

PART II: Fill in the blanks:

1. Geraniums are _____ several weeks before the cutting harvest is to start.

2. _____ is the most popular color in geraniums.

3. _____ is the second most popular color in geraniums.

4. There are several serious diseases of geraniums, and some of these can be transmitted with the _____.

Topic Test
on
HYDRANGEAS

Student: _____ School: _____

Date: _____ Score: _____

Fill in the blanks:

1. The _____ is the most common insect enemy of the hydrangea.
2. Stem tip or leaf bud cuttings are made from _____ to _____.
3. The hydrangea is forced for _____ and _____.
4. _____ causes considerable damage during storage.
5. Hydrangeas are grown outdoors in the _____.

Topic Test
on
TURF GRASSES FOR TEXAS

Student: _____ School: _____

Date: _____ Score: _____

Place a check under T for True or under F for False for each of the following statements:

T	F	
_____	_____	1. Many of the 550 species of grass in Texas are suitable for turf.
_____	_____	2. Bermuda is the turf grass most widely adapted in Texas.
_____	_____	3. St. Augustine is not as cold hardy as Bermuda.
_____	_____	4. St. Augustine is susceptible to certain diseases, notably brown patch and leaf spot.
_____	_____	5. St. Augustine will not live in low, wet areas.

Topic Test
on
ESTABLISHING A NEW TURF

Student: _____ School: _____

Date: _____ Score: _____

Place a check under T for True or under F for False:

T	F	
____	____	1. In all instances, the character of the soil needs to be altered considerably.
____	____	2. Terraces should be avoided if possible because of the difficulty of establishing and maintaining turf on terraces.
____	____	3. A complete fertilizer should be plowed or spaded under to supply the plant nutrients needed for deep root development.
____	____	4. Low-priced seed often are the most costly.
____	____	5. Sprigging or sodding must be used for establishing grasses which cannot be propagated by seed.

Topic Test
on
MANAGING AN ESTABLISHED TURF

Student: _____ School: _____

Date: _____ Score: _____

PART I: Place a check under T for true or under F for false:

T	F	
____	____	1. Nitrogen is the key element in turf production.
____	____	2. Potassium deficiency causes the leaves to be an unhealthy dark green.
____	____	3. Iron chlorosis occurs on soils high in lime.
____	____	4. The root system develops during the fall and early spring.
____	____	5. Mowing too close encourages thinning of the turf.

PART II: Fill in the following blanks:

1. Four major factors in maintaining a turf are _____, _____, _____, and _____.
2. Calcium deficiency causes _____ growth.
3. Chlorosis may be corrected by applying _____ or _____.
4. A soil in good physical condition for plant growth is a mixture of _____, _____, and _____.
5. Aerifying the soil is a means of _____ the soil.

Topic Test
on
TURF PROBLEMS

Student: _____ School: _____

Date: _____ Score: _____

PART I: Place a check under T for true or under F for false:

T	F	
____	____	1. Proper turf grass management is the best means of controlling weeds.
____	____	2. Brownpatch is a fungus disease that attacks only St. Augustine grass.
____	____	3. Fungicides which contain PCNB are terraclor and captan.
____	____	4. If clovers are not removed from the lawn, they should be kept under control by frequent mowing.
____	____	5. Dusts generally are more effective in the control of chiggers than are sprays.

PART II. Fill in the following blanks:

1. Three good sprays for the chinch bug are _____, _____, and _____.

2. Two applications _____ days apart may be necessary for most effective control of bermuda grass mites.

3. Four problems which occasionally arise in the production of a turf are _____, _____, _____, and _____.

4. Brownpatch is a fungus disease that often attacks _____ and _____.

5. Brownpatch may be controlled by spraying the affected and immediate surrounding areas thoroughly with a fungicide containing _____.

Topic Test
on
CAUSES OF PLANT DISEASES

Student: _____ School: _____

Date: _____ Score: _____

Fill in the blanks:

1. The four most important causes of plant disease are _____, _____, _____, and _____.

2. An agent that transmits disease-producing organisms is called a _____.

3. _____ is the best approach to controlling canker disease.

4. A _____ is a plant on (in) which a parasite lives and obtains its food

5. The smallest form of a plant disease is the _____.

Topic Test
on
IDENTIFYING PLANT DISEASES

Student: _____ School: _____

Date: _____ Score: _____

Fill in the blanks:

1. The key to disease control is proper _____.

2. _____ is a rust-like disease lesion; a disease in which scab is a prominent symptom.

3. A _____ is an open wound or dead spot, often sunken, in a stem or branch surrounded by living tissue.

4. A _____ is an outgrowth, often more or less spherical, of organized cells.

5. Knots on roots usually indicate that _____ are present.

6. A _____ is a dried, shriveled fruit, caused by certain fungus diseases.

Topic Test
on
APPLICATION AND SAFETY PRECAUTIONS OF HORTICULTURAL CHEMICALS

Student: _____ School: _____

Date: _____ Score: _____

Fill in the blanks:

1. A _____ sprayer is one of the most common means of applying pest or disease control materials in the greenhouse.

2. Some chemicals kill only on _____, therefore the entire plant should be covered.

3. Always _____ the label before using a chemical.

4. Many of the control materials are _____ to human beings and they must be used in such a way that they do not endanger anyone.

5. For an aerosol application the pesticides are purchased in a ready-to-use container commonly called a _____.

Topic Test
on
CONTROLLING LEAF DISEASES

Student: _____ School: _____

Date: _____ Score: _____

Fill in the blanks:

1. _____ live on secretions from aphids and immature stages of the white fly and cause sooty mold.

2. Lack of _____ causes chlorosis.

3. Oedema is caused by excess _____ or _____.

4. _____ and _____ are two chemicals good for treating mosaic or leaf curl.

5. Proper _____ and _____ are the best treatments for scorch and scald.

Topic Test
on
CONTROLLING STEM, BRANCH, AND TRUNK DISEASES

Student: _____ School: _____

Date: _____ Score: _____

Fill in the blanks:

1. _____ and _____ cause lichens.

2. Plants that have gall are treated by _____.

3. Plants badly infected by dodder should be _____.

4. Plants that have _____ are treated by installing tubes in the infected parts of the tree to drain excess fluids and relieve pressure.

5. Two chemicals used to control green scurf are _____ and _____.

Topic Test
on
CONTROLLING ROOT DISEASES

Student: _____ School _____

Date: _____ Score _____

Fill in the blanks

1. A soil temperature of _____ to _____ degrees is necessary for development of southern blight.

2. _____ soil fumigation is an effective treatment for crown gall and hairy rot.

3. Mushroom root rot can be effectively controlled by fumigation with _____

4. Root knot is caused by _____

5. Always _____ the soil where damping-off and seedling blight are a problem.

Topic Test
on
CONTROLLING DISEASES AFFECTING THE ENTIRE PLANT

Student: _____ School: _____

Date: _____ Score: _____

Fill in the blanks:

1. _____ is an effective treatment for aster yellows.

2. _____ can be used to control verticillium wilt.

3. The _____ part of Texas is affected mostly by verticillium wilt.

4. _____ and CM-19 are both effective controls for botrytis blight.

5. The general name for a chemical used to combat mites is a _____.

Topic Test
on
CONTROLLING LAWN AND TURF DISEASES

Student: _____ School: _____

Date: _____ Score: _____

Fill in the blanks:

1. Lack of _____ causes chlorosis.

2. _____ and _____ are controls for Piricularia leaf spot.

3. For control of rust on bluegrass apply chemicals as _____ in early stages of disease.

4. The control of mushrooms is to _____ and destroy them.

5. The symptoms of fading out are _____ dead areas from a few inches to several feet in diameter.

Topic Test
on
IDENTIFYING PLANT AND SOIL INSECTS AND METHODS OF CONTROL

Student: _____ School: _____

Date: _____ Score: _____

Fill in the blanks:

1. _____ of plants are damaged by grubs.

2. _____ rolls into a ball when disturbed.

3. _____ are microscopic worms that attack roots and cause galls.

4. Leaf rollers are small _____ that wrap leaves around themselves for shelter and food.

5. Aphids are sometimes called _____.

6. _____ are small, attached insects covered with shells or armor that suck sap from the plant.

Topic Test
on
NEMATODES

Student: _____ School: _____

Date: _____ Score: _____

Fill in the blanks:

1. The _____ nematode is the most common type in Texas.

2. Tomatos and _____ are very good hosts for nematodes.

3. Before spending a large amount of money for chemicals, determine if nematodes are causing a significant amount of damage to justify the _____ and _____.

4. _____ and nitrogen nodules are often confused with knots caused by nematodes.

5. Nematode-affected plants have less ability to withstand lack of _____, lack of water, or any adverse condition.

Topic Test
on
CONTROL OF MOLES, GOPHERS, BIRDS, DEER, AND ANTS

Student: _____ School: _____

Date: _____ Score: _____

Fill in the blanks:

1. Conical mounds of dirt pushed up from their main run indicates the presence of _____.

2. _____ and _____ are the most effective means of destroying moles.

3. A bird that has no friends and should be eliminated is the _____.

4. _____ is the best long term control for deer.

5. Moles are unlike gophers because they have _____ tunnels.

Topic Test
on
CONTROLLING WEEDS

Student: _____ School: _____

Date: _____ Score: _____

Fill in the blanks:

1. _____ should be worn while mixing and applying chemical solution.

2. The _____ has been the gardener's most useful tool for over 4,000 years.

3. Peat moss and other organic mulches are applied to soil in weed control to cut off _____.

4. In areas where regrowth of persistent perennial weeds require frequent hoeing, use a recommended _____ weed killer.

5. _____ should be applied to the soil several days before trying to pull up weeds.

Topic Test
on
PRINCIPLES USED TO PREVENT PERSONAL INJURY

Student _____ School _____

Date _____ Score _____

Fill in the blanks:

1. The _____ should do the lifting when a person attempts to pick up a heavy object without using equipment.

2. One pulley only _____ direction of force.

3. A 1/2" pipe hooked onto a hose makes an effective device for _____ post holes.

4. A wall rack for lumber and pipe keeps the materials completely off the ground and away from _____ and _____

5. When you build rock walls and rock gardens, a _____ system suspended from a tripod is very helpful.

Topic Test
on
SELECTION AND MAINTENANCE OF HORTICULTURAL HAND TOOLS

Student: _____ School: _____

Date: _____ Score: _____

Fill in the blanks:

1. A _____ shovel is handy for moving sawdust, manure, and other light materials.

2. The scuffle hoe works best on packed, _____ ground.

3. The two most common shapes of lawn rakes are _____ and _____.

4. The most common hoes have a ____ inch blade.

5. The _____ _____ rake is a good tool for leveling soil or gravel and collecting earth clods.

Topic Test
on
MAINTAINING SMALL POWER EQUIPMENT

Student: _____ School: _____

Date: _____ Score: _____

Fill in the blanks:

1. _____ and _____ should be checked when inspecting a belt.

2. Regularly used equipment should always be checked by the _____.

3. Cover cutting surfaces with used _____ or _____ if a machine is to sit out in the weather for a long period of time.

4. _____ or other solvents may be used to clean an air filter.

5. _____ maintenance consists of periodic equipment inspection and upkeep.

Topic Test
on
OPERATING AND MAINTAINING LAWN MOWERS
SAFELY AND EFFECTIVELY

Student: _____ School: _____

Date: _____ Score: _____

1. The three main categories of power mowers are:

   a. _____

   b. _____

   c. _____

2. What is the general term used to describe the practice of mowing a lawn too close?

3. A sickle bar mower consists primarily of what two parts?

4. What part of plant produces food?

5. How can long clippings damage a lawn?

Topic Test
on
OPERATING ROTARY TILLERS SAFELY AND EFFECTIVELY

Student: _____ School _____

Date: _____ Score _____

Fill in the blanks

1. The part of a tiller that turns and actually does the digging is called the _____.

2. Normally, front tine tillers do not have _____ wheels.

3. If the front tine tiller must be held back to do a proper job of tilling, the _____ should be lowered to cause the tines to dig deeper.

4. _____ rotary tillers are designed for medium to heavy duty work and can thoroughly mix organic matter into the soil.

5. Before starting any tiller, check to see that all clutches or belt tension pulleys are _____.

Topic Test
on
OPERATING GARDEN TRACTORS SAFELY AND EFFECTIVELY

Student: _____ School: _____

Date: _____ Score: _____

Fill in the blanks:

1. The usual horsepower range for garden tractors is _____ to _____ H. P.

2. The two most popular garden tractor transmissions are the _____ type and the _____ type.

3. Extra pulleys may be mounted on either the gearbox shaft or the _____ to permit the use of implements requiring power.

4. Walking type tractors have had moderate improvements such as _____ _____.

Topic Test
on
INTRODUCTION TO HOME LANDSCAPING

Student: _____ School: _____

Date: _____ Score: _____

Fill in the blanks:

1. Gardens can no longer be entirely naturalistic because they do not fit into our _____ way of living

2. A good landscape development results only where plants and architectural materials are _____.

3. When landscape plans are obtained from a nursery without charge, they may be of little value or you may pay for them indirectly through the purchase of _____.

4. The word _____ refers to the entire property.

5. The main problems of designing or arranging elements on the land lie in properly organizing and using the available _____.

Topic Test
on
SELECTING A SITE

Student _____ School: _____

Date: _____ Score: _____

Fill in the blanks.

1. The _____ _____ of the homesite should be your first consideration.

2. Proper _____ will prevent intrustion of industry in residential sections.

3. If streets and sidewalks have not been paved or do not exist, part of the future cost will no doubt be borne by the _____.

4. _____ lots are often though preferable but they make privacy difficult.

5. A lot that is slightly above street level provides _____ and offers a good setting.

Topic Test
on
SCHEDULING LANDSCAPE DEVELOPMENT AND BEGINNING PLANS

Student: _____ School: _____

Date: _____ Score: _____

Fill in the blanks:

1. _____ and _____ are the most essential elements and you should construct them first.

2. _____ are important especially in Texas areas where shade is desirable.

3. Hedges, screens, walls, and fences provide _____ and assist in _____ control around the home.

4. Few gardens can be planned, constructed, and planted in one year without considerable _____.

5. _____ is the term used for a piece of real estate which may be merely a lot or one with a home on it.

Topic Test
on
ANALYZING PROBLEMS AND DETERMINING NEEDS

Student: _____ School: _____

Date: _____ Score: _____

Fill in the blanks:

1. _____ is largely a question of individual taste and past environment.

2. The basic step in the preparation of a program is to decide and analyze specific problems of a chosen _____.

3. The four basic considerations that should be included in successful landscape development are:

   a. _____

   b. _____

   c. _____

   d. _____

4. From an artistic standpoint, everything varies in _____, _____, and _____.

5. Good landscape development always results in an increase of _____ values.

Topic Test
on
DEVELOPING THE LANDSCAPE PLAN

Student: _____ School: _____

Date: _____ Score: _____

List:

1. Four main functions which homesites and farmsites must provide:

   a. _____

   b. _____

   c. _____

   d. _____

2. Six areas of Texas in which plants vary:

   a. _____

   b. _____

   c. _____

   d. _____

   e. _____

   f. _____

Topic Test
on
SELECTING PLANTS

Student: _____ School: _____

Date: _____ Score: _____

Fill in the blanks:

1. _____ and _____ flowering shrubs are not as permanent as woody plant materials and usually do not provide as good covering for garden areas.

2. Most native plants require little _____ or other care when they have become established after transplanting.

3. Plants from the Mediterranean regions and _____ often have similar cultural and moisture requirements to our native plants.

4. Large shrubs or small trees are _____ to _____ feet tall when full grown.

5. _____ shrubs attain a height of 6 to 8 feet at maturity.

Topic Test
on
GRADING, DRAINAGE, AND LANDSCAPE STRUCTURES

Student: _____ School: _____

Date: _____ Score: _____

Place a check under T for true or under F for false for each of the following statements:

T	F	
____	____	1. The minimum width for an entrance sidewalk is eight feet.
____	____	2. Walks should always be as direct as possible.
____	____	3. Landscape planners with a minimum of design experience should avoid curved walks.
____	____	4. The use of splash blocks is the most desirable method of preventing downspouts from eroding soil.
____	____	5. Lowering the grade around existing trees does not disturb their normal functioning nearly so much as does filling.

Topic Test
on
DEVELOPING PERSONAL TRAITS

Student: _____ School: _____

Date: _____ Score: _____

1. What are the three basic ingredients of a salesman?

   a. _____

   b. _____

   c. _____

2. What are two ways in which good habits pay off?

   a. _____

   b. _____

3. What are the best two ways to learn selling?

   a. _____

   b. _____

4. How can a person become a "scientific salesman"?

5. What is required for a would-be salesman to become a tough, aggressive, and effective salesman?

   a. _____

   b. _____

Topic Test
on
DISPLAYING

Student: _____ School: _____

Date: _____ Score: _____

Fill in the blanks:

1. _____ displays are designed to stop the customer and bring him into the store.

2. _____ attracts attention and gives the impression of demand.

3. Each table and shelf should have a _____ to the others.

4. Special racks, tri-plane and peg board tables are excellent for displaying _____ items and other small competitive items.

5. _____ displays are more successful when used for familiar products.

Topic Test
on
ADVERTISING

Student: _____ School: _____

Date: _____ Score: _____

PART I: Fill in the blanks:

1. _____ advertising consists of displays within the place of business.

2. _____ buying results in millions of dollars' worth of sales annually, as the growth of supermarkets shows.

3. _____ advertising is high in cost but is effective because the product can be demonstrated.

PART II: List:

1. Three factors to consider when selecting an advertising medium are:

   a. _____

   b. _____

   c. _____

2. Three methods of "outside of the store" advertising are:

   a. _____

   b. _____

   c. _____

Topic Test
on
LABELING AND PRICING

Student: _____ School: _____

Date: _____ Score: _____

Problem:

What would be the percent mark-up of a plant if the production cost was $1.00 and selling price was $2.00?

Work:

Answer: _____

Topic Test
on
UNDERSTANDING THE CUSTOMER AND MAKING SALES

Student: _____ School: _____

Date: _____ Score: _____

Fill in the blanks:

1. The first problem of a salesman is getting the _____ of the customer.

2. A dangerous practice that many salesmen fall into is trying to arouse interest by overstressing _____.

3. _____ percent of all salesmen quit cold after a single call on a prospect.

4. "_____ is a luxury no salesman can afford."

5. The surest and quickest way to lose a sale is to _____ _____.

Answer Sheet for Test
on
HORTICULTURE AS AN INDUSTRY

True or False:

1 False
2 True
3 True
4 False
5 False
6 False
7 False
8 True
9 True
10 False

Answer Sheet for Test
on
EXPLORING OCCUPATIONAL OPPORTUNITIES

1. Refer to the 18 factors listed in the information sheet. The student should have listed at least 10 factors, in his own words, which should be considered when evaluating the desirability of an occupation.

2. a Greenhouse Worker
   b Nursery Worker
   c Garden Center Employee
   d Assistant Groundskeeper
   e Parks and Landscape Employee

Answer Sheet for Test
on
INTRODUCTION

1. Botany
2. 350,000
3. Sugars, starches
4. Water
5. Carbon dioxide and water

Answer Sheet for Test
on
PHOTOSYNTHESIS

1. Diffusion
2. Phot
3. Atoms
4. (In any order)
   a. Carbon Dioxide
   b. Water
   c. Chlorophyll
   d. Light
5. Molecule

Answer Sheet for Test
on
RESPIRATION

1. Food, oxygen
2. Stored
3. Decreases
4. Carbon dioxide
5. Respiration

Answer Sheet for Test
on
WATER ABSORPTION AND LOSS--NUTRIENT ABSORPTION--
MOVEMENT OF WATER AND NUTRIENTS IN THE PLANT

1. Nutrients
2. Xylem, phloem
3. Bleeding
4. Transpiration
5. Root hair

Answer Sheet for Test
on
PLANT FOOD

1. Cellulose
2. Fat
3. Protein
4. a. Carbon
   b. Hydrogen
   c. Oxygen
   d. Nitrogen
5. Essential

Answer Sheet for Test
on
THE PLANT KINGDOM

1. Thallus
2. Flowering parts
3. Beneficial
4. Algae
5. Four

Answer Sheet for Test
on
TYPES OF GREENHOUSES

Fill in the blanks:

1. Exhaust fans

2. Fall

3. Humidity, oxygen

True or False:

1. True

2. False - It needs to be painted about every two years.

3. False - It is difficult to prevent dripping in houses constructed from film plastic.

Answer Sheet for Test
on
SIZE AND ARRANGEMENT OF GREENHOUSES

1. False - 6 inches

2. True

3. True

4. False - Wood expands when wet.

5. True

Answer Sheet for Test
on
COOLING THE GREENHOUSE

1. 4000 sq. ft. (100' x 40')

2. 7000 sq. ft. (1000 sq. ft. x 7 CFM)

3. 50 sq. ft. (one square foot of padded area needed for each 150 CFM)
$\left(\frac{\text{7500 CFM required}}{\text{150 CFM}}\right)$

Answer Sheet for Test
on
HEATING THE GREENHOUSE

1. True

2. True

3. False

4. True

5. True

Answer Sheet for Test
on
WINTER PROTECTION STRUCTURES

1. Hillside

2. North

3. Damp

4. Damp, dry

5. Cloches

Answer Sheet for Test
on
STRUCTURES FOR SUMMER HEAT PROTECTION

1. North, south

2. Shade

3. 10

4. Shade

5. East

Answer Sheet to Test
on
HUMIDITY AND WATERING

1. True
2. False
3. True
4. False
5. False

Answer Sheet to Test
on
VENTILATION

1. False
2. True
3. True
4. True
5. True

Answer Sheet to Test
on
LIGHTING

1. True
2. True
3. False
4. False
5. True

Answer Sheet for Test
on
WIRING AND ELECTRICAL CONTROLS

1. a. Safe
   b. Adequate
   c. Expandable

2. Safety

3. Eight

4. One-half

5. No. 14

Answer Sheet for Test
on
ORIGIN, COMPOSITION, AND IMPORTANCE OF SOILS

PART I:

1. Sand
2. Organic matter
3. Temperature and rainfall
4. Flour
5. Particles

PART II:

1. a. Topsoil
   b. Subsoil
   c. Parent layer

2. a. Different amounts of air present when soil is formed
   b. Different amounts of organic matter
   c. Different rocks from which soil is formed

Answer Sheet for Test
on
SOIL MOISTURE

PART I:

1. Capillary
2. Fine
3. Evaporates
4. Respiration
5. Aeration

PART II:

1. False - This would tear down structure.
2. True - By adding organic matter
3. False - Overwatering does this.
4. True
5. True

Answer Sheet for Test
on
SOIL MIXTURES

1. Loam
2. Organic matter
3. Sticky
4. Shredder
5. Shrink

List:

a. Uniformity
b. Disease free
c. Low soluble salts
d. Good drainage
e. Good moisture retention
f. No shrinkage
g. Ease of preparation and storage
h. Complete availability

Answer Sheet for Test
on
MULCHES AND THEIR USE

PART I:

1. Peat moss
2. Mid-spring
3. Nitrogen
4. Heat
5. Asphalt

PART II:

1. b
2. c
3. c

Answer Sheet for Test on FERTILIZER NUTRIENTS

1. Nitrogen
2. Calcium
3. Wet
4. Below
5. Broadcast

List:

1. a. Nitrogen
   b. Phosphorus
   c. Potassium
2. a. Calcium
   b. Magnesium
   c. Sulfur

Answer Sheet for Test on SOIL ORGANISMS

1. Bacteria
2. Organic matter
3. Protozoa
4. Fungi
5. Earthworm

List:

6. a. Soil sterilization with steam
   b. Soil fumigation or drenching with chemicals
   c. Seed treatment

Answer Sheet for Test on SOIL STERILIZATION

PART I:

1. Steam
2. Nematodes
3. Two to three weeks
4. Root burn
5. Instantly

PART II:

1. a. To kill soil-borne insects
   b. To kill harmful bacteria, fungus
   c. To destroy weeds
   d. Promote soil granulation

2. a. Avoid inhaling the material.
   b. Avoid contact of fumigant with skin.
   c. Allow enough time for aeration after material is applied.

Answer Sheet for Test on PLANT GROWING MEDIA OTHER THAN SOIL

1. Sand
2. 10 to 20
3. Vermiculite
4. Southern
5. Nitrogen
6. Acid
7. Peat

Answer Sheet for Test
on
INTRODUCTION TO PROPAGATION

PART I:

1. Sexual or asexual
2. Ventilation, temperature, shade, and light
3. Methyl bromide
4. Seeds, nematodes, and disease organisms
5. Clay pots, peat pots, and plant bands

PART II:

1. True
2. False
3. True

Answer Sheet for Test
on
PROPAGATION FROM CUTTINGS

PART I:

1. True
2. False
3. True
4. False
5. False

PART II:

1. 70-75 degrees
2. a. One which can be kept uniformly moist
   b. Provide good drainage
   c. Aeration
3. When roots are 1/2 to 1 inch long
4. From new growth in spring or early summer
5. Soggy

Answer Sheet for Test
on
PROPAGATION BY LAYERING

PART I

1 False

2 True

3 True

4 True

5 False

PART II

1 a Croton
b Hibiscus
c Dracaenas
d Rubber plants

Answer Sheet for Test
on
PROPAGATION BY DIVISION

1. True
2. True
3. True
4. False
5. True

Answer Sheet for Test
on
PROPAGATION BY GRAFTING AND BUDDING

PART I:

1. Stock is the name for the plant onto which you graft.

2. The cambium layer is the soft layer of tissue on a stem or root that lies between the bark and the wood.

3. "T" budding and patch-budding

PART II:

1. True

2. True

Answer Sheet for Test
on
PROPAGATION FROM SEEDS

PART I:

1. True

2. False

3. False

PART II:

1. Sphagnum moss
2. Flat 2" x 4" board or brick
3. Sand or other inert material
4. a. Name of plant or variety
   b. Date seeded
   c. Student's name
   d. Special treatment, if any

Answer Sheet for Test
on
DEVELOPING A PLANT BREEDING VOCABULARY

1. Anther

2. Disc floret

3. Gene

4. Ovary

5. Ray floret

Answer Sheet for Test on PLANT SELECTION AND FUNDAMENTALS OF PLANT BREEDING

PART I:

1. Pollination
2. Fertilization
3. Stamen, pistil or male and female parts
4. Sepals

PART II:

1. Anther
2. Filament
3. Petal
4. Sepal
5. Stigma
6. Style
7. Ovary
8. Ovule

Answer Sheet for Test on HEREDITY

1. True
2. Segregation
3. Mauve
4. Pure lines
5. Ovule, trait

Answer Sheet for Test
on
GENERAL BREEDING TECHNIQUES

1. True

2. False

3. True

4. True

5. False

Answer Sheet for Test
on
TRANSPLANTING ORNAMENTAL TREES AND SHRUBS

1. One to two feet wider, six inches to one foot deeper

2. Same level

3. One-third

4. Five inches or over in diameter

5. Balled and burlapped

Answer Sheet for Test
on
CARE AND MAINTENANCE OF PLANTS

PART I:

1. True
2. False
3. True
4. False
5. True

PART II:

1. Growth habit, blooming characteristics
2. Bareroot
3. Leaf drop, first spring growth
4. Thinning out
5. Better shape, fruitful growth

Answer Sheet for Test
on
INTRODUCTION TO FLORAL CROP PRODUCTION

1. Carnations
2. Floriculture
3. Light
4. Commission
5. Beltsville

Answer Sheet for Test
on
GROWING ANNUALS

1. True
2. False
3. False
4. True
5. True
6. True
7. True
8. True
9. True
10. False

Answer Sheet for Test
on
PERENNIALS

1. Two

2. Loam

3. Chrysanthemum

4. a. Cut
   b. Feeding

5. Fall

Answer Sheet for Test
on
BULBS

1. Bulb

2. Rhizome

3. Divide

4. Sun

5. Rot

Answer Sheet for Test
on
CHARACTERISTICS, IDENTIFICATION, AND
USE OF IMPORTANT POT PLANTS

PART I:

1. Acid soil or peat moss
2. Shallow
3. Cuttings
4. Christmas
5. 80-85 degrees

PART II:

1. (b)
2. (a)
3. (c)
4. (d)
5. (a)

Answer Sheet for Test
on
POINSETTIAS

1. True
2. True
3. True
4. True
5. True

Answer Sheet for Test on CHRYSANTHEMUMS

PART I:

1. True
2. False
3. True
4. False

PART II:

1. Rooted cuttings or cuttings
2. Aphids
3. Fall
4. Chinese

Answer Sheet for Test on GERANIUMS

PART I:

1. True
2. True
3. False
4. False

PART II:

1. Pinched
2. Red
3. Light pink
4. Cuttings

Answer Sheet for Test
on
HYDRANGEAS

1. Two spotted mite or red spider

2. March, May

3. Easter, Mother's Day

4. Bud rot

5. Summer

Answer Sheet for Test
on
TURF GRASSES FOR TEXAS

1. False

2. True

3. True

4. True

5. True

Answer Sheet for Test
on
ESTABLISHING A NEW TURF

1. False
2. True
3. True
4. True
5. True

Answer Sheet for Test
on
MANAGING AN ESTABLISHED TURF

PART I:

1. True
2. False
3. True
4. True
5. True

PART II:

1. Feeding, watering, aerating, and mowing
2. Stunted
3. Iron sulfate or iron chelate
4. Soil solids, water, and air
5. Loosening

Answer Sheet for Test
on
TURF PROBLEMS

PART I:

1. True
2. False
3. False
4. True
5. False

PART II:

1. Diazinon, Ethion, Trithion
2. 10-14 days
3. a. Weeds
   b. Diseases
   c. Insects
   d. Clover
4. St. Augustine and bermuda grass
5. PCNB

Answer Sheet for Test
on
CAUSES OF PLANT DISEASES

1. Fungi, bacteria, viruses, nematodes
2. Vector
3. Prevention by careful pruning
4. Host
5. Virus

Answer Sheet for Test
on
IDENTIFYING PLANT DISEASES

1. Identification
2. Scab
3. Canker
4. Gall
5. Nematodes
6. Mummy

Answer Sheet for Test
on
APPLICATION AND SAFETY PRECAUTIONS
OF HORTICULTURAL CHEMICALS

1. Hydraulic
2. Contact
3. Read
4. Toxic or poisonous
5. Bomb

Answer Sheet for Test
on
CONTROLLING LEAF DISEASES

1. Fungi
2. Iron
3. Rain or overwatering
4. Malathion and Lindane
5. Watering and fertilization

Answer Sheet for Test
on
CONTROLLING STEM, BRANCH, AND TRUNK DISEASES

1. Fungi and algae
2. Pruning
3. Destroyed
4. Slime flux
5. 50% fixed copper and Bordeaux mixture

Answer Sheet for Test
on
CONTROLLING ROOT DISEASES

1. 75 - 95 degrees
2. Methyl bromide
3. Carbon bisulfide
4. Nematodes
5. Sterilize

Answer Sheet for Test
on
CONTROLLING DISEASES AFFECTING THE ENTIRE PLANT

1. DDT
2. Chloropicrin
3. Western
4. Zineb
5. Miticide

Answer Sheet for Test
on
CONTROLLING LAWN AND TURF DISEASES

1. Iron

2. Zineb, Captan

3. Needed

4. Handpick

5. Irregular-shaped

Answer Sheet for Test
on
IDENTIFYING PLANT AND SOIL INSECTS AND METHODS OF CONTROL

1. Roots

2. Pillbug

3. Nematodes

4. Caterpillars

5. Plant lice

6. Scales

Answer Sheet for Test
on
NEMATODES

1. Knot root

2. Okra

3. a. Expense
   b. Labor

4. Crown galls

5. Fertilizer

Answer Sheet for Test
on
CONTROL OF MOLES, GOPHERS, BIRDS, DEER, AND ANTS

1. Mole

2. Baiting
   Trapping

3. Starling

4. Fencing

5. Closed

Answer Sheet for Test
on
CONTROLLING WEEDS

1. Gloves

2. Hoe

3. Sunlight

4. Chemical

5. Water

Answer Sheet for Test
on
PRINCIPLES USED TO PREVENT PERSONAL INJURY

1. Legs

2. Changes

3. Blasting

4. Moisture, insects

5. Pulley

Answer Sheet for Test
on
SELECTION AND MAINTENANCE OF HORTICULTURAL HAND TOOLS

1. Scoop

2. Level

3. Fan-shaped and rectangular

4. 6"

5. Metal bow

Answer Sheet for Test
on
MAINTAINING SMALL POWER EQUIPMENT

1. Tension, wear

2. Operator

3 Grease, oil

4. Gasoline

5. Preventive

Answer Sheet for Test
on
OPERATING AND MAINTAINING LAWN MOWERS SAFELY AND EFFECTIVELY

1. a. Reel
   b. Rotary
   c. Sickle bar

2. Scalping

3. Cutter bar and knife

4. Leaves

5. Smothers the grass

Answer Sheet for Test
on
OPERATING ROTARY TILLERS SAFELY AND EFFECTIVELY

1. Tine

2. Power

3. Depth bar

4. Rear tine

5. Disengaged

Answer Sheet for Test
on
OPERATING GARDEN TRACTORS SAFELY AND EFFECTIVELY

1. 3 1/2 - 10

2. Belt, automotive

3. Jackshaft

4. Rubber tires

Answer Sheet for Test
on
INTRODUCTION TO HOME LANDSCAPING

1. Mechanized

2. Balanced

3. Plants

4. Garden

5. Space

Answer Sheet for Test
on
SELECTING A SITE

1. General location

2. Zoning

3. Homeowner

4. Corner

5. Drainage

Answer Sheet for Test
on
SCHEDULING LANDSCAPE DEVELOPMENT AND BEGINNING PLANS

1. Walks, drives

2. Trees

3. Privacy, temperature

4. Expense

5. Site

Answer Sheet for Test
on
ANALYZING PROBLEMS AND DETERMINING NEEDS

1. Beauty

2. Site

3. a. Suitability
   b. Function
   c. Economy
   d. Beauty

4. Mass, color, texture

5. Property

Answer Sheet for Test
on
DEVELOPING THE LANDSCAPE PLAN

1. a. Access to property
   b. General living area
   c. Work space
   d. Place for private living

2. a. East Texas
   b. Coastal Plains
   c. Central Texas
   d. Texas Plains
   e. Southwest Texas
   f. Western Texas

Answer Sheet for Test
on
SELECTING PLANTS

1. Annual, perennial
2. Watering
3. Australia
4. 12, 25
5. Medium

Answer Sheet for Test
on
GRADING, DRAINAGE, AND LANDSCAPE STRUCTURES

1. False
2. False
3. True
4. False
5. True

Answer Sheet for Test
on
DEVELOPING PERSONAL TRAITS

1. a. Knowledge of self
   b. Knowledge of people
   c. Knowledge or product

2. a. Promotions
   b. Dollars (profits)

3. a. Experience (learn by doing)
   b. Observing others

4. Analyze each sale or failure

5. a. Diligence
   b. Perseverance

Answer Sheet for Test
on
DISPLAYING

1. Floor window

2. Bulk

3. Relationship

4. Impulse

5. Bin

Answer Sheet for Test on ADVERTISING

PART I:

1. Point of sale
2. Impulse
3. T. V.

PART II:

1. a. Effectiveness
   b. Cost
   c. Coverage
2. Any three of these:
   a. Newspaper
   b. Television
   c. Radio
   d. Handbills
   e. Direct mail
   f. Road signs

Answer Sheet for Test on LABELING AND PRICING

Work:

To the teacher: Mark-up is based on selling price. In other words, $1.00 is 50% of $2.00. Therefore, the percent mark-up is 50%.

Answer: 50%

Answer Sheet for Test
on
UNDERSTANDING THE CUSTOMER AND MAKING SALES

1. Attention

2. Price

3. 48

4. Discouragement

5. Misrepresent the facts

1140
VT 01140

AGRICULTURAL EDUCATION

Agricultural Cooperative Training

VOCATIONAL AGRICULTURE

ED013339

910: Agricultural Machinery - Power

Teachers Copy

CLASS

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Teaching materials for Agricultural Cooperative Training in the agricultural machinery occupations have been prepared largely by Mr. Benny Mac Venable, Vocational Agriculture Teacher, Judson High School, Converse, Texas and Mr. Durwin Hill, Vocational Agriculture Teacher, Graham, Texas.

These teachers developed this material during a four-week period at the Center during the summer of 1966.

Some units were developed by the Agricultural Education Department of Texas Technological College, Lubbock, Texas.

A Suggested Basic Course Outline for Agricultural Machinery Service and Repair, Texas Education Agency (1966), was utilized as an outline for the units and the topics developed.

J. B. Payne
Farm Mechanics Specialist

MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
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(Address) Texas A&M University, College Station, Texas 77843

DATE: June 28, 1967

RE: (Author, Title, Publisher, Date) Benny Mac Venable, Vocational Agriculture Teacher, Converse, Texas and Mr. Durwin Hill, Vocational Agriculture Teacher, Graham, Texas. Title: Agricultural Machinery - Power

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Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Introduction

TOPIC: Orientation

OBJECTIVE: To develop an understanding of the importance of the retail agricultural machinery industry and study the organization and management of agricultural machinery dealership.

REFERENCES: Required:

1. Information Sheet

Supplemental:

2. Farm and Power Equipment Retailers Handbook, National Farm and Power Equipment Dealers Association, 2340 Hampton Avenue, St. Louis, Missouri 63139, pp. 1-7.

QUESTIONS or ACTIVITIES:

1. What does a machinery dealer expect of his employees?
2. How has agricultural machinery dealers been of assistance to farmers?
3. Has the decrease in the number of farm workers resulted in a decrease in production?
4. Fifty years ago one farmer could produce food and fiber for six other persons. What can that same farmer do today?
5. How has farm machinery help raise the standard of living of the farmer?

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Information Sheet
on
ORIENTATION

A person planning to work in the service occupations of an agricultural machinery dealership must understand the organization and management of the dealership if he is to be effective as a service employee. He must understand (1) the importance of the local dealership and the agricultural machinery industry to the agricultural industry of the community, nation, and world, (2) the relationship of the local dealership to the farmer and the parent organization, (3) the ways the local dealership carries out its business, (4) the jobs and job functions of employees in the local dealership, and (5) show the relationship of farming to merchandise handled by the dealership. A local agricultural machinery dealer expects his employees to be able to do their jobs with a high degree of speed and efficiency. In order to meet these expectations, the employees must have a thorough knowledge of the complete operation of the business.

Agricultural machinery dealers have played a vital role in the social and economic life of those engaged in production agriculture as well as the standard of living of all people.

1. They have provided the farmer with efficient and economic production tools.

2. Modern agricultural machinery has lowered the costs of production for the farmer. The following table bears out this fact.

Farm Output and Labor and Machinery Inputs
Index 1947-49 = 100

(Indices)

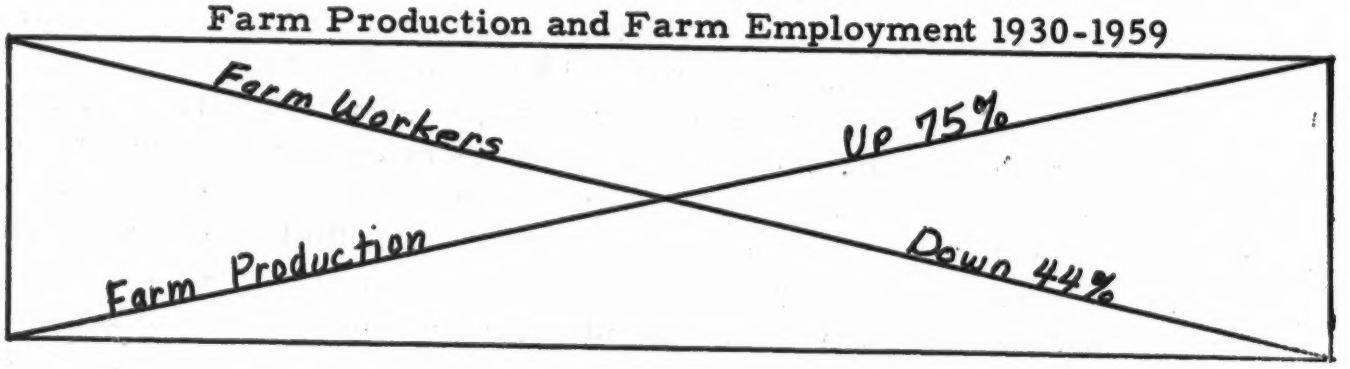
Year	Farm Output	Farm Labor	Power and Machinery	Labor Plus Machinery	Relation of Combined Labor and Machinery Inputs to Output
1910	61	135	28	163	133
1920	70	143	44	187	133
1930	72	137	55	192	133
1940	82	122	58	180	110
1950	101	90	118	208	103
1955	113	76	136	212	94
1956	114	72	137	209	92
1957	114	68	138	206	93
1958	124	66	137	203	84
1959	126	64	139	203	81

Orientation
(Information Sheet continued)

The use of agricultural machinery has promoted an increase in farm production and income in spite of a decrease in the number of persons employed on the farm.

1. While farm workers have decreased in number, farm production has increased.

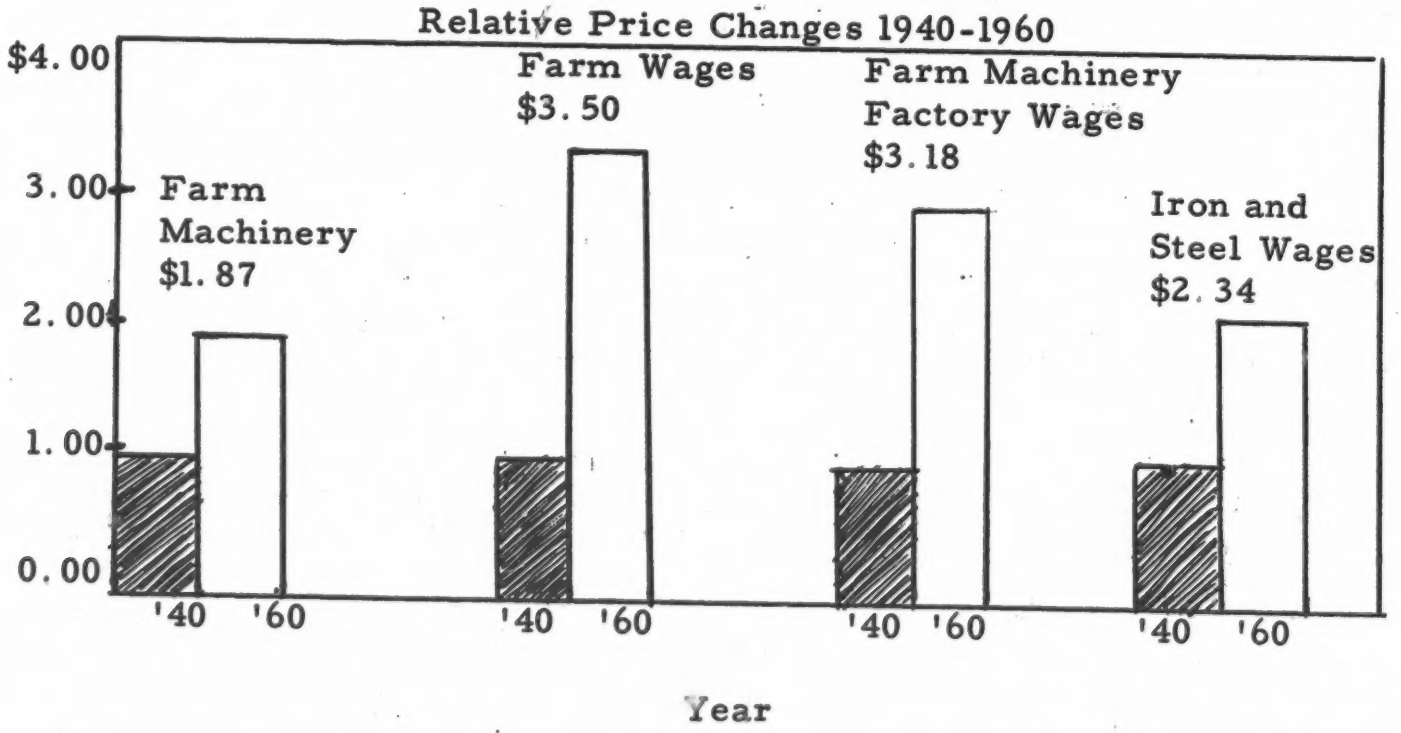
Farm Production and Farm Employment 1930-1959



2. The agricultural machinery industry has managed to keep its price rise on production costs relatively low.

Price
Change

Relative Price Changes 1940-1960



3. Fifty years ago one farmer could produce food and fiber for six other persons, whereas today, that same man can produce food and fiber for at least 29 others.

4. Today, 40 percent of the farms produce 87 per cent of the food and fiber sold from the farms.

The use of modern agricultural machinery has aided in raising the standard of living of the farmers.

1. Today farmers have more time for recreation, more conveniences, better educational advantages and improved facilities.

2. The investment in agricultural machinery is highest on farms in states having the highest standard of living.

3. The development and use of labor saving machines have made it possible for millions of farm workers to enter other industries, the arts, sciences, and professions.

****

Materials for this Information Sheet was taken from Organization and Management of Machinery Dealerships, The Center for Research and Leadership Development in Vocational and Technical Education, The Ohio State University, 1965

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Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Introduction

TOPIC: Orientation

OBJECTIVES: To understand the methods of distributing agricultural machinery.

REFERENCES: Required:

1. Information Sheet, "Orientation"

Supplemental:

2. Farm and Power Equipment Retailers Handbook NFPED Association, pp. 7-21

QUESTIONS or ACTIVITIES:

1. How does agricultural machinery get from the manufacturer to the farmer?
2. Who designs new machines?
3. How are parts supplied to the dealer?
4. Who sells agricultural machinery to the farmer?
5. Who is responsible for storage of the equipment?

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Information Sheet on ORIENTATION

The distribution of agricultural machinery follows this route: from manufacturer-to branch house - to dealers - to customers. All orders for machines by the local dealership are placed with the branch house.

The above pattern of distribution accounts for practically the entire output of domestic sales of tractors and other agricultural machinery.

The primary function of the manufacturer is to supply the agricultural machinery needed by the agricultural industry.

1. Manufacturers employ competent product engineers to design the new machines needed by the agricultural industry.

2. Manufacturers supply the branch houses with the parts and some machines to supply their dealers.

In addition to performing these functions, the manufacturer does the following:

1. Keeps in touch with machinery problems and needs of farmers

2. Through research, develops machines and systems to meet the needs of the farmer

The function of the branch house is to move the machinery from the factories to the farms in the most economical manner.

1. The branch house provides storage for the manufacturer.

2. The task of sales and distribution for the manufacturer is undertaken by the branch house.

3. Through this medium, the manufacturer gets national distribution more quickly and more thoroughly.

4. Retail dealers get more prompt and reliable service.

5. As the manufacturer's distributive agent, the branch house keeps the manufacturer advised on market conditions and needs of a particular area.

Orientation
(Information Sheet continued)

6. The branch office lowers substantially the manufacturer's handling cost of agricultural machinery and ultimately the farmers' purchasing costs.

7. The branch house buys parts in large quantities, relieving the manufacturers of the details of selling, warehousing, shipping of merchandise to individual dealers, and carrying of dealer accounts.

8. The branch house carries adequate stocks of repair parts at strategic locations, resulting in better service to the dealer, and thus the customer.

The distributor (branch house) builds a good dealer's organization and confines all his efforts to selling through dealers.

1. The distributors organization includes a service department with personnel who thoroughly understand the servicing of each machine handled.

2. A well developed program of selling is maintained by the distributor who aids the dealer in realizing a greater profit through better service to the customer.

The local agricultural machinery dealer is the vital link in this distribution pattern.

1. The dealer is the final link between the manufacturer and the user of the machine.

2. The dealer contributes greatly to the farmer's knowledge of machinery servicing.

3. He demonstrates the efficiency of the company machines to the farmer and explains how the machine can benefit the farmer.

4. He extends credit in many cases to the farmer so the machine can pay for itself in labor saved or money earned.

5. The dealer makes an effort to understand farm machinery problems and the need of the farmer and conveys these needs back to the manufacturer to provide a basis for improvement of farm machines through research.

Organizational Structure of a Local Agricultural Machinery Dealership

Agricultural Machinery Dealer

Ag. Machinery Assistant Manager

Sales

- Ag. Machinery Sales Supervisor
- Ag. Machinery Salesman

Clerical

- Ag. Machinery Office Supervisor
- Ag. Machinery Bookkeeper

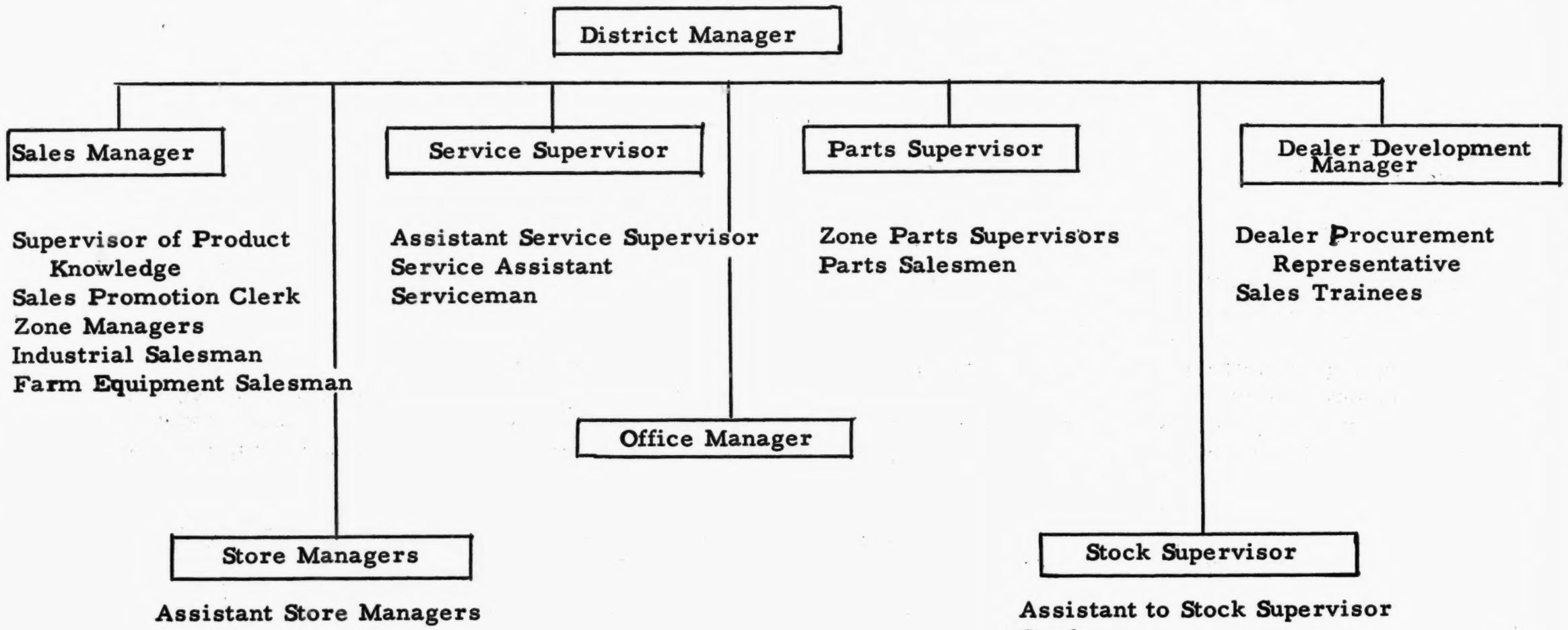
Parts

- Ag. Machinery Parts Supervisor
- Ag. Machinery Parts Man

Service

- Ag. Machinery Service Supervisor
- Ag. Machinery Mechanic
- Ag. Machinery Mechanic's Helper
- Ag. Machinery Set-Up Man
- Ag. Machinery Deliveryman

An Example of the Organizational Structure of a Major Line Agricultural Machinery Branch House



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Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Introduction

TOPIC: General Shop Safety

OBJECTIVE: To develop an understanding of the importance of developing proper safety habits.

REFERENCES: Required:

1. Information Sheet, "General Shop Safety"

Supplemental:

2. Automotive Mechanics, Crouse, pp. 29-30and 425

3. Automechanics, Glenn, Chapter 18

QUESTIONS or ACTIVITIES:

1. Why is the proper attitude so important in the shop?
2. Why is visiting a bad practice in the shop?
3. Why should you avoid horse play in the shop?
4. What should you do after handling acids or batteries?
5. How should heavy objects be lifted?

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Information Sheet
on
GENERAL SAFETY PRACTICES

The practice of safety in the shop goes beyond the knowledge of the proper use of hand tools and equipment. A most important consideration is your attitude. You must understand the hazards of the job you are about to undertake and must appreciate the need for applying such safety practices that will protect you from injury. Awareness of personal safety comes only through an understanding of the dangers which are present. Most accidents are caused by thoughtlessness, so you must be on guard at all times.

It is most important to give the job your undivided attention. "Visiting" is not permitted because it distracts you and may lead to an accident.

Horseplay, scuffling, punching, or playing pranks is dangerous. Some boys cannot pass by without striking a classmate, and the immediate response is to strike back. In no time at all both boys are scuffling. This childish action may result in a fall or possible injury from sharp tools, steel benches, and heavy equipment which are always present in a shop. Keep such physical activity for the athletic field where it is an approved activity.

Walk-avoid running! A running person cannot always keep from slipping with the possibility of serious injury. Bumping the operator of a machine might cause him to have an accident which would be your fault. Cultivate personal caution at all times. A cautious person is one who knows and observes safe procedures. Learn that caution and foresight pay off. A person who has learned to cultivate personal caution has trained himself to visualize the results of his actions.

Make it a habit to remove any article lying on the floor before someone trips over it. Learn to recognize unsafe conditions. In doing so you are protecting yourself and fellow workers. Get into the habit of removing sharp pointed tools from bench edges where you, or someone else going by, may get hurt-this is an application of personal caution. Store sharp-edged tools in racks and not in drawers where someone could cut himself when picking up other implements.

A protruding nail is an invitation to a first-aid station; either hammer it down or pull it out. Remove any splinters from boxes or pieces of wood which could puncture your skin.

Scraps of sharp metal on the floor could pierce someone's shoe, causing a serious wound-pick them up and place them in the scrap box.

General Safety Practices
(Information Sheet continued)

Wipe spilled oil or grease off the floor-even though you did not spill it. Preventable falls send far too many people to the hospital.

Report any injury to your instructor immediately. No matter how small the injury-report it! It is far better to waste antiseptic than to ignore one small wound.

If something gets into your eye, it is dangerous to rub it. Instead report to your instructor immediately.

Be sure to wash your hands after handling caustics, acids, or batteries to avoid getting chemicals on your skin and into your eyes.

Asking for help when lifting a heavy object is a sign of mental strength, not weakness. Many serious injuries are caused by lifting improperly, lifting objects too heavy for one man, or lifting unwieldy shapes. More than 25% of all disabilities are caused by the improper handling of materials. This is the largest single cause of disability from all accidents. Sprains, strains, and hernias-the results of improper lifting-are painful and disabling.

When lifting a heavy object, place your feet close to the object for proper balance. Keep your elbows as straight as possible and bend the knees while gripping. Use your large leg muscles to lift-not the back muscles. Keep your back straight. When lifting a heavy object with the help of others, be sure that a signal is given by one of the team so that excess strain is not placed on any one member of the group. Teamwork accomplishes much more than individual effort.

Carry all objects in such a manner that you can see clearly where you are going. Long objects should be carried by two people to protect others.

Power tools are provided with guards to prevent accidents. They are placed there for your protection. Be sure to call the instructor's attention to any loose or missing guard.

Wearing the proper clothing is very important when working in the shop. Each shop requires a specialized protective garment depending on the nature of the work. Some shopwork demands additional temporary protection when doing special jobs. This may take the form of goggles and gloves when welding; goggles or face shield for grinding; or a rubber mat when working around live electrical circuits.

Gloves should be worn when handling hot objects, especially when welding.

General Safety Practices
(Information Sheet continued)

The hand tool is still very important, despite the development of complex machine tools. Everyone has need for hand tools, but not everyone knows how to use or care for them properly. A recent study of shop accidents showed that 66% of all injuries in one year were caused by misuse of the common hand tool. Most hand tool accidents are caused by (1) improper storage, (2) failure to keep the tool in good condition, (3) using the tool improperly, and (4) failure to use the right tool for the job.

Hand tools should be stored in a tool rack which has a place for each tool; they should not be stored in drawers or boxes. Tools should be cleaned frequently and stored in a dry place to prevent rusting. A light coating of oil will keep them bright under adverse conditions.

Wrenches are designed to be inserted from the side of a nut (as in the case of an open-end, adjustable, monkey, or pipe wrench), or over the top (socket or box wrench) to hold it firmly for removing or tightening.

If you have to pull hard on a wrench, make sure that it seats squarely or it may slip. Pushing on a wrench is dangerous; if the nut breaks loose suddenly you may skin your knuckles, However, if you do have to push on the wrench, use the palm of your hand.

Whenever you do have to exert any real force, there are two important points to remember: (1) Always place the wrench on the nut so that the pulling force is applied to the strong, stationary side of the handle, as it can withstand the greatest stress. (2) After placing the wrench on the nut, tighten the adjusting knurl so that the jaws fit the nut securely, to prevent slipping.

Hammering on a wrench or extending it with a pipe places an excessive strain on a wrench which it is not designed to take.

When chipping, always wear goggles to protect your eyes. If others are working close by, make sure they are protected from flying chips by a screen, or else chip in a direction which is clear of workers. Remember-the time to take precautions is before you start a job, not after someone is injured.

It is dangerous to use a file without a handle, as the end of the tang is quite sharp. If the file "hangs up" by catching on the work, your hand might jam against the end of the tang, resulting in a very painful puncture wound.

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Material for this Information Sheet was taken from AUTOMECHANICS by Harold T. Glenn

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Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Introduction

TOPIC: Orientation

OBJECTIVE: To understand the jobs and job functions in the organization of the local agricultural machinery dealership.

REFERENCES: Required:

1. Information Sheet

Supplemental:

2. Farm and Power Equipment Retailers Handbook, 2340 Hampton Ave., St. Louis, Missouri, 63139, pp. 74-76;251-256.

QUESTIONS or ACTIVITIES:

1. What are the five areas the local dealership operation is divided into?
2. What are the duties of management?
3. What are the duties of a salesman?
4. What are the duties of the parts man?
5. What are the duties of the mechanic?
6. What are the duties of a set-up and delivery man?

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Information Sheet
on
ORIENTATION

The operation of the agricultural machinery dealership is divided into five areas.

1. Management
2. Sales
3. Clerical
4. Parts
5. Service

The nature of the work carried out in each area is determined by its function in the operation of the total business.

People in each area are employed with specific responsibilities.

1. Management

   Determine company policies
   Exercise financial control over the business
   Select, train and supervise employees
   Forecast and plan future company business
   Direct customer and employee relations
   Promote sales
   Coordinate jobs

2. Sales

   a. Sales Supervisor

      Directs sales work
      Directs sales records
      Promotes sales
      Trains sales employees
      Assists in job coordination

b. Salesman

Finds prospective buyers
Conducts demonstrations
Appraises used machinery
Closes sales
Makes financial arrangements for customer to purchase machinery
Maintains sales room
Follows up past sales

3. Clerical

a. Office Supervisor

Directs record keeping
Directs office procedures
Directs collections
Directs payments
Checks financial standing of potential customers

b. Bookkeeper

Posts books
Directs depository funds
Writes orders and letters
Prepares payroll
Writes contracts
Assists in closing books

4. Parts

a. Parts Supervisor

Directs ordering and selling of parts
Selects parts employees
Trains parts employees
Maintains inventory control
Maintains catalogues and price lists
Plans merchandising programs

b. Parts Man

Dispenses shop parts
Dispenses customer parts

Maintains parts inventories
Checks inventories
Maintains price catalogue
Constructs displays
Maintains parts identification

5. Service

a. Service Supervisor

Directs personnel
Selects and trains personnel
Maintains service records
Advises on service problems
Inspects repair jobs
Directs machinery storage
Schedules machinery assembly
Prepares delivery orders
Directs delivery

b. Mechanic

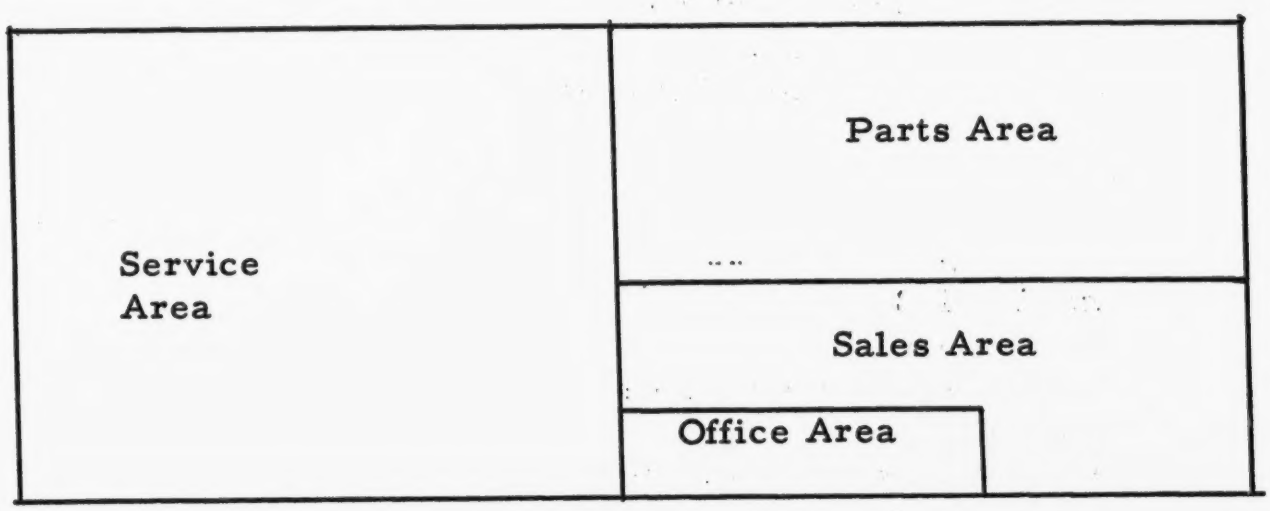
Makes general repairs
Handles field repairs
Conducts special operations
Reconditions trade-ins
Makes pre-delivery checks
Maintains demonstration units
Services rolling stock
Maintains shop equipment

c. Set-up and Deliveryman

Picks up and receives new machinery
Assembles new machinery
Delivers and starts machinery

Orientation
(Information Sheet continued)

These areas have well-defined limits in which to operate in the dealership.



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Material for this Information Sheet was taken from the Organization and Management Dealerships, The Center for Research and Leadership Development in Vocational and Technical Education, The Ohio State University, 1965

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Assignment Sheet for INTRODUCTION

UNIT: Introduction

TOPIC: Hand Tools-Identification and Use of Metals and Layout Tools

OBJECTIVE: To develop an understanding of how to detect certain metals and to properly use layout tools.

INTRODUCTION: Farming is becoming more merchandised each year. With increased use of mechanized comes a need for a greater number of repair jobs. Many simple jobs, such as removing broken bolts, threading, tapping, and reinforcing are cold metal jobs. These tasks become easier as one learns to properly use the tools at his disposal.

REFERENCE: Required:

The Farm Shop, T. J. Wakeman, pp. 83-88

QUESTIONS or ACTIVITIES:

1. What two factors determine the amount of carbon the structural arrangement of metals?
2. What is the name given to the heating and cooling process by which cast iron is made soft, strong, and mallable?
3. How will the sparks look when a high carbon steel is placed on a grinder?
4. What size combination square blade is most suitable for general work?
5. What is the purpose of a scratch awl?

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Assignment Sheet
for
INTRODICTION

UNIT: Introduction

TOPIC: Hand Tools-Cutting Cold Metal

OBJECTIVE: To develop an understanding of how to select proper tools for cutting cold metal and to become aware of the correct methods involved.

INTRODUCTION: The need for cutting cold metal in a farm shop arises quite often. Much valuable time and effort can be saved by learning the proper tools to use and by developing skills in the methods of cutting metal.

REFERENCES: Required:

The Farm Shop, T. J. Wakesman, pp. 88-92

QUESTIONS: or ACTIVITIES:

1. Why are soft-back blades more widely used than the hard-back hacksaw blades?
2. What are the four standard shapes for cold chisel cutting edges?
3. What procedure should be used when cutting round stock with cold cutters?
4. What two types of metal should be cut with bolt cutters?
5. Why are cold chisels tempered?

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Assignment Sheet for INTRODUCTION

UNIT: Introduction

TOPIC: Hand Tools-Shaping Stock and Filing

OBJECTIVE: To develop an understanding of the methods used in shaping stock and to learn different types of files and their use.

INTRODUCTION: The skills of shaping stock and filing metal are needed frequently in the farm shop. There are several fundamental principles of which one should be aware before bending stock.

REFERENCES: Required:

The Farm Shop, J. T. Wakeman, pp. 93-96

QUESTIONS or ACTIVITIES:

1. How do sharp corner bends affect metal?
2. What are the two tools needed to twist cold metal?
3. What type of metal is used to make files?
4. List the six parts of a file.
5. What should be done to prevent the tang from being a hazard?
6. List the eight types of files.

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Assignment Sheet for INTRODUCTION

UNIT: Introduction

TOPIC: Hand Tools-Drilling

OBJECTIVE: To develop an understanding of the tools and techniques used in drilling metal.

INTRODUCTION: Several different drilling machines can be used for drilling cold metal: the power drill press, the post drill, the drilling post ("Old Man") and a hand ratchet, the electric portable drill, and the breast drill.

REFERENCES: Required:

The Farm Shop, T.J. Wakeman, pp. 96-101

QUESTIONS or ACTIVITIES:

1. What is the most widely used drilling machine in cold metal work?
2. What number of twist drill is smallest?
3. At what size do fractional size drills start?
4. Why must metal be clamped tightly to the drill press table before drilling?
5. What type of vise is used to hold round stock?

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Assignment Sheet for INTRODUCTION

UNIT: Introduction

TOPIC: Hand Tools-Tapping and Threading

OBJECTIVE: To develop an understanding of tapping and threading techniques.

INTRODUCTION: A beginner in a farm shop usually does not work long before he runs into the problems of tapping and threading. These tasks are relatively simple if the proper techniques are observed.

REFERENCE: Required:

The Farm Shop, T. J. Wakeman, pp. 101-105

QUESTIONS or ACTIVITIES:

1. What are the two common types of bolt and nut threads?
2. What type of thread is used in tractor engines?
3. What are the three types of taps?
4. What are the three common types of dies?
5. What is a screw plate?

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Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Introduction

TOPIC: The Parts of Machines

OBJECTIVE: To learn proper identification of parts of farm equipment that are essential in the construction of a workable machine.

INTRODUCTION: The component parts of farm equipment include those parts that are essential to construct a complete high-quality operative machine.

REFERENCES: Required:

1. Farm Machinery and Equipment, Smith, Ch. 5
2. Ball & Roller Bearings, American Association of Agricultural Engineering and Vocational Agriculture.

Supplemental:

3. Tractors and Crawlers, Frazee-Bedell, pp. 64-85.

QUESTIONS or ACTIVITIES:

1. Explain the function and application of a cam.
2. Define and explain the difference between an anti-friction and friction bearing.
3. What is the function of a bearing?
4. What are the types of ball bearings?
5. What are the types of roller bearings?

UNIT: Introduction
TOPIC: The Parts of Machines
(Assignment Sheet continued)

6. How do roller bearings differ from ball bearings?

7. How would a person determine the proper bearing to use?

8. Explain why a bearing must be properly lubricated.

9. Where are tapered roller bearings used?

10. What kind of bearings need bushings?

VOCABULARY: The following key words or terms have been used in this assignment and should now be a part of your vocabulary. Explain or define each:

Intermittent	Load line
Axial	Load line angle
Carburizing	Misalignment
Case harden	Preload
Creep	Press fit
Crowned	Push fit
Deflection	Raceway
End play	Radial
End shake	Radial clearance
Heat treatment	Separable
Loading grooves	Spherical
Radial load	Thrust load

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Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Introduction

TOPIC: The Parts of Machines

OBJECTIVE: To develop an understanding of types of fasteners, washers, snap rings, and springs used in farm machinery.

INTRODUCTION: In every trade or occupation the problem of properly fastening parts of objects together is extremely important. At one time in history the supply of common nails, bolts, and bailing wire was sufficient. Today this is no longer the case. Today's mechanic must be familiar with names, sizes, uses, and standards of the most commonly used fasteners.

In this assignment we will discuss and illustrate some kinds, sizes and types of common fasteners so that you may familiarize yourself with them.

It is felt that this is most necessary because of the complex, high speed and precision world in which we live, and the safety conscience employees and employers of today's industry.

REFERENCES: Required:

1. Information Sheet, "Fastening Devices"
2. Farm Machinery and Equipment, Smith, pp. 50-54.

Supplemental:

3. The Farm Shop, Wakeman & McCoy, pp. 105-106.

UNIT: Introduction
TOPIC: The Parts of Machines
(Assignment Sheet continued)

QUESTIONS
or
ACTIVITIES:

I: Place in the blanks in the margin the number of the answer which you think makes a correct statement of the following:

1. ____ The pitch of a screw is (1) the number of threads on the screw; (2) the distance between threads; (3) the angle between thread faces; (4) the diameter of the threads; (5) none of these.

2. ____ The proper device for determining the pitch of a given screw is (1) micrometer; (2) rule; (3) calipers; (4) pitch gauge; (5) none of these.

3. ____ Most of the new-type fasteners now on the market came from (1) the aircraft industry; (2) confiscated German patents; (3) the building trades; (4) the shipbuilding industry.

4. ____ Hexagon socket-head screws are also known as (1) Phillips head; (2) clutch head; (3) cross head; (4) slotted head; (5) none of these.

5. ____ The chief advantage of the spline and clutch head screws is the fact that they are (1) neat in appearance; (2) easy to withdraw; (3) safer; (4) able to absorb more turning force; (5) none of these.

6. ____ To find the length of flat head wood screws, one measures (1) overall length; (2) from bottom of slot to point; (3) the shank; (4) none of these.

UNIT: Introduction
TOPIC: The Parts of Machines
(Assignment Sheet continued)

7. ____ Self-tapping screws are used extensively in sheet metal chiefly because (1) they have a better appearance; (2) they are stronger than other fasteners; (3) they are easily installed; (4) they do not require washers; (5) none of these.

8. ____ A flat head cap screw 1/4 inch in diameter and 1 1/2 inches long with coarse series threads will usually be described:
(1) 1/4" Cap Screw 1 1/2-20NC-FLT. HD.
(2) 1/4" x 1 1/2"-20NC-FLT. HD. Cap Screw
(3) 1/4" FLT. HD. Cap Scres 1 1/2"-20NC.

9. ____ Rivets are not practical for use in fastening metal parts which (1) require considerable strength; (2) must be assembled accurately; (3) will be removed or replaced periodically; (4) are subjected to vibration; (5) none of these.

FASTENING DEVICES

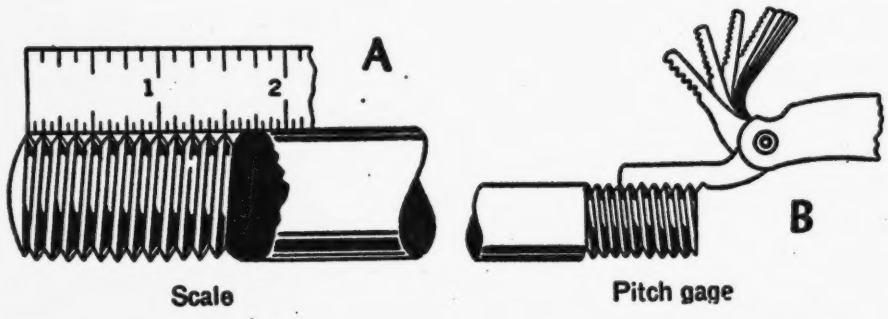


Figure 1. MEASURING SCREW PITCH

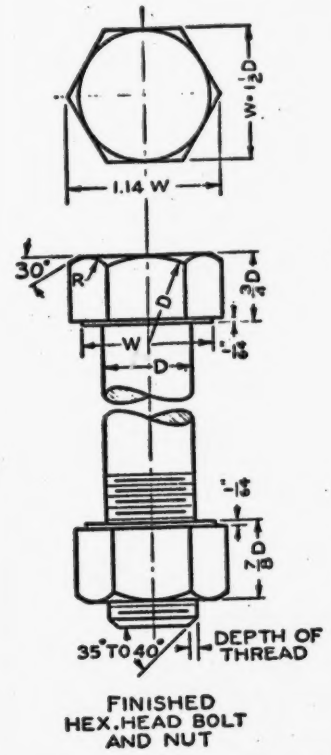


Figure 2. BOLT DIMENSIONS

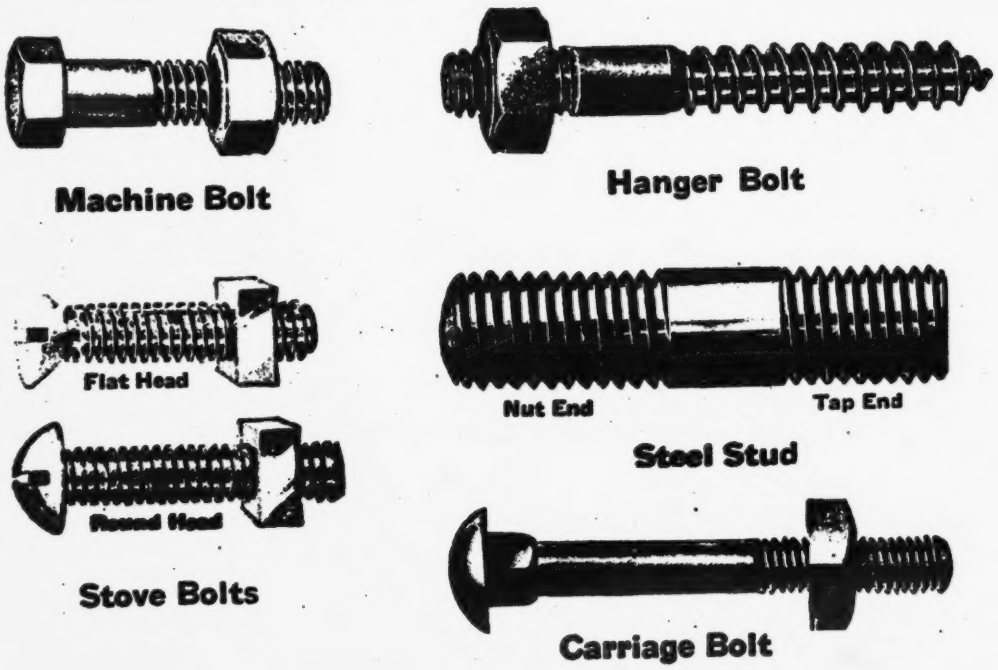
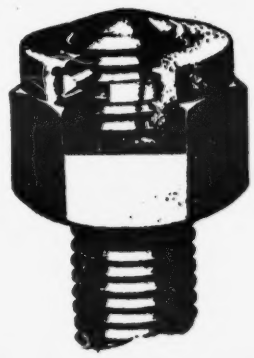
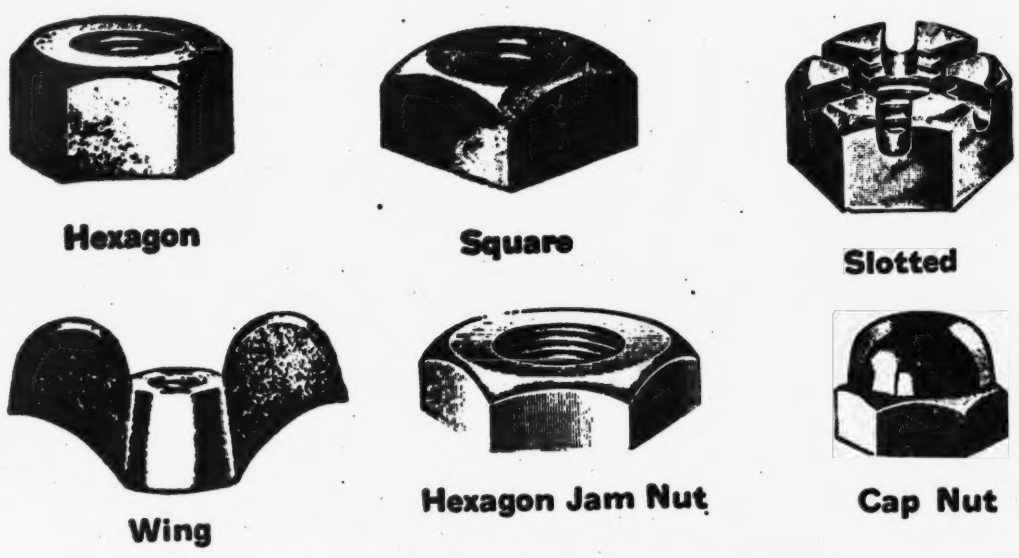


Figure 3. BOLTS





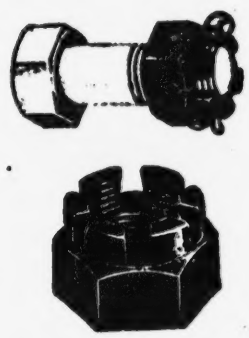


Fig. 4. NUTS

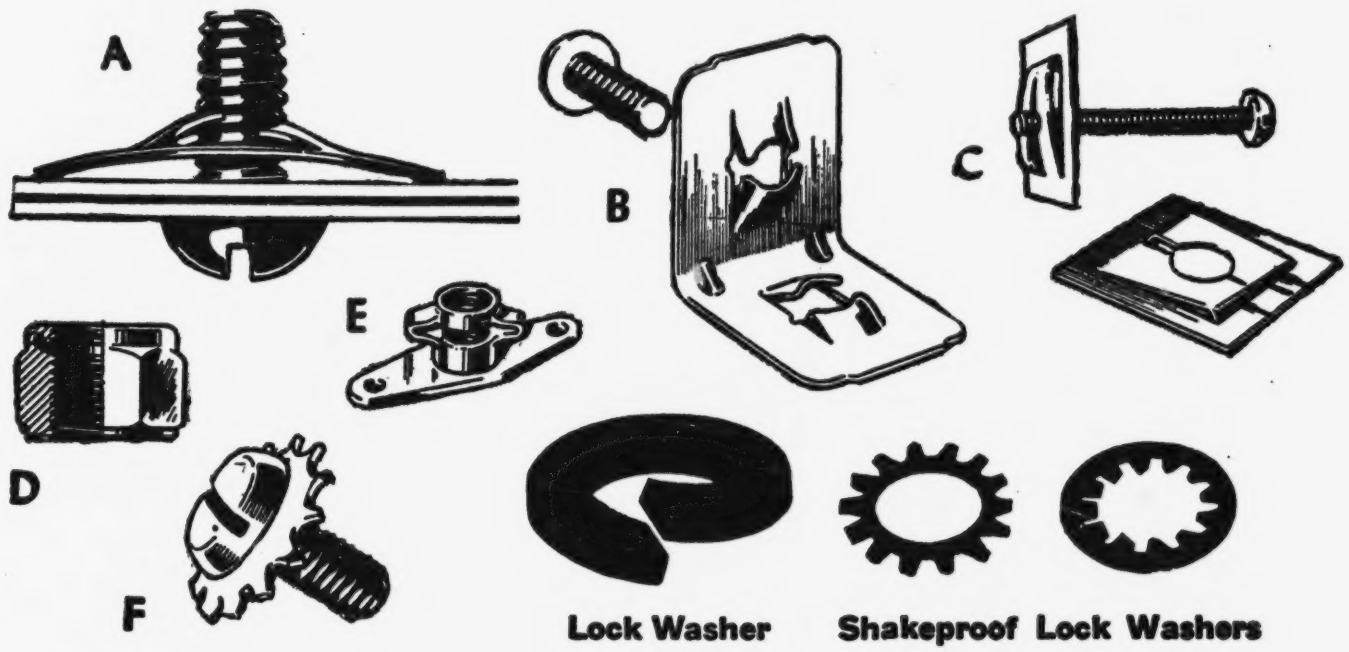


Fig 5 LOCK NUTS and WASHERS

Fig 6

CAP SCREWS

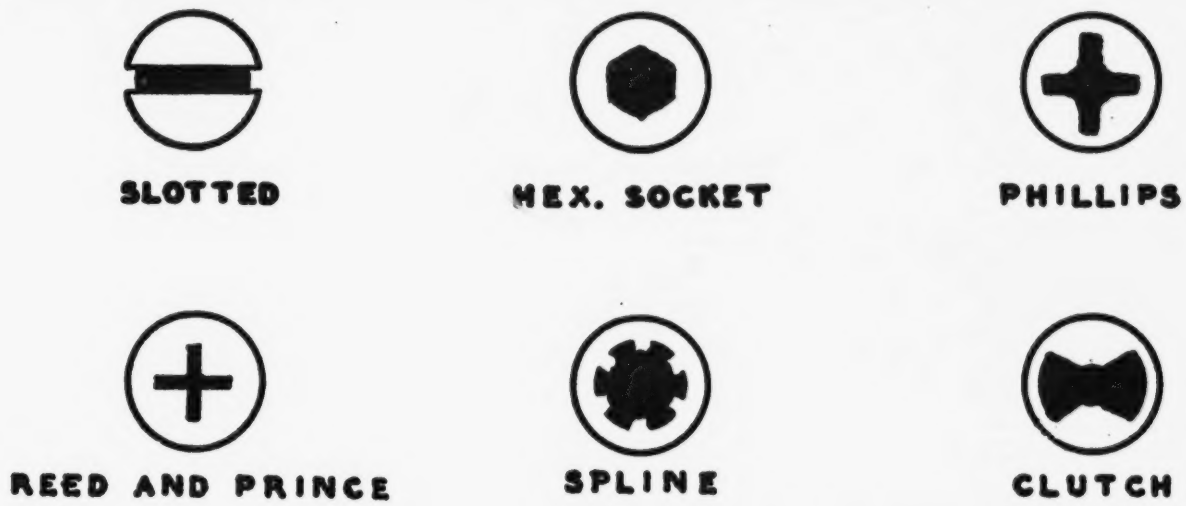


Fig 7 TYPES of RECESSED HEADS

Fig. 8. MACHINE SCREWS

Fig. 9. SELF TAPPING SCREWS

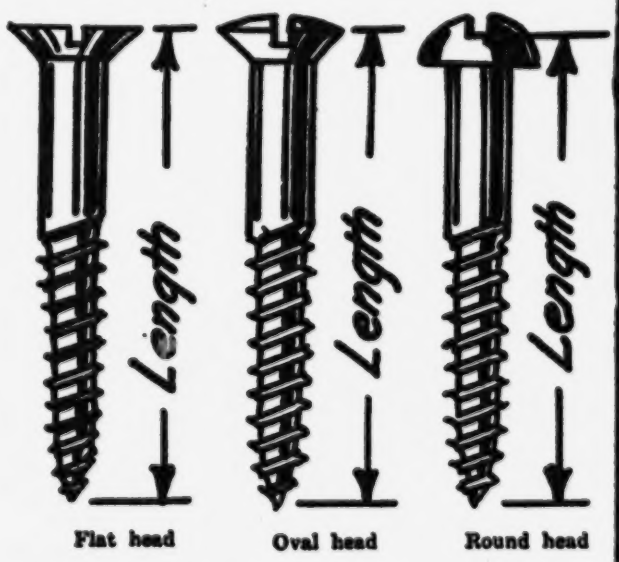


Fig. 10. WOOD SCREWS

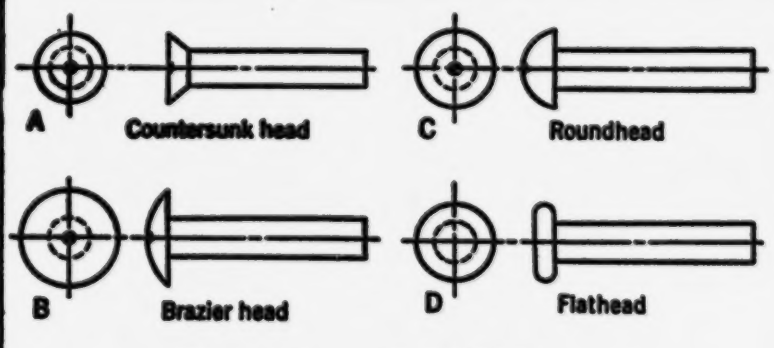


Fig. 11. RIVETS

Fig. 12. NAILS

UNIT: Introduction
TOPIC: The Parts of Machines
(Assignment Sheet continued)

IV. Fill in the blanks with a word or words to made a true, complete sentence.

1. The new standard system governing the manufacture of fastening devices used in this country is called the _____.

2. The two principal pitch series in this standard are _____ and _____.

3. The abbreviations for the above series are _____ and _____ respectively.

4. The meaning of "pitch" as applied to threads is: _____.

5. In the standard thread form, the basic angle between the sides of two threads is _____ degrees.

6. The head size of a standard hex bolt is the distance across opposite _____.

7. The nuts for standard bolts come in three thicknesses: _____, _____, and _____.

8. The head size of a standard bolt is approximately _____ times its diameter.

9. The length of bolts is measured from _____ to _____.

10. Bolts and their nuts are usually tightened by means of _____.

11. Screws which are used to fasten light or thin metal sheets without the use of tapped holes are called _____.

UNIT: Introduction
TOPIC: The Parts of Machines
(Assignment Sheet continued)

12. Two other names for the above type screws are _____ and _____.

13. A short steel rod threaded on both ends is called a _____.

14. Thin washers with teeth around the inside or outside edges or both are called _____ washers.

15. A thin nut which is used with a thicker one to keep it from loosening on the bolt is called _____.

16. Enlarging and shaping the end of a pipe or metal rod, such as a rivet, is called _____.

17. The three most common types of heads for set screws are _____, _____, and _____.

18. The unit denoting the sizes of tinners' rivets is _____.

UNIT: Introduction
TOPIC: The Parts of Machines
(Assignment Sheet continued)

11. ___ Cap screws are ordinarily used with nuts to fasten two pieces of metal.

12. ___ Bolts are sold with their nuts accompanying them.

13. ___ The most common type of cap screw is the hex head.

14. ___ The majority of screw pitches are uneven numbers.

15. ___ Most machine screws are of the coarse series.

16. ___ Machine screws ordinarily have threads the entire length of the shank.

17. ___ NC and USS may be used to designate American Coarse series threads.

18. ___ Stove bolts usually have hex nuts.

19. ___ Machine screws are smaller than cap screws.

20. ___ Carriage bolts are used to fasten wood to wood or wood to metal.

21. ___ Hanger bolts are used to fasten metal to metal.

22. ___ Castellated nuts are self-locking.

23. ___ Each type of recessed head screw requires a different type of screwdriver bit or wrench.

24. ___ Primarily, countersunk rivets are used in assembling aircraft to make them stronger.

25. ___ "Blind" rivets are so-called because they have no heads.

26. ___ The charge in explosive rivets is set off with an electric spark or sharp blow with a hammer.

UNIT: Introduction
TOPIC: The Parts of Machines
(Assignment Sheet continued)

III. Place + for TRUE and 0 for FALSE opposite the following statements:

1. ___ The form of a thread in the fine series is different to that in the coarse series.

2. ___ The hexagon head bolt and cap screws are the most used fastening devices in automobiles and modern machines.

3. ___ The distance across the flats of a standard bolt head determines its wrench size.

4. ___ The old U. S. Standard has been replaced by the American Standard.

5. ___ The American Standard Fine Series is also known as NF and SAE.

6. ___ Square headed bolts are used extensively in automobiles.

7. ___ The nut for any standard bolt will fit any standard screw of the same diameter and pitch.

8. ___ All bolts and screws tighten by turning clockwise.

9. ___ The thread standards used in this country also apply to foreign countries.

10. ___ Few bolts and screws have fractional numbers of threads per inch.

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Information Sheet on FASTENING DEVICES

THREADED FASTENERS

Distinction Between Bolts and Screws

Despite the progress made in standardizing machine parts, there is still considerable misunderstanding and confusion regarding the names, thread standards, and sizes of bolts and screws.

The public is inclined to make a distinction between two general types of threaded fastening devices, calling one "bolt" and the other "screw." Some manufacturers list every such device as "bolt" regardless of its size or type. Others may list a device as a "bolt" while other manufacturers may list the identical object as a "screw." While there is no single clearcut distinction between a bolt and a screw, there are a few generally accepted distinctions between them:

1. A bolt is usually thought of as a device used with a nut to fasten two parts together. A screw is usually thought of as a device for fastening two pieces together by passing through a hole in one and screwing into a tapped hole in the other, without the use of a nut. Bolts are usually sold with the nuts accompanying them, while screws are not provided with nuts.

2. The head (and nut) of a bolt is generally square or hexagon and is tightened by means of a wrench. The head of a screw is usually round in shape and is provided with a slot or some other means of tightening with a blade, such as a screwdriver. (Exception: hex cap screw)

3. The size of bolts is usually given in fractional inch sizes, such as 1/4", 5/16", etc., while the size of screws may be in fractional inch sizes, but is usually expressed in numbers from 0 to 30, which is the guage size of the steel wire from which the screws are made.

Fastening Devices
(Information Sheet continued)

Screw Threads

The threads on bolts and screws are spiral ridges made by cutting spiral grooves around the body of a cylindrical piece of metal stock. (See Figure 1.) These grooves are cut by means of a tool known as a die or by an automatic screw cutting machine which uses a die or chaser, and in the case of large sizes requiring accuracy, they may be cut on a lathe or on a thread milling machine. The shape of the groove (and hence the shape of the ridge) is determined by the shape of the cutting tool used, and it is obvious that this shape must be standard (always the same) or else bolts, screws, and nuts will not be readily interchangeable. The standard form for threads of bolts and screws is discussed in a later section.

In the following discussion, the term "screw" will not refer to the object known as a screw, but will refer to the threaded portion of any fastening device, whether it be a bolt, screw, or nut.

The pitch of a screw is the distance between corresponding parts of adjacent threads. The number of threads per inch can be measured with a rule as shown in Figure 1-A, which shows the number to be eight. Note that the first thread is not counted. Measuring the number of threads with a rule is difficult if there is not a full inch of threads; the reason being that if the number is odd, say thirteen, the half or quarter-inch graduation on the rule will be opposite a "valley" or groove of the thread and may be difficult to read.

The preferred way to measure pitch is with a screw pitch gage, shown in Figure 1-B. The pitch of a given screw is determined by mating the threads with the teeth of the proper leaf of the gage and then reading the pitch which is stamped on the leaf. The proper leaf is found by trial and error. The screw pitch gage can be used for finding the pitch of internal threads (as in nuts) as well as external threads.

The threads per inch for American (National) Standard threads are shown in Table 1. Such a table is quite useful in finding the proper screw for a certain tapped hole, for replacing a nut on a bolt, or for drilling and tapping a hole for a screw.

Fastening Devices
(Information Sheet continued)

Note that it can be seen from this table that practically all the number of threads per inch listed are not only whole numbers but are even numbers as well. In fact, there are only five odd-numbered threads per inch for screws of sizes No. 0 to 3" in the Coarse Series (13, 11, 9, 7, and 5), and there are none in the Fine Series. The only fractional number of threads per inch (4 1/2) is for sizes 2" and 2 1/4" Coarse Series.

Screw-Thread Form

By 'thread form" is meant the shape of a thread that would be revealed if the longitudinal section bolt or screw were shown. There are about eight different thread forms recognized by the American Standard, most of them being used for special purposes. The thread form used almost exculsively in the manufacture of both bolts and screws is the American Standard, which is illustrated in the drawing to the right. Many foreign countries use different thread forms, making the exchange of such bolts and screws impossible.

$$p = \text{pitch} = \frac{1}{\text{No. threads per in.}}$$

f=1/8 of p.
d=depth of thread

American Standard Thread Form

Screw Thread Series

The American Standard Thread Form is divided into two principal series: coarse and fine. The form of the thread is the same regardless of whether it is coarse or fine, the difference being in the number of threads in one inch for the same diameter screw or bolt. The designation of these two series is (1) American Standard Coarse (also known as NC and USS), and (2) American Standard Fine (also known as NF and SAE).

Thus a certain bolt, say a hexagon head, 1/4" in diameter, 2 1/2" in length, may have American Standard threads of either the coarse series (NC;USS) or the fine series (NF;SAE) and its description in a catalog will be:

Fastening Devices
(Information Sheet continued)

1/4 - 20 x 2 1/2 (NC or USS) Hex Head Bolt
1/4 - 28 x 2 1/2 (NF or SAE) Hex Head Bolt

The 20 and 28 have reference to the number of threads per inch for a bolt of 1/4" diameter in the course and fine series respectively.

For a bolt of larger diameter, say 1/2", it is necessary that the threads must be larger and fewer per inch for both the coarse and the fine series. In this case the thread description of the bolt will be:

1/2 - 13 x 2 1/2 (NC or USS)
1/2 - 20 x 2 1/2 (NF or SAE)

Definite standards have been set up governing the number of threads per inch for each size screw. The coarse series threads are used with machine bolts and screws for general industrial use, which, it is said, comprise about 80 % of all manufactured.

The fine series threads (or about 20% of machine screws) were adopted when it was found that the coarser threads would not stand up under the pressure and vibrations found in modern machinery, principally automobiles. The term SAE refers to "Society of Automotive Engineers," which was instrumental in the standardization of the machine screw threads.

For use in automobiles, the Society of Automotive Engineers adopted still another series, the Extra Fine thread series, for use in certain instances with thin metal where the thread engagement is small. In this series, a 1/2" screw will have 28 threads per inch, instead of 20 in the American Standard Fine series.

BOLTS

One of the most common types of fastening devices found in industry is the bolt, which is a steel rod, threaded on one end with a head on the other. The head is usually six-sided (hexagon or hex), and each side is called a "face," and the distance between any two opposite faces (flats) of the head determines the wrench size.

Fastening Devices
(Information Sheet continued)

Bolt Sizes

The dimensions of a bolt are determined by using its diameter (D) as the unit of measurement. This is shown in Figure 2.

1. The diameter of a bolt is the diameter of the body (not the head), the smallest being usually 1/4". The diameters range from 1/4" to 3".

2. The length of a bolt is measured from the underside of the head to the end and varies according to the use to which the bolt is put.

3. The head size of a bolt (W) is the wrench size and is the distance across flats. For standard hexagon machine bolts, it is equal to 1 1/2 times the diameter of the bolt. However, the bolts used by automobile manufacturers do not follow this formula exactly. An explanation of S. A. E. bolt and nut sizes is given in the Information Sheet, "Wrenches."

Designation of Bolt Sizes

When referring to bolts as in orders, parts lists, and correspondence, a standard manner of designating the necessary information is used, with the data listed in the following order:

1.	Diameter	4.	Finish
2.	Length	5.	Type head
3.	Type thread	6.	Name

This information is usually abbreviated as shown in the following example:

1/2" x 2 1/4" - 20NF - 2 Fin. -HEX. MACHINE BOLT

Types of Bolts

The most common types of bolts used for general industrial purposes are: (1) machine bolt, (2) stove bolt, (3) carriage bolt, (4) stud bolt (or stud), and (5) hanger bolt. All are shown in Figure 3 on the page of illustrations.

Fastening Devices
(Information Sheet continued)

NUTS

Nuts are of the same size, thread form, and pitch, as the bolt they fit. The standard hexagon nut is also the same diameter as the bolt head, but is somewhat thicker. The thread of a nut is internal (female), and the same standard thread systems apply to them as those previously discussed. Usually the sharp corners on square or hexagon nuts are chamfered to prevent injury to the hand.

Nuts are designed in several types to suit different needs. The most common types are pictured on the page of illustrations and are square, hexagon, slotted head hexagon, castle (or castellated), cap (also called acron and bline), and wing. The hexagon is by far the most-used nut in automotive work, and comes in three different thicknesses: Heavy (also called standard), light (also called half nut), and jam (also called lock). The jam nut is the thinnest and is used with another nut, usually a light or half nut, to lock it on the bolt.

Small thin nuts are sometimes incorrectly calles "taps" in certain parts of the country. (A tap is a fluted, threaded tool for cutting inside threads.)

Lock Nuts and Washers

Practically all nuts should be used with a washer of some type. However, some nuts have special safety devices which make this unnecessary. The slotted and castellated nuts (Figure 4) are used with cotter pins or safety wire to prevent them from loosening on the bolt. A few new type lock nuts, which were originally designed for the aircraft industry and which are now being used in other industries, are shown in Figure 5.

Spring steel nuts, such as those shown in Figure 5-A-B- C, are a class of nuts which are growing in popularity due to the fact that they can be installed very quickly and have the combined functions of nut and lock washer. The speed nut, Figure 5-A, has two forked prongs which engage the thread of the bolt and which are sprung inward to engage the bolt tightly when the nut is tightened. These nuts have numerous applications where no appreciable amount of strain is encountered, chiefly in radio and electrical installations and the assembly of parts made from plastics. They are made in angle brackets (Figure 5-B), as well as long metal strips with several "nuts" stamped at desired intervals.

Fastening Devices
(Information Sheet continued)

Another type of spring steel fastener is the "Stalock" fastener (Figure 5-C), which grips the thread almost one complete round. This nut may be re-used, whereas many other types are sprung with first use.

An altogether different type of lock nut is shown in Figures 5-D and 5-E. It has two threaded portions through which the screw turns, each being slightly out of "pitch" with the other, causing a compressive action as the nut is tightened.

Lock washers are of several types, the most common being the split ring type shown in Figure 5. Other types have come from the aircraft industry which required light weight washers with great "holding power" and the ability to withstand severe vibration. These are put into a general class known as "shakeproof" washers and come in two chief styles as shown in Figure 5. They have twisted, tapered teeth which engage both the nut and the work so as to make loosening unlikely. Those with teeth inside are for use with fillister head screws, while those with outside teeth are to be used with hexagon and square nuts and screw heads.

SCREWS

Methods of Driving Screws

Although a few types of screws are designed to be tightened with a wrench, the majority of them are provided with slots or sockets for engaging the blade or bit of a screwdriver or specially designed wrench. In recent years the trend has been away from the use of slotted head screws, the reasons being that the screwdriver blade must be properly formed and fit the slot snugly in order that the maximum amount of turning force can be applied without splitting or "chewing up" the screw head. Also, slotted head screws are difficult to start straight unless the screwdriver blade is exactly centered in the slot. The most popular types of driving devices used with screw heads (See Figure 7) and the names by which they are known are:

1. Slotted head for use with the conventional type screwdriver. One type of slotted head screw, used chiefly in radio work

Fastening Devices
(Information Sheet continued)

(Figure 9-A), also has a hexagon head, making it suitable for both ordinary screwdriver or a "Spin-tite" wrench.

2. Hexagon socket head, also known as "Allen head," is used with the "L" shaped, hexagonal Allen wrench or key, shown in Figure 8.

3. Phillips head has a cross-shaped recess and is used with a Phillips screwdriver. Its chief values are ease of starting, attractive appearance, and the fact that the screwdriver cannot slip off the screw head while turning.

4. Reed-Prince head, also known as "croos head," is somewhat similar to the Phillips head and is used with a specially formed screwdriver bit.

5. Spline socket head, also called "fluted head," uses a special splined wrench which permits a maximum amount of force to be applied without splitting or straining the screw head.

6. Clutch head is used with a special screwdriverbit designed to permit considerable turning force. It is claimed that this type screw head makes starting screws in hard-to-get-at places easier since the screw will fit the bit snugly without falling off.

The recessed type of screw head was used principally with set screws and machine screws until a comparatively short time ago. Today, the use of such screw heads has been extended to almost every type of threaded fastening device, including stove bolts, self-tapping screws, and wood screws.

Needless to say, the universal use of special screw heads of the types described above necessitates the purchase of many different types and sizes of screwdrivers by the mechanic. The good mechanic always uses the correct type and size of driver for each specific screw.

Screw Specifications

Screws are designated in the same manner as bolts as shown in the example below:

Fastening Devices
(Information Sheet continued)

(Complete)	No.	10 x 1 1/2" - 24-3FIN. FILL HD. MACHINE SCREW
(Abbreviated)		10 x 1 1/2" - 24 FILL HD. MACH. SCR.
(Complete)	No.	3/8 x 2 1/2" - 24NG-3 FIN. NX. HD. CAP SCREW
(Abbreviated)		3/8 x 2 1/2" - 24 NF-HX. HD. CAP SCR.

Cap Screws

The largest screw for fastening two pieces of metal together is the cap screw, which passes through a clearance hole in one piece and fastens it by screwing into a tapped hole in the second piece (See Figure 6). They are available with threads of either the American Standard Coarse or Fine series and in sizes from 1/2" to 1" and over. The lengths are usually from 1/2" to 6".

The heads of cap screws are in five general types: hexagon (the most common), flat, button, fillister, and socket (or recessed).

Machine Screws

Machine screws - shown in Figure 8 - are similar to cap screws in shape and head type, but differ principally in the fact that they are smaller (usually in sizes from Nos. 0 to 12) and have threads of only the coarse series. As a rule, machine screws are threaded all the way from the head to the end.

Set Screws

Set screws (Figure 8) are fastening devices used to set a wheel, collar, or hub on its shaft. They are usually headless, although some come with square heads. The headless type is provided with slots or hexagon sockets for scresing them into the hub so that none of the screw projects on the outside. The diameter of the socket is, in nearly all cases, half the diameter of the screw.

The points of set screws are of several types: flat, cup, cone, oval, and dog. The same standard thread systems apply to set screws as those previously discussed.

Fastening Devices
(Information Sheet continued)

Right and Left Hand Threads

All bolts, screws, and their nuts are right hand (RH) unless specified left hand (LH). Right hand means that the nut is turned in the right hand (clockwise) direction to tighten it.

Left hand screws are used only when required, as, for example, when the nut is in contact with a part turning in a counter-clockwise direction and the friction tends to loosen a right hand nut.

Self-Tapping Screws

Self-tapping screws, also called "Parker screws" and "Sheet metal screws," resemble ordinary wood screws except that they are shorter and have threads the entire length of the screw. They are used principally in fastening thin metal parts and sheet metal together, but are also used with plastics. The screws are of very hard metal, and the threads "form" rather than "tap" threads into the metal into which they are screwed. There is a type, however, which actually taps threads into a drilled hole. It resembles a machine screw with "interruptions" or slits along the end which present cutting edges at each thread, which tap the threads as the screw is tightened. (See Figure 9-B.)

Parker self-tapping screws are made in two types, "A" and "Z", and are available with six different types of heads, (See Figure 9), each of which may have the slotted or Phillips recessed head, as shown in Figure 9-C.

Drive Screws

Drive screws are a combination of screw and nail. They are used chiefly to fasten sheet metal, plastics, leather, and paper to wood by driving them nearly home with a hammer and tightening with a screwdriver a turn or two.

One type of drive screw, designed for metal work, is made of hardened steel and is used to fasten thin metal parts to brass, aluminum, and iron castings by driving the screw all the way home with a hammer after it has been started in a hole drilled to the proper size to receive it.

Fastening Devices
(Information Sheet continued)

RIVETS

Use of Rivets

Rivets are used to fasten together two pieces of metal which will not likely require disassembling later. Riveting is the "upsetting" the end of the rivet shank which has been passed through punched or drilled holes in the metal pieces. "Upsetting" is the forming of a second head by shaping the end of the rivet in several different ways while the head is held firmly in place ("bucked") with a bucking bar or dolly which is usually held by another person.

Before the development of welding, riveting was practically the only method of fastening two pieces of heavy metal together permanently. Today, the use of large steel rivets is chiefly limited to structural steel and boiler work in which the steel rivets are driven red-hot. Only the "soft rivets," which are made of aluminum, copper, and other soft metals and which can be driven cold, will be discussed here. The ends of such rivets are "upset" by hammering or peining, with hammer and a rivet set, and with pneumatic hammers called rivet "guns."

Types of Rivet Heads

The most common types of rivet heads are shown in Figure 11. In general, each type is used for the following types of work:

1. Countersunk rivets are used where streamlining is necessary to prevent "drag" due to air or water flow, and for appearance. The principle of countersinking used with wood and metal screws is used with rivets, permitting the heads to be flush with the surface of the metal.

2. Brazier head rivets are used chiefly in aircraft assembling and repairing where countersinking is not practical and where "drag" must be kept as low as possible by making the rivet heads thin.

3. Round head rivets are used where maximum strength is important and "drag" and appearance are of little concern.

Fastening Devices
(Information Sheet continued)

4. Flat head rivets are used for general purposes where both strength and compactness are important. Tinners' rivets are of this type and are made of soft steel and are usually tinned to prevent rusting.

Special Rivets

One of the chief drawbacks to the use of ordinary rivets is the fact that both sides of the work must be accessible for driving and bucking. For places where only one side of the work can be reached, several patented "blind" rivets are available, most of which use a metal screw or plug inside the hollow rivet which compresses and upsets the end when the screw or plug is withdrawn. One type of "blind" rivet uses a small explosive charge in the hollow end which explodes when heat is applied to the head, thus upsetting the end of the rivet.

Size of Rivets

The size (diameter) of rivets is expressed in three manners:

1. Fractional inch sizes
2. Gauge
3. Weight

The size of aluminum rivets is given in fractional inch sizes, usually in 32nds, and the length of the shank is usually expressed in 16ths of an inch.

Tinners; rivets have standard lengths for each size, which is expressed in weight. The weight, such as 6 ounces, 1 pound, and the like, represents the number of ounces or pounds that 1000 such rivets weigh. The smallest size is 6 ounces (1000 weigh 6 ounces). and the largest is 3 pounds.

Material for this information sheet was taken from "Fastening Devices For General Industrial Metal Shop", pp. 1 - 10.

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Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Introduction

TOPIC: Transmission of Power

OBJECTIVE: To develop an understanding of the ways that power is transmitted from its origin to use.

INTRODUCTION: Power remaining at the source of production is of no value to the operator. To utilize this power it must be transferred by some method to a place of adjustment and use. Often times it is necessary to adjust power into several speeds to fully utilize it. In this assignment the methods of transmitting this power will be studied.

REFERENCES: Required:

1. Farm Machinery and Equipment, H. P. Smith, Ch. 4.

Supplemental:

2. Modern Farm Power, pp. 182-187.

3. Farm Gas Engines and Tractors. pp. 404-445. 475-479.

QUESTIONS or ACTIVITIES:

1. What are the six methods of transmitting power in connection with farm equipment?

2. What is the advantage of a V-belt over flat belts?

3. When is a V-belt properly fitted?

4. How can belt lengths be determined?
   a. V-belt
   b. Flat belt

5. What formula may be used to calculate the speed or size of pulley?

UNIT: Introduction
TOPIC: Transmission of Power

6. Explain how the pitch of the sheave will vary speeds.

7. Explain the proper direction of travel when using a pressed-steel hook chain.

8. List the names of the types of gears that are shown in figures 4-17, page 34 in the Farm Machinery and Equipment, Smith.

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Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Introduction

TOPIC: Tractor Design

OBJECTIVE: To develop an understanding of different types and sizes of farm tractors.

INTRODUCTION: The tractor is the farmers "power house". It is a moveable powerhouse. Most all farm machines can be operated by the tractor and many other attachments can also be used such as grader and ditcher blades, manure loaders, scoops, power shovels, post hole diggers, wood saws, load carriers and many others. Each implement attached must "match" the tractor in size and capacity.

Farmers are the principle users of tractors. In a recent ten (10) year period, the number of tractors used by farmers almost doubled which shows how rapidly our farming is being mechanized.

REFERENCES: Required:

1. Machines for Power Farming, John Wiley and Sons, Ch. 2.

2. Farm Tractors, FT-53-Humble, page 3.

Supplemental:

3. Farm Power, Moses and Frost, pp. 289-304.

4. Tractors and Crawlers, Frazee and Bedell, Ch. 1.

5. Operation, Care and Repair of Farm Machinery, John Deere and Company.

UNIT: Introduction
TOPIC: Tractor Design
(Assignment Sheet continued)

QUESTIONS or ACTIVITIES:

1. What are the major types of tractors?
2. What type is most popular? Why?
3. What are the ways of rating sizes of tractors?
4. In what ways are all tractors alike?
5. What are the basic elements of all farm tractors?

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Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Internal Combustion Engines

TOPIC: Theory of Operation

OBJECTIVE: To develop an understanding of the process involved in transforming fuel to power in a two cycle and four cycle engine.

INTRODUCTION: Do all engines have spark plugs? Of course, the answer is no. Do all engines have valves? Again the answer is no. We would then say it is apparent that engines differ in physical characteristics. It should be just as evident that differences exist between different types of engines in the process of transforming fuel to power.

To be a good mechanic one must not only be able to recognize the different types of engines by the types of fuel and number of strokes per cycle but must have a good understanding of why and how each operate.

In this assignment we are concerned with understanding exactly what happens on each stroke for both the two and four cycle engines.

REFERENCES: Required:

1. Information Sheet, "Two and Four Stroke Cycle Engines".

2. "Farm Tractors-Basic Principles, Operation, and Maintenance", Engineering Bulletin No. FT-53, pp. 3-7.

3. Selecting and Storing Tractor Fuels and Lubricants, American Association for Agricultural Engineering and Vocational Agriculture, pp. 3-5.

UNIT: Internal Combustion Engines
TOPIC: Theory of Operation
(Assignment Sheet continued)

Supplemental:

4. "Briggs and Stratton Corporation", MS3553-24, page 3

5. Modern Farm Power, Bromensherger and Bishop, Ch. 2

QUESTIONS or ACTIVITIES:

1. What is a four cycle engine?

2. What is a two cycle engine?

3. Explain the operation of a four cycle carburetor type engine.

4. Explain the operation of a two cycle carburetor type engine.

5. How is lubrication provided for in a two cycle engine?

VOCABULARY: The following key words or terms have been used in this assignment and should now be a part of your vocabulary. Explain or define each.

Intake valve

Exhaust valve

Piston

Crankshaft

Spark plug

Cylinder

Connecting rod

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Information Sheet
on
TWO AND FOUR STROKE CYCLE ENGINES

The first successful four-stroke cycle internal combustion engine was developed by a German in 1876. An Englishman patented a two-stroke cycle engine in 1878. Experimentation on various systems of converting heat to power had been underway in various countries for at least 200 years prior to the successful development of an internal combustion engine. In some of the early experiments gun powder was used as fuel but did not prove practical.

Power which is used to move the tractor is created within the cylinders of the engine and transmitted through the crankshaft, transmission, differential, and final drive to the rear wheels. The way the power is utilized after it is produced by the engine is determined by the power transmitting systems attached to the engine. However, regardless of the kind of work which is done by the power, whether it is pumping water or powering a self-propelled combine, the origin of power is still the same--that is through the combustion of fuel and air within the cylinders of an engine. See Figure 6, page 4, reference 2, for an illustration of the conversion of compressed air-fuel mixture to power. Since the piston is attached to a connecting rod, which is attached to a crankshaft in an offset position from the center of the crankshaft, the force exerted on the piston by combustion drives the piston downward causing the crankshaft to turn. This represents rotary motion.

Internal combustion engines are of two types: two-stroke cycle and four-stroke cycle. A STROKE includes that movement of the piston from the top of the stroke (TDC--Top Dead Center) to the bottom of the stroke (CDC--Crank Dead Center) or from CDC to TDC. This means that with each complete revolution of the crankshaft the piston moves from a point back to that point, for example TDC to TDC, and has made two strokes.

A CYCLE is composed of the number of strokes required for a complete series of events from the point the cylinder is ready to receive the fuel-air mixture (carburetor engine) or the air only (diesel engine) to the point at which the spent gases are expelled from the cylinder and is ready to receive a new supply of fuel-air mixture or air. A two-stroke cycle engine requires two strokes for this process. A four-stroked cycle engine requires four strokes to complete a cycle. It is common terminology to refer to 2-cycle or 4-cycle engines; in this case the 2 and 4, respectively, refer to the number of strokes required for a complete cycle of events.

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Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Internal Combustion Engines

TOPIC: Engine Types

OBJECTIVE: To develop an understanding as to engine types classified according to blocks, valves, cylinders and fuels, as well as basic engine parts.

INTRODUCTION: Successful farm machinery repairmen know that farmers today depend upon machinery to a very great extent. One of the basic elements of all farm power machinery is the engine. This may be a gasoline or diesel depending upon the owners choice. Basically both engines are constructed and operate similarly. To be able to better understand the operation of an engine a person needs to be familiar with its basic construction and parts.

In this topic we explore the basic engine parts, methods of classification and some materials used in the parts.

REFERENCES: Required:

1. Machines for Power Farming, Stone and Gulvin, Ch. 3

2. "Farm Tractors," Engineering Bulletin, No. FT53, pp. 3-9.

Supplemental:

3. Diesel and High Compression Gas Engines, Kates.

QUESTIONS or ACTIVITIES:

1. How are engines classified according to fuel?

2. What four systems are necessary to make an engine?

3. What are the principal engine parts?

UNIT: Internal Combustion Engines
TOPIC: Engine Types
(Assignment Sheet)

4. How do diesel and carburetor type engines differ in block construction?

5. How are engines classified according to cylinders?

6. How are engines classified according to blocks?

7. How do valves vary within engines?

8. How do diesel and carburetor type engines differ in operation?

VOCABULARY: The following words were used in this assignment and should be part of your vocabulary. Define the following:

1. Bore
2. Stroke
3. Piston displacement
4. Intake valve
5. Exhaust valve
6. Piston
7. Crankshaft
8. Spark plug
9. Cylinder
10. Connecting rod
11. Fuel injection

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Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Internal Combustion Engines

TOPIC: Power Measurements

OBJECTIVE: To develop an understanding of the amount of power which is developed by an engine and how this power is measured.

INTRODUCTION: What is horsepower? What is "Brake Horsepower"? What is "Draw-bar Horsepower"? Do you know how to measure each of these? When dealing with farm machinery, it is important that this information be familiar to you.

In this assignment we will be concerned with measuring horsepower at the various locations of the tractor.

REFERENCES: Required:

1. Farm Tractors, FT-53, pp. 98-100
2. Machines for Power Farming, Ch. 7

Supplemental:

3. Tractors and Crawlers, Frazee and Bedell, Ch. 1, pp. 13-24
4. Farm Gas Engines and Tractors, Jones, Ch. 5, page 45

QUESTIONS or ACTIVITIES:

1. Define horsepower.
2. What is a btu and what is its relationship to horsepower?
3. Although the tractor is the source of power, what is required to make use of the power?

UNIT: Internal Combustion Engines
TOPIC: Power Measurements
(Assignment Sheet continued)

4. Where are the four main points of measurement of horsepower on a farm tractor?

5. Why is "indicated horsepower" different to "brake horsepower"?

6. What conditions affect the calculating of drawbar horsepower?

7. If 32% of the potential heat energy of the fuel is lost through exhaust and 40% is lost in the cooling water, what is the remaining 28% known as?

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Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Internal Combustion Engines

TOPIC: Power Plant Construction and Terminology

OBJECTIVE: To develop an understanding of how and why power plants are designed and constructed as they are and to develop the ability to refer to the parts using the proper terminology.

INTRODUCTION: Do you know why the engine in a tractor is designed as it is? Do you know how to properly care for that engine? An understanding of basic engine construction and the correct terminology to use is essential in gaining the skill necessary to work on an engine. It does not matter how good an engine is constructed, it will not be efficient in its operation unless you have the ability and skill to operate and maintain it correctly. In this exercise we will study the relationship of one part to another and the function of each part to complete and make possible the function of the whole engine.

REFERENCES: Required:

1. "Machines for Power Farming," Chapter 3

2. Information Sheet

3. Service manual for respective tractor being studied

Supplemental:

4. "Briggs & Stratton," bulletin

5. "Farm Tractors", Humble bulletin

QUESTIONS or ACTIVITIES:

1. Cylinders are often known as the _____ of the engine

2. Each cylinder is an airtight chamber, closed on one end by the _____ and at the opposite end by the _____.

UNIT: Internal Combustion Engines
TOPIC: Power Plant Construction and Terminology
(Assignment Sheet continued)

3. The piston and connecting rod assembly is made up of a number of parts. Identify these parts on the attached illustration.

4. What is the purpose and advantage of a cylinder liner?

5. Identify the parts of a cylinder head and related parts on the attached illustration.

6. Identify the parts of the crankshaft and related parts on the attached illustration.

7. Identify the parts of a camshaft and related parts attached.

8. Study the parts of the valve assembly which is attached and be able to identify each.

9. Identify the parts of a cylinder block and its related parts as shown on the attached illustration.

10. Identify the parts of the rocker arm assembly as illustrated on attached sheet.

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Information Sheet
on
POWER PLANT CONSTRUCTION AND TERMINOLOGY

Gasoline engines are composed of many small parts. Each part serves a specific function or, in many cases, several functions. The efficient tractor mechanic must have a thorough understanding of the many parts of a gasoline engine and the functions they perform.

Because of the peculiar function of each part, each falls into a natural group, referred to as an assembly or a system.

Gasoline engines may be grouped into the following systems:

1. Stationary parts
   a. Cylinder block
   b. Cylinder head
   c. Crankcase
   d. Oil pan
   e. Cover
2. Moving parts
   a. Pistons and rings
   b. Connecting rods and wrist pins
   c. Crankshaft
   d. Main bearings
   e. Flywheel
   f. Camshaft and camshaft gear
   g. Valves
   h. Rocker arm assembly
   i. Oil pump and accessories

Powet Plant Construction and Terminology
(Information Sheet continued)

3. Electrical system

   a. Battery

   b. Generator and charging circuit

   c. Ignition circuit (distributor, coil, spark plugs, breaker points, condensor and magneto)

   d. Cranking motor (starter)

4. Fuel, air, and exhaust systems

   a. Air cleaner

   b. Fuel tank

   c. Fuel line, cut-off valve, strainer, and filter

   d. Fuel pump (only in tractors that do not have the fuel tank located above the engine)

   e. Carburetor

   f. Manifold, muffler, and exhaust pipe

   g. Governors

5. Cooling system

   a. Radiator, hose, and pressure cap

   b. Water pump

   c. Thermostat

   d. Fan

Tractor engines may be grouped into four basic classes, classed according to fuels. These are: (1) gasoline, (2) distillate, (3) LP gas and (4) diesel. Although these engine classes require different fuels basically the engine is constructed very similar.

Power Plant Construction and Terminology
(Information Sheet continued)

The cylinder block is the basic frame of the engine. It supports all the components in relation to one another and maintains them in alignment. The most important requirement of the cylinder block is rigidity. In most cases, tractor engines are made of cast iron alloy.

Cylinder blocks may vary in design. They may be of the integral bore type; that is, the cylinder bore is machined directly into the material of the block. It may have separate and removable cylinder sleeves. The removable sleeve may be of the wet type (the coolant comes in direct contact with the outer surface of the sleeve), or it may be of the dry type (the sleeve or liner is inserted in the bore and is not in direct contact with the coolant).

Valve-in-block engines have the valve seats, ports, and guides in the block casting with their respective water jactets; whereas, the 1-head engine block has only the cylinder bore water jackets.

If the block skirt extends only to the center line of the crankshaft main bearing, it is known as a "short skirt." If it extends below the center line of the crankshaft main bearing, it is known as a "deep skirt."

Many engine blocks may have oil galleries cored in. Others may have steel tubes inserted to act as galleries; whereas, others may have oil lines and fittings to carry oil to the various parts.

As a rule, the cylinder head is made of the same material as the cylinder block. It serves as a cap and is attached to the top of the engine block and covers the upper cylinder openings, thereby forming a combustion chamber.

The crankcase is the lower part of the cylinder block; it confines the lubricating oil near the engine's moving parts in the four-cycle engine. It also supports the crankshaft and camshaft bearings.

The oil pan serves as a reservoir to hold the crankcase lubricant and seals the lower part of the engine in the four-cycle engine.

Various types of covers are used on the timing train, the valve train, and sometimes on other components or inspection-holes. They are usually made of stamped steel.

Power Plant Construction and Terminology
(Information Sheet continued)

The moving parts of the engine that receive the gaseous energy produced in the combustion chamber and deliver it to the output end of the engine in the form of useful power are referred to in this module as the moving parts.

1. Pistons and rings

   Cylinders are sealed and the gaseous pressure transmitted to the connecting rod by the piston and its rings.

   The top section of the piston is the crown, and the lower section is the skirt.

   The upper set of rings, compression or power rings, are carried by the crown of the piston. The lower set of rings, oil control rings, are carried by the skirt of the piston.

2. Connecting rods and wrist pins

   A connecting rod is a bar or strut with a bearing at each end. The purpose of the connecting rod is to transmit the piston thrust to the crankshaft.

   The connecting link between the connecting rod and the piston is the wrist pin.

   There may be three arrangements of wrist pins.

   a. The wrist pin is secured in the piston, and the bearing is held in the connecting rod end.

   b. The wrist pin is fastened to the connecting rod, and the bearing is part of the piston.

   c. The wrist pin is free and bears against bearings in both the piston and the connecting rod.

3. Crankshafts

   Crankshafts deliver force to the transmission and power train as a result of the thrust from the connecting rod.

   Some crankshafts are designed with counterweights opposite the crank pins. These relieve the load on the main bearing by offsetting the inertia forces.

Power Plant Construction and Terminology
(Information Sheet continued)

4. Bearings

The purpose of bearings is to support rotating shafts and other moving parts that transmit power from one engine part to another.

Bearings reduce the friction between the moving surfaces by separating them with a film of lubricant and carry away the heat produced by unavoidable friction.

5. Flywheels

The flywheel is a heavy wheel or disk attached to the crankshaft. Through rotation, the flywheel acquires kinetic energy. It stores additional kinetic energy when it speeds up and gives back that energy when it slows down.

The main purpose of the flywheel is to reduce the speed fluctuations of the crankshaft, caused by the difference in the amount of energy exerted on the piston during the power stroke and during the compression stroke.

Single-cylinder engines require larger flywheels than multi-cylinder engines, because energy variations during a complete cycle are greater in single-cylinder engines.

6. Camshaft and gear

The camshaft is a lobed shaft which provides accentric action for opening the valves. It is driven from the crankshaft by a timing gear or through a timing chain.

7. Valves

The purpose of valves is to open and close ports in the combustion chamber. Since there are two ports for each cylinder, there must be two valves. The intake valve allows the fuel-air mixture to enter the chamber when the valve is open. Exhaust valves open to allow burned gases to escape from the combustion chamber into the exhaust system. Both valves are closed on the compression and power strokes.

8. Rocker arm assembly

The purpose of the rocker arm assembly is to actuate the valves at

Power Plant Construction and Terminology
(Information Sheet continued)

the proper time. The rocker arm assembly is actuated by the camshaft and consists of valve lifters, push rods, rocker arms rocker arm shaft brackets, rocker arm shaft and accessory parts.

9. Oil pump and accessories

The oil pump is located in the oil pan. Its function is to provide engine lubrication. Pumps are of three types: vane, piston, and gear. Because of their long life and trouble-free operation, gear pumps are used in most engines.

In many engines, oil filters are located between the oil pump and the engine parts to remove abrasive particles.

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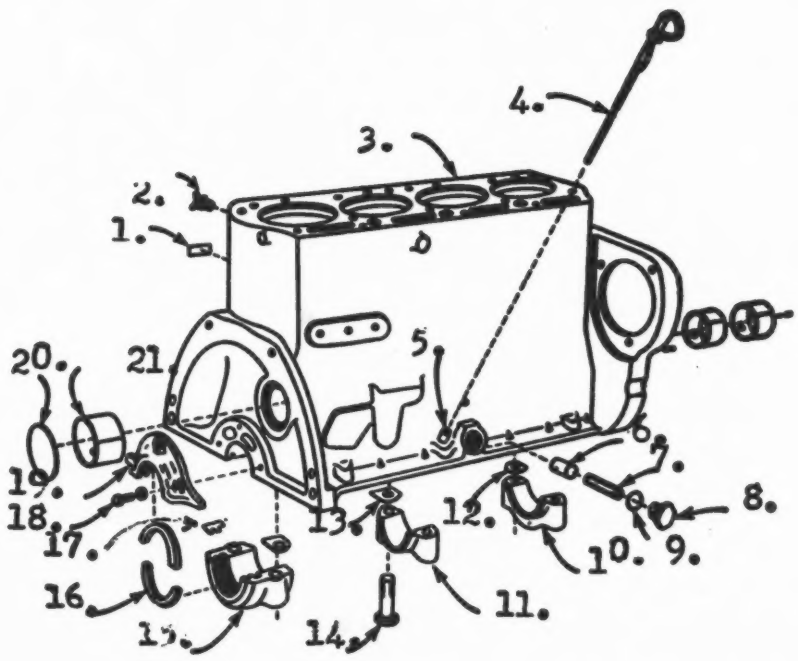
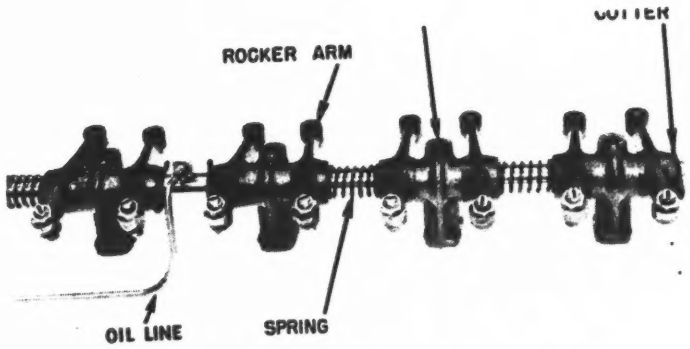
Material for this Information Sheet was partially taken from GASOLINE TRACTOR ENGINE SYSTEMS, Agricultural Machinery-Service Occupations Module No. 14, The Center for Research and Leadership Development in Vocational and Technical Education, Columbus, Ohio, 43212.

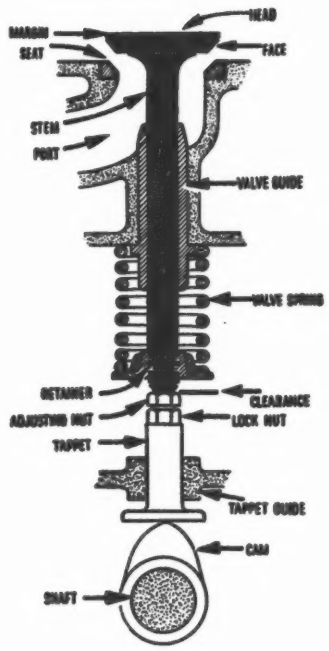


Cylinder block and related parts (Allis-Chalmers Mfg. Co.).

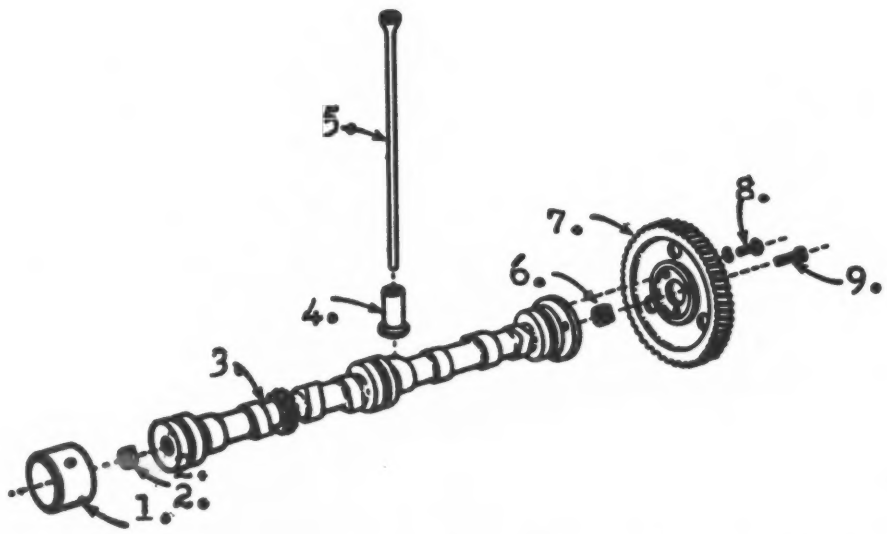


Rocker arm assembly

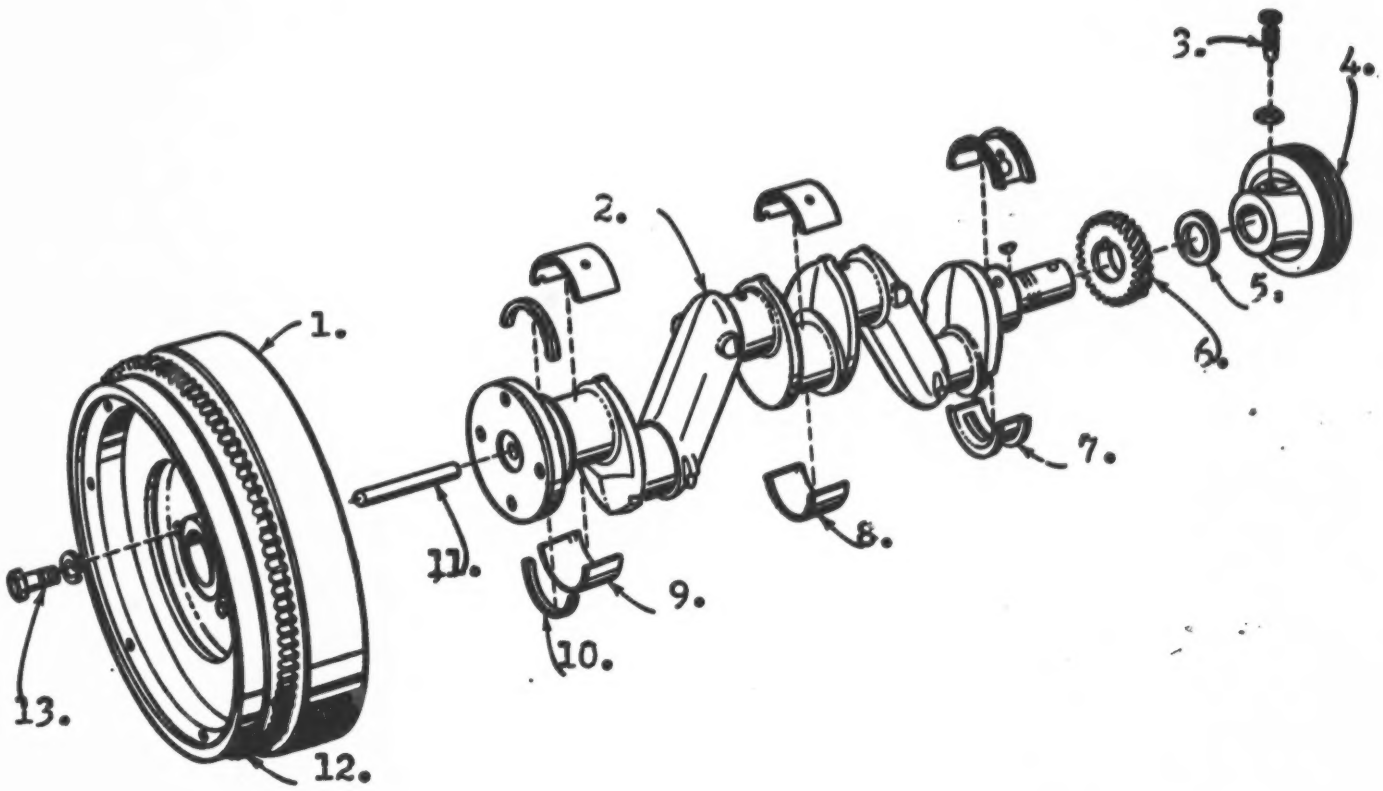
Courtesy: Oliver Corporation



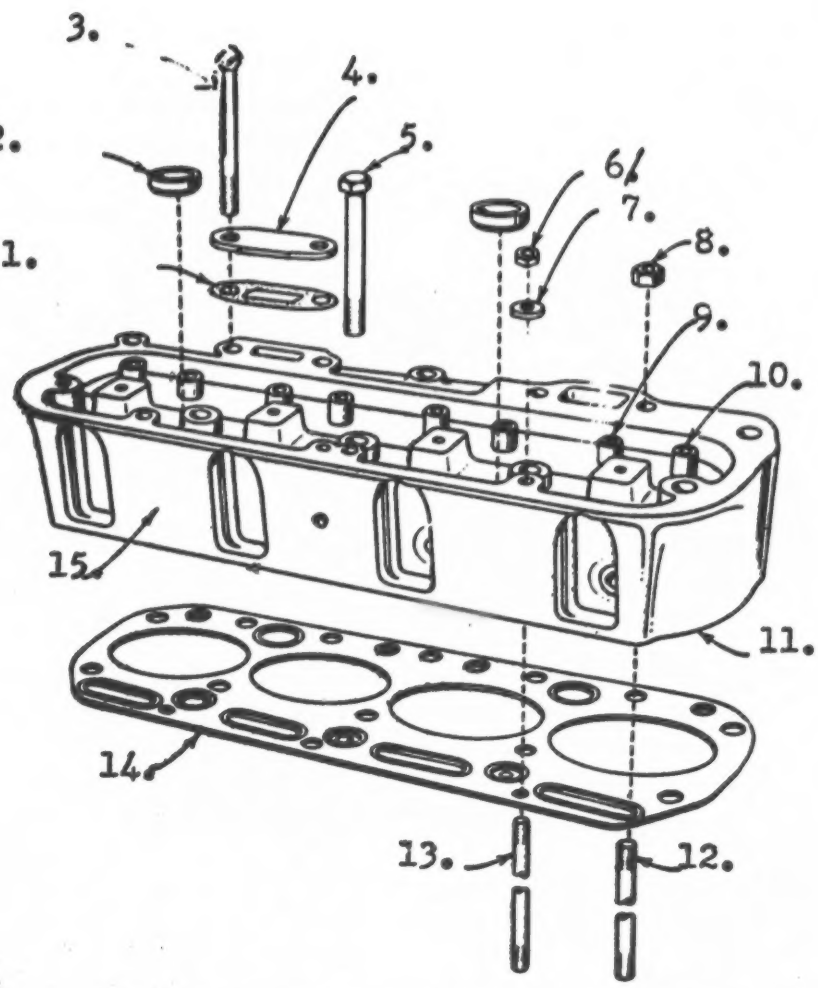
The L-head valve assembly.
Courtesy: Black and Decker



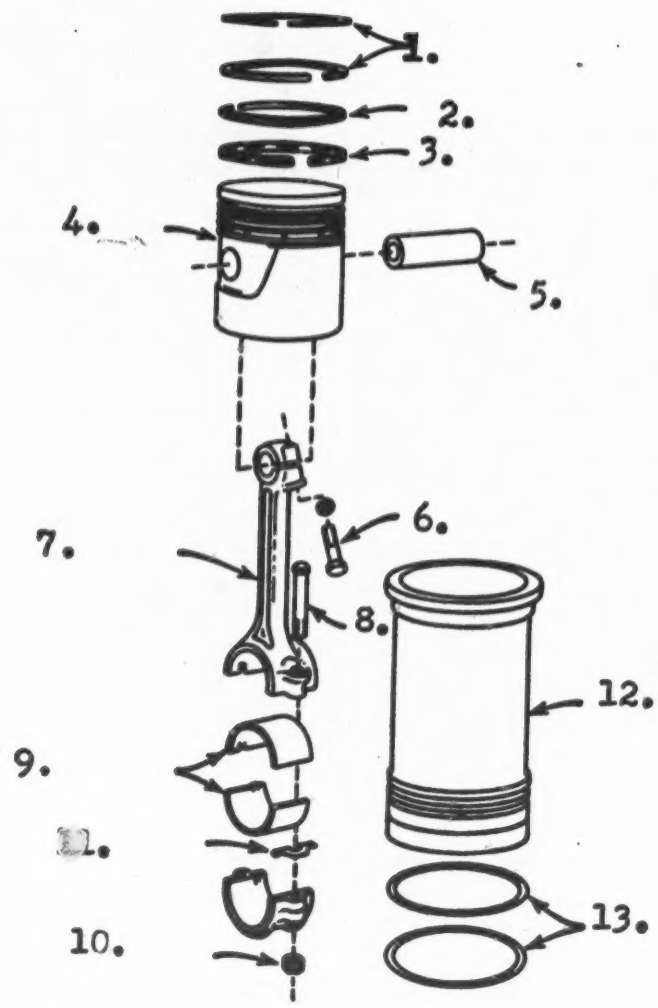
Camshaft and related parts (Allis-Chalmers Mfg. Co.).



Crankshaft, flywheel, and related parts (Allis-Chalmers Mfg. Co.)



Cylinder head, gasket and related parts (Allis-Chalmers Mfg. Co.)



Piston and parts, connecting rod and bearings, cylinder liner (Allis-Chalmers Mfg. Co.).

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Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Internal Combustion Engines

TOPIC: Power Plant Disassemble, Assemble and Repair

OBJECTIVE: To develop an understanding of the procedure to follow in disassembling an engine, checking for items in need of repair and assembling the engine.

INTRODUCTION: Do you know the proper sequence to follow in disassembling and assembling an engine? Often times labor is wasted because someone will try to disassemble an engine and not know the proper order to follow. They will try to remove a part which cannot be removed until something else is first removed. This assignment will cover a lot of territory however it is felt necessary to include this one lesson in order to give a complete logical sequence to follow in working on engines. As we study this lesson both carburetor and diesel engines will be considered. It must be kept in mind that no one procedure will fit every brand of engine therefore, when working on a specific brand always use the repair manual for that brand.

REFERENCES: Required:

1. "Dealers Repair Manual".

2. Information Sheet, "Power Plant Disassemble, Assemble and Repair".

Supplemental:

3. Farm Gas Engines and Tractors, Jones, Ch. 7.

QUESTIONS or ACTIVITIES:

1. What is the best way to clean an engine in preparation for overhauling it?

2. What five major steps are necessary in preparing an engine for an overhaul job?

UNIT: Internal Combustion Engines
TOPIC: Power Plant Disassemble, Assemble and Repair
(Assignment Sheet continued)

3. What two additional parts must be removed from a diesel engine?

4. As a person disassembles an engine what are some important points that he should look for when determining if the engine should be completely overhauled or not?

5. How can a starter ring gear be removed from the flywheel?

6. When removing any bearing cap, rod cap or two pieces of metal that must be fitted together, how can these be marked so that you may be sure to replace them exactly as they were removed?

7. What engine parts assure good oil pressure?

8. When torqueing down bolts how many pounds of torque should be increased each time?

9. What is end ring clearance?

10. How should the rings be installed on the piston?

11. When installing pistons which way should the notch or arrow on the piston top point?

12. In what order are the cylinders of an engine numbered?

13. How may a generator be checked for proper working order?

14. How may a thermostat be checked for proper operation?

15. How is the thermostat properly installed?

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Information Sheet
on
POWER PLANT DISASSEMBLE, ASSEMBLE AND REPAIR

Thorough cleaning is the first step in preparing an engine for overhaul. The best method is steam cleaning; but if this is not possible, clean the engine with a mixture of one part "Gunk" concentrate (a cleaning compound made for dirty engines) with four parts kerosene. Paint the engine with this mixture and allow it to soak for 20 minutes; then wash it off with a spray of water.

After the engine has been thoroughly cleaned, follow these steps to prepare it for overhaul:

1. Remove engine accessories. These include the hood, shrouds, radiator shell and grill.

2. Drain the coolant from radiator and block into a clean container and inspect it for rust particles and other foreign particles.

3. Remove all radiator clamps and hoses, noting those that need to be replaced. Record this information on the reconditioning sheet.

4. Remove the radiator holding bolts and the radiator.

   a. Check the radiator for bent fins, external leakage, and corrosion build up inside the radiator.

   b. If the radiator needs repair, send it to a radiator shop.

5. Remove external engine parts.

   a. Battery clamp and battery

      (1) Remove battery cables removing the ground cable first.
      (2) Inspect cables and note condition.
      (3) Using a hydrometer and voltmeter, test the battery and recharge it, if necessary.

Power Plant Disassemble, Assemble and Repair
(Information Sheet continued)

b. Starter

c. Water manifold and thermostat

(1) Check thermostat and note its condition.

d. Carburetor (gasoline engine only)

(1) Remove linkage.
(2) Turn valve on gas tank off and remove gas line.
(3) Remove air cleaner base and note its condition.

e. Governor

Diesel engines do not have the same type of governor as gasoline engines. Omit this step on the diesel engine.

(1) Disconnect linkage and oil line.
(2) Remove bolts around the housing.
(3) Slip governor unit from housing.
(4) Check spring for tension.

f. Intake and exhaust manifold

g. Air cleaner

(1) Check condition of air cleaner. An excessively dirty cleaner may suggest possible clues to causes of internal malfunctions.

h. Spark wires, spark plugs, and distributor

A diesel engine has a different type of fuel and ignition system. The following procedures should be followed when removing the injector and injector pump.

1. Injector

a. Turn fuel valve off at tank.

b. Remove fuel lines from injectors.

(1) All fuel lines from pump to injectors must be removed at each end.

Power Plant Disassemble, Assemble and Repair
(Information Sheet continued)

(2) Remove line bracket.
(3) Be careful not to bend lines.

c. Remove injector

(1) Remove hold-down nuts.
(2) Use crowfoot bar to pry injector out.
(3) Remove injector, being careful not to bump the nozzle tips.
(4) Wrap injector in a soft cloth to avoid damage to the nozzle tips while they are out of the engine. Always remove the injector before removing the head.

2. Injection pump

a. Locate marks used in timing pump.

b. Rotate engine until marks are in proper position and the number one cylinder is on the compression stroke.

c. Remove throttle and stop linkage attached to pump.

d. Remove fuel lines.

e. Remove primary fuel line from pump.

f. Remove bolts holding the pump to the block.

g. Remove oil line that runs from the pump to block.

h. Remove pump.

i. Any calibration of the pump must be made on a test stand. Most dealers do not do this job but send pumps to special diesel repair shops. Some pumps, however, may be calibrated on the engine, operating at maximum load and using a ball fuel meter or dynamometer to measure fuel consumption.

j. Three types of injection pumps have been developed for use on diesel engines.

Power Plant Disassemble, Assemble and Repair
(Information Sheet continued)

(1) Ro sa master
(2) Boash
(3) Simms

Manufacturer's specifications should be followed when overhauling these pumps.

k. Clean injection pump screen which is located on head of pump.

(1) Remove plug.
(2) Remove screen and "o" ring.
(3) Wash in solvent and blow dry with compression.
(4) Install screen on plug and ring.
(5) Install injection pump in head.

After thorough testing and removal of all accessories and external parts, the engine is ready to be overhauled. A mechanic should learn well the following procedure, which outlines a complete engine overhaul, before he accepts employment and proceeds to overhaul a tractor engine in an agricultural machinery dealership.

Disassemble the engine in the following manner, and make observations of worn parts, and other faults.

1. Valve cover

a. Remove valve cover by taking out four attachment bolts. Make sure that the area around the cover is clean and dirt free before the cover is removed.

2. Rocker arm assembly

a. Oil must flow to the rocker arm assembly through an oil line or stud which retains this assemble. Locate the flow openings and check to see if they are plugged.

b. Remove the oil line.

3. Push rods

4. Head nuts or capscrews

Power Plant Disassemble, Assemble and Repair
(Information Sheet continued)

These are special nuts or capscrews of high strength steel. Under no circumstances should nuts or capscrews of any other material be used for this purpose.

5. Remove head

a. Visually inspect the head, noting the following:

(1) Condition of valves
(2) Condition of headgasket
(3) Condition of top of piston

(a) Excessive carbon indicates bad rings.
(b) Piston loose in cylinder

(4) Pitting in the piston top and cylinder wall

Pitting is caused by water entering the combustion chamber through the head gasket or a crack in the head or sleeve.

(5) Taper of the cylinder wall

The taper of the cylinder is checked by a dial indicator or inside micrometer. Measure the diameter of the cylinder where the top ring travels and above the piston when at bottom dead center. By subtracting the latter measurement from the former the amount of taper can be determined. Compare the taper with maximum taper given in the manufacturer's specifications for the tractor.

(6) Check cylinder for being out of round.

To check a cylinder for being "out of round," use the same tools as those used to check taper.

6. Remove valves from head and determine condition.

a. Place head on work lead.

b. Using suitable valve compressor, compress spring and cap

and remove the two locks located on the end of the valve stem.

c. Release valve compressor.

d. Remove spring and valve cap. Some engines may have rotating valve caps on the exhaust valves. These caps allow valves to rotate, thus keeping the seat clean and free of carbon. Also, some engines may be equipped with two valve springs on each valve, allowing more positive valve seating.

e. Remove valves.

(1) Visually inspect each valve for excessive burning.
(2) Check valve stem for sticking in the guide, which is caused by carbon in the guide. The guide should be cleaned or replaced.
(3) Check the valve seat for burning or cracks.

At this point in the overhaul procedure, study all observations made to determine whether a complete overhaul is necessary or whether reconditioning of the valves would bring the compression back to within manufacturer's recommendations. If the tractor needs a complete overhaul, follow these procedures:

1. Remove the engine block from the tractor mounting.

a. Drain oil from the oil pan by removing the plug in the bottom of the pan.

b. If necessary, remove the front axle and axle support, which is bolted to the engine block.

(1) Disconnect the front axle wishbone supports and steering linkage.
(2) Place safety jack under the transmission to support the engine while removing the front axle and wheels.
(3) Remove bolts around the rear engine bell housing. Usually there are one or two line-up pins in the rear bell housing which often stick and need to be freed by prying the engine away from the transmission.

Power Plant Disassemble, Assemble and Repair
(Information Sheet continued)

c. Attach engine lifting straps to the block so that when the engine is lifted from the mountings it will be balanced. Use short capscrews to replace the head studs or capscrews.

d. Hook sound chain falls on hydraulic lifting crane to engine strap and remove the engine block from its mountings.

2. Place engine on an engine stand and fasten it down tightly. If an engine stand is not available, lay the engine block on its side on a workbench.

3. Remove oil pan.

Take off capscrews around the oil pan, and check it for sludge deposits in the bottom.

4. Remove oil pump.

a. Remove oil pump screen and pick-up tube. In some cases this tube may be a part of the pump.

b. Remove locks on safety wire from the capscrews or nuts which hold the oil pump in place.

c. Turn the pump housing back and forth until it comes free.

5. Remove fly wheel.

a. Remove pressure plate.

(1) Remove capscrews on the pressure plate evenly.
(2) Be prepared to catch the pressure plate and clutch disk, as they drop when the last capscrew is removed.

b. Remove flywheel nut locks and nuts

(1) It may be necessary to lay a 2" x 4" block of wood, 12" long, beside the crankshaft to keep the crandshaft from turning during removal of flywheel nuts.

Power Plant Disassemble, Assemble and Repair
(Information Sheet continued)

(2) Tap flywheel off with a soft mallet hammer.
(3) Because of the weight of the flywheel, be careful not to drop it while removing from the engine.

6. Check the flywheel starter ring gear for missing teeth and slippage on the flywheel, and record findings.

a. Remove ring gear from the flywheel, cutting halfway through the ring gear with a cutting torch and splitting the remainder with a chisel, or cutting halfway through with a 1/4" drill and splitting the remainder with a chisel.

Be extremely cautious to avoid cutting with the torch or drilling into the flywheel.

b. Install new ring gear.

(1) Lay ring gear on flat fire bricks that completely support it.
(2) Use a torch to heat ring gear to 360° or until it turns a dark straw color.
(3) Quickly place ring gear on flywheel and let cool into place.

7. Remove pistons.

a. On engines with sleeves, install a short capscrew and large washer at the top of each sleeve to hold sleeve while removing piston.

b. Cut ridge frame cylinder with a suitable ridge removing tool. Follow manufacturer's instructions for using the tool to remove the cylinder ridge.

c. Rotate crankshaft until the number one piston is at the bottom of its stroke.

d. Remove lock nuts on cotter pins from connecting rod.

e. Mark rod cap with a center punch on both halves to make certain it is reinstalled in the same position it was before

disassembly. Also, notice whether mark is on the crankshaft side, and record observation.

f. Remove connecting rod nuts.

g. Remove rod cap.

(1) Inspect insert for excessive wear, pitting, and corrosion.
(2) Remove upper insert bearing.

h. Push piston out of cylinder.

i. Throw inserts away and reinstall cap on rod.

j. Repeat steps a through i to remove the remaining pistons.

8. Inspect piston, pins, and connecting rods.

a. Clean piston.

(1) Remove old rings.
(2) Remove carbon from the piston top with a scraper.
(3) Remove carbon from ring bands with a broken ring.
(4) Do not use a wire brush for cleaning these parts.
(5) Clean oil groove and oil return holes. The oil return holes should be cleaned with a drill bit of the same size as the oil return holes so as not to enlarge the holes.
(6) Using a micrometer, check the size of the pistons against manufacturer's specifications, and determine whether they are within limits. A micrometer check also reveals whether the pistons are standard or oversized.
(7) Compare the ring band of piston with that of a new ring and check it with a feeler gauge. Insert ring in groove. Check the distance between the ring edge and groove wall. Check size of gap with manufacturer's specifications for maximum allowance clearance. These measurements, along with visual inspection and piston size, indicate whether the piston should be replaced.

Power Plant Disassemble, Assemble and Repair
(Information Sheet continued)

b. Inspect connecting rod.

Put the connecting rod cap in place on the rod with punch marks lined up and rod nuts torqued to manufacturer's specifications. Using an inside micrometer, check whether the inside of the rod is out-of-round and the connecting rod opening is within manufacturer's specifications. If the measurements are not within specifications, install a new rod or recondition the old rod at a machine shop.

c. Check wrist pin.

(1) Remove wrist pin from rod.

(a) Mark piston and rod with a center punch to make sure they are reinstalled in the same position they were before disassembly.
(b) Remove snap rings on lock bolts that retain pin in the piston.
(c) Using a brass punch, drive the pin out of the rod. Some pistons require that the wrist pin be pressed out. This is a job for a machinist who has a special piston holder and press.

(2) Using a micrometer, check pin to see whether it is within manufacturer's specifications.
(3) Check inside of the rod bushing with a telescopic gauge and outside micrometer to determine whether the opening is within manufacturer's specifications.
(4) Record all measurements in order to determine what parts should be replaced or reconditioned.

9. Check cylinder for taper and being out-of-round.

These checks are made with an inside micrometer or dial indicator. If the taper is not within specifications or the cylinder is out-of-round, install new sleeves or rebore the cylinders.

10. Remove crankshaft.

a. Before removing crankshaft, check end play. One bearing,

usually the center or rear bearing, controls the end play with a thrust ring built on the insert or a separate ring. Locate the thrust bearing, and pry crankshaft forward. Insert feeler gauge in the opposite side and measure the gap. Record the gap and check it against manufacturer's specifications. If a new bearing is needed, it may be obtained in oversize thrust to take up for wear on the crankshaft flange.

b. Remove front crankshaft pulley.

(1) Remove set screw, nut, or retaining bolt from the pulley.
(2) Using a suitable puller, remove crankshaft pulley.
(3) Be careful to fit puller jaws on the solid part of the pulley.
(4) Check pulley for cracks and excessive wear on the sealed surface.

c. Remove timing cover.

(1) Remove all capscrews and nuts on the retaining cover.
(2) Pry cover off.
(3) Notice if the crankshaft end-play adjusting setscrew is built into the retaining cover.

d. Check backlash between camshaft and crankshaft gear with dial indicator.

(1) Mount dial indicator on front of engine with needle resting on camshaft gear teeth.
(2) Rotate camshaft back and forth without moving the crankshaft. Take dial reading and compare with manufacturer's specifications listed as camshaft gear backlash. If backlash is excessive, new gears are needed.

e. Check timing marks on the camshaft and crankshaft gears. The marks must line up before disassembly and at reinstallation.

f. Mark main bearing cap in relation to block. Be care-

Power Plant Disassemble, Assemble and Repair
(Information Sheet continued)

ful to put caps back in the same position and place when reinstalling them.

g. Remove main bearing capscrew or nuts. Some nuts or capscrews have locks, and others are self-locking.

h. Remove main bearing cap by tapping it with a soft mallet hammer. Inspect the insert bearing for pitting, grooving, and excessive wear. At this point it may be necessary to remove the rear main oil seal retainer and seal.

i. Remove crankshaft. Try to keep it standing on end to avoid possible warping.

j. Reinstall main caps on block and tighten them to prevent damage to the caps.

11. Check the crankshaft.

a. Using a micrometer, check each journal for the following:

(1) Out-of-round condition
(2) Excessive wear
(3) Taper of journal

Micrometer readings should be recorded and compared with manufacturer's specifications.

b. Check rear oil seal surface.

c. Check straightness of crankshaft.

(1) Using two "V" blocks, rest the number one journal on one block and the rear main journal on the other block.
(2) Set dial indicator needle to ride against the center main bearing and rotate shaft. Record the dial reading. If the reading is excessively high, a new crankshaft or regrinding of the old one, is needed. Compare the dial readings with the manufacturer's specifications to determine whether to replace, regrind, or reuse the crankshaft.

Power Plant Disassemble, Assemble and Repair
(Information Sheet continued)

12. Remove cylinder sleeves.

    a. Use a suitable puller to pull sleeves out of the block. Sometimes wet sleeves may be driven out of the block with a hard wood block.

    b. Remove the capscrews that hold the sleeve in place. If the engine does not have sleeves, have the cylinder rebored at a local machine shop.

13. Remove camshaft.

    a. Remove retaining bolts behind cam gear.

    b. Slip camshaft out of the block. It is not necessary to remove the gear from the camshaft unless the gear needs replacing, in which case it must be done in a press.

    c. Be careful not to let the camshaft lobes scrape on the cam bushing when slipping it out of the block.

    d. Check camshaft with a micrometer to determine the bearing journal and lobe sizes, and compare these measurements with the manufacturer's specifications.

14. Remove valve lifters and check them for excessive wear and pits in the flat surfaces.

15. Remove camshaft bushing.

    a. Use a suitable driver plug fitted to the cam bushing and drive out all bushings.

    b. Camshaft bushings, the heart of good oil pressure, should be replaced on all overhauls.

16. Clean engine block.

    a. Soak block in cleaner tank and wash with hot water.

        Blow out all oil passages with air. If steam cleaner is available, steam the block and force steam through the oil passages.

Power Plant Disassemble, Assemble and Repair
(Information Sheet continued)

b. The block should be cleaned after the cylinders have been rebored.

c. Using 80 grit sandpaper, sand the top of the block and the base where the sleeves are installed. Caution: the cylinder must be clean around the top flange and at the bottom where the "O" rings seal.

d. Check block for cracks.

Up to this point in the overhaul procedure, disassembly of the engine and inspection of its parts, has been emphasized. The emphasis now turns to the installation of new parts and reassembly of the engine. The following procedure should be followed in reassembling the engine and installing parts:

1. Install camshaft bushings.

   a. Coat the surface of the bushings with light number 10 oil and install them in the block with a driving plug.

   b. Make sure that the oil holes in the bushing align with the oil holes in the block.

2. Install cylinder sleeves.

   a. Before installing "O" rings on the sleeve or in the block, try each sleeve in the block to make sure it falls into place without having to be forced.

   b. Install "O" rings on sleeve or in the block, using the lubricant recommended by the manufacturer.

   c. Push sleeve into place with hand or a light tap of a soft mallet hammer.

   d. Check protrusion of sleeve above block to make sure that it comes within the manufacturer's specifications. Shims may be added under sleeve flange to increase the protrusion.

3. Coat valve lifters with number 30-weight oil and install them in the block.

Power Plant Disassemble, Assemble and Repair
(Information Sheet continued)

4. Install camshaft.

   a. Coat bearings with number 30-weight oil.

   b. Slide the camshaft through each bearing. Do not let lobes slide on the bushings.

   c. Check for free rotation of the camshaft. If it does not rotate freely, the bushings have been improperly installed.

   d. Install camshaft retaining bolts, and check end play of shaft with dial indicator to compare with manufacturer's specifications.

5. Install crankshaft.

   a. Remove main cap.

   b. Install new bearing inserts in the block and cap. Make certain that the two bearing halves are installed opposite each other.

   c. Coat bearing with 30-weight oil.

   d. It may be necessary to install one-half of the rear main oil seal.

      (1) Coat back of seal with aviation sealer.
      (2) Soak inside with 30-weight oil.
      (3) Push into channel.

   e. Place crankshaft in the block. Make certain that the camshaft and crankshaft gear timing marks are in line.

   f. Install main bearing caps.

      (1) Place plastic gauge strip on the bearing and install the cap.
      (2) Align marks on caps with marks on the block.
      (3) Install main bearing bolts and locks.
      (4) Torque bolts down, 20 pounds at a time, to manufacturer's specifications.

Power Plant Disassemble, Assemble and Repair
(Information Sheet continued)

(5) Remove cap and read plastic gauge on the bearing. This indicates the bearing clearance. If too much clearance is read, oversized bearings are needed.

g. Check crankshaft end-play.

6. Install front timing cover.

a. Install front crankshaft seal in cover.

(1) Coat outside of seal with aviation sealer.
(2) Coat inside with number 30-weight oil.
(3) Tighten all bolts uniformly.

7. Install crankshaft pulley.

a. Coat pulley seal surface with 30-weight oil.

b. Make sure inside of pulley is clean. If it is not, use sandpaper to clean and clear it.

c. Use a block of wood and hammer to tap the pulley into the crankshaft and install retainer.

8. Install pistons on connecting rod.

a. Read manufacturer's instructions for installing rings.

b. Check rings for size.

(1) Insert rings in cylinder and measure end gap with feeler gauge. All rings except the oil rings, must be checked.
(2) Check manufacturer's specifications to be within clearance limits. If ring end clearance is inadequate, it should be filed.

c. Check piston cylinder clearance.

Insert piston into cylinder and check side clearance to be within manufacturer's specifications.

Power Plant Disassemble, Assemble and Repair
(Information Sheet continued)

d. Assemble connecting rod and piston.

(1) Have the pin and bushing fitted at a machine shop that has honing and aligning equipment.
(2) Install piston and rod together, making sure the mark on top of the piston is toward the front of the engine and the mark on the rod is in proper relation to the camshaft.
(3) Install locks on pins.
(4) Caution: follow manufacturer's guide for locating piston to rod alignment.

9. Install piston and connecting rod in the sleeve.

a. Install rings on the piston with a recommended ring expander.

(1) Carefully place each ring on the piston with the top marking up.
(2) Make sure rings are in the right grooves.
(3) Follow ring manufacturer's specifications for installing rings on piston.

Example: (a) Oil ring should be installed in the bottom groove with the level toward the top.
(b) The scraper ring must be installed in the second groove with the outside notch down.
(c) The compression ring must be installed in the top piston groove with the inside notch up.

b. Remove rod cap.

c. Cover piston and rings with number 30-weight oil.

d. Place ring compressor around piston and compress rings. Note: Follow the manufacturer's specifications for the type of compressing tool to use.

e. Slide skirt of piston into sleeve, making sure the notch or arrow is toward the front of the block.

Power Plant Disassemble, Assemble and Repair
(Information Sheet continued)

f. Tap piston into sleeve with hammer handle. Only light pressure is needed to force the piston out of the ring compressor. Make sure the connecting rod aligns with the crankshaft as the piston is tapped into the cylinder. Be careful not to scratch the crankshaft journals.

g. Install rod bearing and check.

(1) Coat the upper half of the bearing insert with 30-weight oil and insert in the connecting rod.
(2) Push connecting rod with piston attached down onto crankshaft.
(3) Install lower half of bearing insert into the cap and cover with oil.
(4) Place a strip of plastic gauze on the insert in the cap.
(5) Install cap on connecting rod.
(6) Tighten rod bolts or nuts according to manufacturer's specifications.
(7) Remove rod bolts or nuts and read the plastic gauge. Compare these clearance readings with the manufacturer's specifications. If the clearance is greater than those prescribed by the manufacturer, use oversized bearings and repeat steps five and six.
(8) Install lock nuts and bend metal locks around nuts.
(9) This procedure should be used when installing all rod bearings.

10. Overhaul and install the oil pump.

a. Disassemble oil pump.

(1) Remove gear from pump, using suitable puller.
(2) Remove all parts from pump and clean them thoroughly.
(3) One should install an oil pump overhaul kit, which includes new gears, shaft, gasket, and pressure regulating valve, when overhauling an oil pump.
(4) Install new pump parts.

(a) Check backlash between gears.

Power Plant Disassemble, Assemble and Repair
(Information Sheet continued)

(b) Check gear-to-housing clearance.
(c) Check gear end clearance.
(d) Compare these findings with manufacturer's specifications. If the readings are higher than those set down in the manufacturer's specifications, replace the housing.

(5) Install pump into the block, torque bolts to manufacturer's specifications, and lock with wire or metal locks.
(6) Fill oil pump inlet tube with number 30-weight oil to aid in priming the pump.

11. Install oil pan.

a. Coat block with aviation sealer and stick gasket to it.

b. Install pan and tighten bolts. Do not tighten bolts too tight, as they will break the gasket.

12. Recondition cylinder head.

a. Clean head.

(1) Using a 1/4 hp. drill with a wire brush, remove carbon from the head.
(2) Use a carbon scraper to remove excess carbon that cannot be removed with a wire buffer.
(3) Clean around valve seats.
(4) Wash the head in a cleaning solution and then hot water.

b. Remove and replace valve guides.

(1) Drive guides out of head with a suitable guide driver and hammer.
(2) Using emery paper, clean hole in head where guides are inserted.
(3) Wipe guides and blow area around guide holes clean with compressed air.
(4) Coat guide with number 10-weight oil and drive in place with driver and hammer.

Power Plant Disassemble, Assemble and Repair
(Information Sheet continued)

(5) Follow manufacturer's specifications for length of guide protrusion.

c. Grind valve seats.

(1) Select valve guide pilot to fit guide.
(2) Select a stone to fit the valve seat outside diameter and the degree of angle on the seat.
(3) Set grinder on the seat and reface the seat.

(a) Make sure the seat is within allowable limits for width of seat.
(b) If the seat is too wide, use a 15° and 75° stone to narrow the seat.

d. Using a straight edge, check the head for warp.

e. Reface valves.

(1) Clean valves with wire brush.
(2) Using a micrometer, measure the valve stem for comparison with the manufacturer's specifications.
(3) Set valve grinding machine for proper valve face angle.
(4) Reface all valves.

Check valve head thickness after grinding to be certain it is within manufacturer's specifications.

(5) Resurface valve stems on grinding machine.
(6) Place valve in the head and check margin of seat on valve face with bluing. Grind seat to bring it within manufacturer's specifications, and allow proper valve seating.
(7) Check valve springs.

(a) Using a valve spring tester, check spring length and the tension at a given length.
(b) Compare these measurements with the manufacturer's specifications and replace valve springs not within manufacturer's limits.

Power Plant Disassemble, Assemble and Repair
(Information Sheet continued)

(8) Coat valves and stems with number 30-weight oil and place in the head.
(9) Install valve spring and keeper.

(a) Check valve spring to see if there is any difference in the top and bottoom by check-for coils being close together.
(b) Install valve seals on stem of valve if recommended by the manufacturer.

f. Clean and check energy cells.

Note: Some diesel engines use what is called an "energy cell" or "precombustion chamber" to increase combustion efficiency.

(1) Remove cell from head.

(a) Remove bolts from cell.
(b) Remove bolts from cell hold-down bars.
(c) Remove bars and caps.
(d) Remove cell with the necessary special puller and slide hammer, and check for burnt tips and enlarged hole. Keep all cells and caps together.
(e) Soak cell in carbon remover, wash, and blow dry with compressed air.
(f) Lap the cap and cell on a special lapping tool.
(g) Clean hole in head and check for burnt places where cell may leak. If the cell has been leaking, replace the compression.
(h) Replace any burnt cell.
(i) Assemble and install in reverse order, following the procedure outlined by the manufacturer.
(j) Torque nuts and hold-down bar to manufacturer's specifications.

13. Install head on block.

a. Install a new head gasket.

Power Plant Disassemble, Assemble and Repair
(Information Sheet continued)

b. Coat gasket with a recommended gasket sealer.

c. Install all head bolts and snug them down.

d. Use torque wrench to finish tightening head bolts. Follow manufacturer's sequence for torquing head bolts.

14. Install push rods.

Make certain that each rod is set in the valve-lifter socket.

15. Recondition rocker arm assembly.

a. Remove all arms from shaft.

(1) Remove cotter pin and washer.
(2) Note where oil holes are in respect to the shaft.

b. Resurface all rocker arms on valve refacing machine.

c. Check rocker arm shaft with micrometer for excessive wear and compare with manufacturer's specifications.

d. Clean shaft internally to keep sludge from plugging oil holes.

e. Assemble rocker arms and shaft.

16. Install rocker arm assembly on head.

a. Fit all rocker arm balls into socket of push rod.

b. Make sure oil feed stud on line is in the proper place.

c. Back up adjusting screws.

d. Tighten rocker arm assembly to head.

Power Plant Disassemble, Assemble and Repair
(Information Sheet continued)

17. Adjust valves.

    They should always be adjusted cold before starting engine.

18. Install valve cover.

    Coat valve cover with sealer and stick gasket to it. Do not coat the other side of the cover gasket.

19. Overhaul and install distributor (gasoling tractor only).

    a. Remove distributor cap.

        (1) Check for cracks, corrosion on points, and other signs of wear.
        (2) Remove rotor and inspect.

    b. Remove points.

        Check conditions of points.

    c. Remove condensor.

        Test condensor on tester.

    d. Remove point plate.

    e. Check spark advance weights for sticking.

    f. Check spark advance spring tension.

    g. Check distributor shaft and bushing for excessive wear.

    h. Assemble in reverse order.

    i. Lubricate advance weights with number 10-weight oil.

    j. Install new points and condensor.

    k. Adjust the distributor to the manufacturer's specifications on high cam and lubricate cam with distributor cam grease.

Power Plant Disassemble, Assemble and Repair
(Information Sheet continued)

1. Install rotor and cap.

20. Install and time distributor.

21. Install spark plug wires.

    a. Check spark plug wires for cracks and bad insulation.

    b. Check terminals, making certain that they fit tight in the distributor cap and on the spark plug.

    c. Check the spark plug firing order.

        (1) Remove the spark plug in the number one cylinder
        (2) Rotate crankshaft until the number one piston is almost at the top of the compression stroke.
        (3) Insert spark plug.
        (4) Install the wire on the spark plug and in the distributor cap wire plug opening which the rotor in the distributor points to.
        (5) Install the remaining wires in rotation, running them to the plugs according to the firing order.
        (6) The cylinders are numbered starting with the first cylinder, which is the closest to the radiator, and counting back.

22. Install injector pump (diesel tractor only).

    a. Rotate engine to bring the number one cylinder to the top of its compression stroke.

    b. Line up crankshaft pulley on flywheel timing marks.

    c. Turn the injector pump to proper timing mark and slide it into the block, meshing the gear on the pump with the gears on the crankshaft.

    d. Recheck alignment of all markings.

    e. Reassemble all parts in the reverse order.

Power Plant Disassemble, Assemble and Repair
(Information Sheet continued)

23. Overhaul and install water pump.

a. Remove fan from the pump.

b. Remove fan hub and pulley with a pulley puller and mark the position of the hub on the shaft.

c. Remove rear pump cover.

d. Remove pump impeller from shaft.

e. Remove seal assembly.

f. Remove snap ring and then shaft and bearing from the pump housing.

g. Clean housing with a scraper and sand paper and blow clean with compressed air.

h. Install new water pump kit.

(1) Using soft hammer, tap shaft and bearing into housing, and install snap ring.
(2) Install new seal in the pump impeller.
(3) Press impeller into place on the shaft. Do not tap on the shaft or seal, as it will break the seal.
(4) Press fan hub onto shaft in its original position.
(5) Install gasket and rear pump cover.
(6) Install a new pump gasket.
(7) Install pump on engine.

24. Overhaul and install generator.

a. Overhaul generator.

(1) Remove and inspect generator cover.
(2) Remove terminal wire from armature brush holder
(3) Remove wire from field to armature brush.
(4) Remove long bolts from the commutator end-frame, and remove frame and generator brushes.
(5) Remove field housing from pulley end-frame. Remove the pulley by removing the attachment nut and pressing the shaft from the pulley.

Power Plant Disassemble, Assemble and Repair
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(6) Remove pulley key and top armature shaft from the bearing.
(7) Remove bearing from frame and check, clean, and repack it with grease. Clean generator parts in cleaning solution, wash with water, and blow dry with air under low pressure.
(8) Check commutator end-frame bushing and armature shaft for excessive wear. Replace bushing, if necessary.
(9) Check armature

(a) Grawler test
(b) Induction test
(c) Light short test

(10) Check field coil.

(a) Light continuity test
(b) Light short test

(11) Turn commutator on metal turning lathe and undercut mica. Smooth commutator with fine sandpaper.
(12) Install new brushes and make certain they fit properly against the commutator.
(13) Assemble the generator, reversing the disassembly order outlined above.

b. Install generator on engine.

(1) Install new fan belt and tighten.

(2) Polorize generator.

25. Overhaul and install starter.

a. Remove starter and inspect its parts.

b. Remove screws holding field wires to brush holders.

c. Remove end-frame bolts and frame. Center punch housing for use in aligning the frame and housing.

Power Plant Disassemble, Assemble and Repair
(Information Sheet continued)

d. Remove bolts from drive-end frame and remove the frame.

e. Remove armature from field housing.

f. Remove and inspect drive mechanism.

(1) Check for broken spring.
(2) Check for sheared drive bolt.
(3) Check for untrue gear teeth.
(4) Check for sticking screw mechanism caused by heavy grease, oil, or rust.
(5) Clean parts, install new parts, as needed, and lubricate with 10-weight or a lighter oil.

g. Check field coils.

(1) Use light test for continuity.
(2) Use light test for detecting a short.

h. Check armature.

(1) Use grawler test.
(2) Use light test for shorts.
(3) Use grawler test for induction.
(4) Turn commutator on metal lathe. Do not undercut the mica on a starter commutator.

i. Check end-frame bushing for excessive wear, and replace if necessary.

j. Check armature lamination for wear, which would suggest worn bushings.

k. Seat new bushings on commutator.

l. Reassemble starter, and install on the engine.

26. Install water manifold.

a. Check thermostat.

(1) Place the thermostat in a pan of water.

Power Plant Disassemble, Assemble and Repair
(Information Sheet continued)

(2) Heat the water with a torch.
(3) Note the temperature of the water when the thermostat opens.
(4) Check this temperature reading with the manufacturer's specifications for temperature at which the thermostat should open. If the thermostat does not open within manufacturer's specifications, replace it with a new one.

b. Install thermostat in the head, with coil toward the block.

c. Install water manifold gasket and water manifold on the head.

27. Install intake and exhaust manifold.

a. Scrape and sand head and manifold gasket surfaces.

b. Install gasket on head.

c. Install manifold.

d. Torque bolts uniformly to meet manufacturer's specifications.

27A. On diesel engines the manifold heater must be cleaned and adjusted at this stage in the overhaul procedure.

a. Remove heater from manifold.

b. Check for burnt insulator material that may be shorting heater element.

c. Check insulated bolts.

d. Check element for burnt spots.

e. Check element for proper ground.

f. Reassemble element and install in the manifold.

g. Test the heater element.

(1) Connect manifold to the positive post of a 1250 battery.
(2) Connect insulated terminal to negative post. Wait 60 seconds and check the element. It should be red hot.

Power Plant Disassemble, Assemble and Repair
(Information Sheet continued)

28. Overhaul and install fuel injectors (diesel only).

a. Remove injectors and attach to pump injector tester.

(1) Note pressure build-up until the injector injects fuel.
(2) Keep hands away from the injector nozzle, as the fuel is under high enough pressure to penetrate the skin.
(3) Watch spray pattern.
(4) Check injector to see if it will hold pressure to within 300 lbs. of pop-off without leaking at tip.

b. Clean injector.

(1) The injector should be cleaned and reset according to the procedures outlined by the manufacturer.
(2) Cleanliness is of utmost importance here because all parts are built with close tolerance.

c. Install injector after overhauling the engine.

d. Using a piece of dowl stick wrapped in a soft cloth, wipe the injector hole clean.

e. Place a new copper gasket on the injector and install the injector in the head.

f. Tighten the injector hold-down nuts uniformly, according to manufacturer's specifications.

g. Install fuel lines.

Note: The following procedure should be carried out after the fuel filters are cleaned.

h. Bleed injector.

(1) Loosen all injector lines at the injector and set the throttle to start.
(2) Crank engine until fuel leaks from lines.
(3) Close all lines and start engine.
(4) Loosening one line at a time, let all air out of the line.

Power Plant Disassemble, Assemble and Repair
(Information Sheet continued)

29. Overhaul and install governor (gasoline tractor only).

    a. Clean governor.

    b. Disassemble unit and check for the following:

        (1) Worn linkage
        (2) Worn weight pins
        (3) Worn and flat spots on weight balls
        (4) Worn bearing, bushing, and shaft
        (5) Worn and broken thrust bearing
        (6) Tension on governor spring

    c. Reassemble entire unit.

    d. Install new gasket, using aviation sealer to seal gasket to housing, and install the governor on the engine.

30. Overhaul and install carburetor.

    a. Disassemble entire carburetor.

        (1) Remove screw around the float, and split carburetor.
        (2) Remove float by slipping pin out of bracket.

            (a) Check float for dents.
            (b) Shake float to see if there is fuel inside it.

        (3) Remove float needle valve assembly, seat, and seat gasket.

            (a) When installing the seat, make sure the new seat gasket is in place.
            (b) Needle, seat, and gasket should always be replaced for good fuel regulation.

        (4) Remove all jets.
        (5) Soak all parts in a carburetor cleaning solution for one hour.
        (6) Wash with hot water, and blow dry with compressed air.

Power Plant Disassemble, Assemble and Repair
(Information Sheet continued)

b. Assemble carburetor.

(1) Install carburetor overhaul kit.
(2) Install jets in the lower and upper carburetor housing
(3) Install float seat in upper carburetor housing.
(4) Install float and pin. Adjust float according to manufacturer's specifications.
(5) Reassemble remaining parts.
(6) Check choke butterfly to see that the anti-flooding valve is operating properly.
(7) Preset all outside adjustments to manufacturer's specifications.

c. Install new carburetor flange gasket.

d. Install carburetor on the engine.

e. Start engine and set the carburetor for maximum R. P. M.'s by adjusting the governor spring according to the manufacturer's specifications.

31. Set spark plug gap and install spark plugs.

a. Measure the spark gap with a feeler gauge. Compare this gap with the manufacturer's specifications and adjust with a bending tool.

b. Attach spark plug wires.

32. Install oil filter.

a. Install gasket on oil filter bracket, using aviation sealer and bolt filter to block.

b. Soak oil filter element in either number 10-or number 20-weight oil and install filter in bracket.

33. Remove, clean, and install fuel filters (Diesel tractors only).

a. Remove primary fuel filter element. This is the filter closest to the tank.

Power Plant Disassemble, Assemble and Repair
(Information Sheet continued)

(1) Turn fuel off at tank.
(2) Remove cap screw from top of bracket.
(3) Remove fuel filter cup.
(4) Remove element from filter cup.
(5) Wash filter cup in diesel fuel.
(6) Install new elements in filter cup.
(7) Fill filter cup with clean diesel fuel.
(8) Install filter cup in bracket, and install on the engine.

b. Bleed filter.

(1) Loosen bleed screw on the top of the filter. Turn fuel on and open bleed screw until air bubbles cease.
(2) Tighten bleed screw.

c. Clean secondary filter.

(1) Turn fuel valve off.
(2) Disconnect fuel lines.
(3) Remove filter from bracket.
(4) Remove fuel line fittings from old filter.
(5) Discard old filter.
(6) Reinstall fuel line fittings in new filter, using aviation sealer on fittings.
(7) Reassemble secondary filter.
(8) Turn fuel valve on.
(9) Loosen bleed screw in the top of the filter and let the air out of the filter cup.

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Material for this information sheet was taken from Module No. 16, "Tractor Repair", The Center for Research and Leadership Development in Vocational and Technical Education, The Ohio State University, Columbus, Ohio.

Agricultural Education
Teaching Materials Center
College Station, Texas
******
Texas Education Agency
Texas A&M University
(cooperating)

Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Lubricants and Lubricating Systems

TOPIC: Lubricants (Engine oils and their functions)

OBJECTIVE: To develop an understanding of oils and their function in an internal combustion engine.

INTRODUCTION: How long can an engine be run without oil and not harm it? First let's say that it is possible to run an engine without oil for a short period of time however the resulting damage is usually beyond repair. Proper lubrication of a tractor engine is a major factor in its continued efficient operation at low maintenance costs. It is obvious that oil serves as a lubricant to prevent metal to metal contact. Oil also has other equally important functions which are not so obvious but should be equally as well understood by the tractor mechanic. It is generally agreed that crankcase oils perform five major functions in engine lubrication. These are:

1. Lubricate moving parts
2. Assist in cooling
3. Seal the combustion gases in the cylinders
4. Aid in keeping the engine clean
5. Protect against rust and corrosion

In the remainder of this assignment we will attempt to determine what is required of a crankcase oil to perform these functions.

REFERENCES: Required:

1. Gulf Farm Tractor Guide

2. Tractor Maintenance AAAE + VA, pp. 18-21

UNIT: Lubricants and Lubricating System
TOPIC: Lubricants (Engine oils and their functions)
(Assignment Sheet continued)

3. "Farm Tractors - Basic Principles, Operation, and Maintenance", Engineering Bulletin FT, pp. 63-64.

Supplemental:

4. Selecting and Storing Tractor Fuels and Lubricants, pp. 27-39.

QUESTIONS or ACTIVITIES:

1. To lubricate all parts of an engine properly, oil must possess the proper "body". What is meant by "body"?

2. How does body affect lubricating qualities of oil?

3. What is viscosity?

4. How does heat affect viscosity?

5. What causes thickening of oil after long continued use in LP - Gas engines?

6. Even though the same chemical reaction occurs (as in 5 above) in gasoline and diesel engines, why is the same result of thickened oil not apparent?

7. What are the major engine parts which depend almost entirely upon the circulation of oil for cooling?

8. What specifically happens when the circulation of oil through the bearings of an operating engine is interrupted?

9. What is the most important characteristic of an oil if it is to seal properly?

10. How do detergent - dispersant oils keep an engine clean?

UNIT: Lubricants and Lubricating Systems
TOPIC: Lubricants (Engine oils and their functions)
(Assignment Sheet continued)

11. Under what types of operating conditions are detergent - dispersant crankcase oils especially valuable in keeping engines clean?

12. Why does contamination of oil occur more readily under the conditions specified in number 11 above?

13. Why is it that all oils do not prevent rust and corrosion in engines?

14. What happens to oil additives as they perform their functions in an engine?

15. List five specific contaminants which make it more advisable to change oil because of oil contamination rather than because of oil deterioration.

VOCABULARY: The following key words or terms have been used in this assignment and should now be a part of your vocabulary. Explain or define each:

Viscosity	Oil contaminants
Oxidation	Detergent - dispersant
Dilution	Additive

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Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Lubricants and Lubricating Systems

TOPIC: Lubricants: Crankcase-Oil Viscosity (Grade) and Crankcase-Oil Type (Service Classification)

OBJECTIVE: To develop the ability to select the proper oil for a tractor engine.

INTRODUCTION: Just any oil is not good enough. The preceding statement does not refer to brand names but to actual viscosity and type of oil as have been scientifically determined and stamped on the container. On an oil container we will find designations of viscosity (grade), such as SAE 30, SAE 20W, SAE 10W-30 or some other SAE designation. We will also find single or multiple designations of API service classifications (type), for example ML or MS, DG and others, all of which will be studied in this assignment.

The operator's manual is the key to determining the viscosity grade and the crankcase oil type to be used for a specific engine. However, there are other factors to consider which will require knowledge of the grade and classification systems as well as good judgment on the part of the mechanic who may service the tractor or advise the operator as the the characteristics to look for in an oil.

To illustrate this point study the attached table from John Deere Operator's Manual, OM-R39699, 3020 Tractors.

By careful study of the table you will note that AIR TEMPERATURE will determine the oil viscosity (SAE Grade). The other factor, EXPECTED TYPE OF ENGINE SERVICE, will determine the crankcase oil type (API Service Classification) which should be used.

UNIT: Lubricants and Lubricating Systems
TOPIC: Lubricants: Crankcase-Oil Viscosity (Grade) and Crankcase-Oil Type (Service Classification)
(Assignment Sheet continued)

After studying the introduction to this assignment, by careful reading of the references and answering the following questions, you should have a working knowledge of the factors involved in selecting the proper oil for a tractor engine.

REFERENCES: Required:

1. Selecting and Storing Tractor Fuels and Lubricants, pp. 28-29, 34-36. Questions 1-9; pp. 28-29, 10-12; page 34.

2. Information Sheet on "Oil Grades and Service Classification."

Supplemental:

3. "Farm Tractors-Basic Principles, Operation, and Maintenance " Engineering Bulletin No. FT-53, pp. 64-65, 69.

4. "Gulf Farm Tractor Guide", pp. 16-18.

QUESTIONS or ACTIVITIES:

1. What does SAE mean when used preceding a viscosity grade?

2. A lower viscosity grade number indicates that the oil is more fluid or less fluid?

3. What does the "W" indicate which follows the SAE number of the lower viscosity numbers?

4. What single-viscosity grades are available at the present time?

5. Why do viscosity recommendations issued by a tractor company vary with different types, sizes and models of tractors, as well as for different temperature operating conditions?

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Information Sheet
on
LUBRICANTS AND LUBRICATING SYSTEMS

Gear oils are primarily used in the transmissions and rear-axle housings of agricultural machinery. In many respects they are similar to heavy crankcase oils, but their functions are somewhat different. They are given different viscosity-grade numbers (SAE: 80, 90, and 140) and different API classifications to prevent their being confused with crankcase oils.

As tractor horsepower has increased, gears have been improved to meet increased pressure and greater work loads. Gears have become smaller and tooth pressure has increased. In addition to the rolling action which occurs between gear teeth, gears go through a wiping action that tends to wipe away the oil layer separating the two gear surfaces. Additives have been added to gear oils to meet the more severe operating conditions now encountered and to cut down on the wear of gears caused by these increasingly severe operating conditions.

Temperature affects the viscosity of gear oils in the same manner that it affects crankcase oils, Therefore, it is necessary to consider viscosity grade and type classification when selecting gear oils.

1. Gear oil of proper viscosity has enough body to hold moving surfaces apart.

2. If gear oil is too heavy, engine power is wasted; the oil may channel and provide little or no lubrication thus making gears very hard to shift.

3. If the gear oil is too light, the oil film becomes so thin that high points on the sliding surfaces contact and wear rapidly.

Gear oils, like crankcase oils, contain certain kinds of additives depending upon their service classification. These additives include:

1. Anti-oxidants
2. Rust preventatives
3. Foam inhibitors

Lubricants and Lubricating Systems
(Information Sheet continued)

Lubricating grease is basically a lubricating oil with a soap-type thickening agent added to give it consistency. Different types of grease are used on agricultural machinery as determined by the operating requirements of a particular piece of equipment.

1. Lime soap is used in chassis grease; this results in a water-resistant grease that can be used anywhere where high operating temperatures are not present.

2. Soda soap is used to form a semi-smooth grease and is often referred to as wheel-bearing grease.

3. Lithium soap combines the water resistance and heat resistance of the other greases to provide a multipurpose lubricant that is suitable for all-round use on farm machinery.

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Material for this Information Sheet was taken from Agricultural Machinery Assembly and Lubrication, The Center for Research and Leadership Development in Vocational and Technical Education, The Ohio State University, Columbus, Ohio.

UNIT: Lubricants and Lubricating Systems
TOPIC: Lubricants: Crankcase-Oil Viscosity (Grade) and Crankcase-Oil Type (Service Classification)
(Assignment Sheet continued)

Table From John Deere 3020 Tractor Operator's Manual OM - R39665

ENGINE OR AIR CLEANER OIL VISCOSITY

Depending upon the prevailing air temperature, use the following weight of oil in the engine crankcase and air cleaner:

DIESEL

Air Temperature	Single-Viscosity Oil	Multi-Viscosity Oil
Above 32°F. -10°F. to 32°F. Below-10°f.	SAE 30 SAE 10W	SAE 20W-40 SAE 10W-30 SAE 5W-20*

GASOLINE OR LP-GAS

Air Temperature	Single-Viscosity Oil	Multi-Viscosity Oil
Above 90°F. 32°F. to	SAE 30	SAE 20W-40
90°F. -10°F. to 32°F.	SAE 20W	SAE 10W-30
Below -10°F.	SAE 10W	SAE 10W-30
	SAE 5W*	SAE 5W-20

*Use of SAE 5W or 5W-20 oil may cause some increase in oil consumption. Check oil level more often when using this oil.

Be sure to select the oil you will use both by viscosity and by expected type of engine service; for example - ASE 20W-40, Service DS, for diesel engines; or SAE 20W-40, Service MS, for gasoline or LP-Gas engines.

UNIT: Lubricants and Lubricating Systems
TOPIC: Lubricants: Crankcase-Oil Viscosity (Grade) and Crankcase-Oil Type (Service Classification)
(Assignment Sheet continued)

6. What results may be expected from using a lighter grade oil than is recommended?

7. What results may be expected from using a grade that is too heavy?

8. What are "multi-viscosity" oils?

9. How many grades of a single-grade oil may a multi-grade oil replace?

10. What do the letters API mean?

11. What do the following letters mean?
ML; MM; MS; DG; DM; Ds

12. Which API Service Classification is not recommended by any farm tractor manufacturer?

13. Using the table from the John Deere Operator's Manual and table IV, page 36, Reference 1, determine the SAE Grade and minimum API Class of oil to use for the following conditions: Determine for both spark ignition and diesel.
    a. Air temperature 80° F., mowing.
    b. Air temperature during working hours 80°-110° F., mowing.

ADDITIONAL INFORMATION: Under the current API Classifications disregard such terms as "Regular," "Premium," and "Heavy Duty," as they are not necessarily meaningful.

VOCABULARY: The following key words or terms have been used in this assignment and should now be a part of your vocabulary. Explain or define each:

Operator's manual
LPG
Multi-viscosity
SAE Grade
API Service Classification

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Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Lubricants and Lubricating Systems

TOPIC: Lubricants: Gear Oils, Hydraulic Oils, and Lubricating Greases

OBJECTIVE: To develop an understanding of the requirements for oils and greases in tractor lubrication and to develop the ability to select oils and greases for tractor lubrication other than for the engine.

INTRODUCTION: A hunter must know the caliber of his weapon and the purpose for which it is to be used before he can select the proper ammunition. A tractor mechanic should be just as knowledgeable about a tractor before making recommendations or servicing a transmission, differential, power take-off, pulley housing, final drive, or hydraulic system. The Farm Tractor Tune-Up and Service Guide (see reference) and also individual operator's manuals are very specific as to recommendations for the lubrication of each part of the tractor. These recommendations not only vary between manufacturers but also may vary between models of the same make. For example, some tractors use the same lubricant for the transmission and hydraulic system, whereas others require specific gear oil for one and a hydraulic oil for the other. Lubrication is the best preventive maintenance that can be performed but the lubricant must be used which has been determined by the manufacturer to satisfy the requirements of a particular machine. Never guess - look it up!

In the remainder of this assignment a closer look will be taken at gear oils, hydraulic oils, and lubricating greases. Opportunity will also be provided to compare the oil requirements of different makes of tractors.

UNIT: Lubricants and Lubricating Systems
TOPIC: Lubricants: Gear Oils, Hydraulic Oils, and Lubricating Greases
(Assignment Sheet continued)

REFERENCES: Required:

1. Information Sheet, "Lubricants and Lubricating Systems".

2. Selecting and Storing Tractor Fuels and Lubricants, pp. 40-45.

3. Farm Tractors-Basic Principles, Operation, and Maintenance. Engineering Bulleting No. FT-53, Table V, page 82.

4. Farm Tractor Tune-Up and Service Guide.

Supplemental:

5. Operator's Manual for the make of tractor student is studying.

QUESTIONS or ACTIVITIES:

1. Why are gear oils given a different set of viscosity-grade numbers and a different set of API classification (types) than crankcase oils?

2. What are the SAE numbers for gear oils? (Reference 2, Table V. page 82.

3. What are the four types of gear oils as established by the American Petroleum Institite?

4. What are the two types commonly used for tractor transmissions and differentials?

5. Why is it that a knowledge of the API service classification of gear oils cannot be used when servicing certain makes of tractors?

6. What are the two purposes for which hydraulic oils are used in tractors?

7. What are the four kinds of oils which may be used (depending on recommendation of the manufacturer) for hydraulic systems?

UNIT: Lubricants and Lubricating Systems
TOPIC: Lubricants: Gear Oils, Hydraulic Oils, and Lubricating Greases
(Assignment Sheet continued)

8. What are the functions of additives which are usually present in hydraulic oils?

9. What type of grease is recommended for most jobs which require a lubricating grease?

10. What are two common additives used in lubricating grease?

11. Using the Farm Tractor Tune-Up and Service Guide, determine the type and grade of oil for the systems of the following tractors.

	Power Steering	Implement Control	Transmission	Differential
WD Allis-Chalmers Gasoline				
John Deere 2-10 Gasoline				
Ford 501 Gasoline				
Oliver 1800 Diesel				

	Power Take-off	Pulley Housing	Final Drive
WD Allis-Chalmers Gasoline			
John Deere 2010 Gasoline			
Ford 501 Gasoline			
Oliver 1800 Diesel			

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Assignment Sheet
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AGRICULTURAL MACHINERY MECHANICS

UNIT: Lubricants and Lubricating Systems

TOPIC: Lubricating Systems

OBJECTIVE: To develop an understanding of how oil lubricates an engine.

INTRODUCTION: The life of an engine depends to a great degree upon the type of lubrication it receives. Some engines require a special oil, some have special fittening devices , others have no filters, while still others have special devices to lubricate the engine.

In this study we will determine what is necessary to properly lubricate an engine.

REFERENCES: Required:

1. Farm Gas Engines and Tractors, Jones, pp. 332-345.
2. Machines for Power Farming, Stone and Gulvin, pp. 62-65.
3. Tractor Maintenance, AAAE and VA, pp. 21-28.

Supplemental:

4. "Gulf Farm Tractor Guide", pp. 36-37.
5. "Farm Tractors-Basic Principles, Operation, and Maintenance", Engineering Bulletin No. FT-53, pp. 59-64.
6. Dealers Manuel

UNIT: Lubricants and Lubricating Systems
TOPIC: Lubricating Systems
(Assignment Sheet continued)

QUESTIONS or ACTIVITIES:

1. A good lubrication system should be:
   a.
   b.
   c.
   d.

2. Although a lubricating system may have the above named features, it must also possess two additional factors to be completely satisfactory. These are:
   a.
   b.

3. The most important parts of a gasoline engine which require lubrications are:
   a.
   b.
   c.
   d.
   e.
   f.

4. Generally, engine lubrication systems may be classified in three groups. These are:
   a.
   b.
   c.

5. What maintains the correct pressure and controls the quantity of oil circulating in the force feed oil system?

6. What is the most widely used type of oil pumps?

7. Any engine having an enclosed crankshaft must have two oil indicators. These are:
   a.
   b.

8. What are two types of oil indicators?
   a.
   b.

UNIT: Lubricants and Lubricating Systems
TOPIC: Lubricating Systems
(Assignment Sheet continued)

9. If engine oil pressure drops rapidly the cause could be one or a combination of the following reasons:
   a.
   b.
   c.
   d.
   e.

10. Why is a breather a necessary part of an enclosed-crankcase engine?

11. What factors may cause oil dilution?

12. Many engines are equipped with a system of crankcase ventilation. What is the purpose of the ventilation system?

13. What is the primary function of an oil filter?

14. Name five ways in which oil filters vary?
   a.
   b.
   c.
   d.
   e.

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Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Fuel Systems

TOPIC: Fuels and Principles of Combustion

OBJECTIVE: To develop an understanding of the properties of fuels and how they produce power.

INTRODUCTION: Will a gasoline engine operate efficiently with diesel fuel? If not, why? Each type fuel has its own characteristics and must be used in engines suited for that fuel.

REFERENCES: Required:

1. Information Sheet, "Fuels and Principles of Combustion".
2. Machines for Power Farming, Stone and Gulvin, Ch. 4.

Supplemental:

3. "Farm Tractors Basic Principles, Operation, and Maintenance," Engineering Bulletin FT-53.
4. "Gulf Farm Tractor Guide".
5. Modern Farm Power, Chapter 5
6. Tractor Fuels and Lubricants, Selecting and Storage, pp. 11-14

QUESTIONS or ACTIVITIES:

1. List the five essential characteristics of internal combustion fuels.
2. Fuel for internal-combustion engines are classified in two ways. Name them.

UNIT: Fuel Systems
TOPIC: Fuels and Principles of Combustion
(Assignment Sheet continued)

3. What are the three main classifications of fuel?

4. What are the three leading sources of LP gas?

5. What are the most common types of liquid fuels?

6. What is volatility?

7. Gasoling for automotive vehicles and stationary power units is available in what grades?

8. Distinguish between detonation and preignition.

9. Define and explain combustion as applied to internal combustion engine and hydrocarbon fuels.

10. What is octane rating of fuel?

11. How is diesel fuel graded and what are the main grades?

12. What is centane rating of diesel fuels?

13. What are the two worst enemies of diesel fuel?

VOCABULARY: The following words or terms have been used in this assignment and should be a part of your vocabulary. Define or explain each:

Distillate

LP gas

Detonation

Preignition

Combustion

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Information Sheet
on
FUELS AND PRINCIPLES OF COMBUSTION

Fuels for an internal combustion engine must be specific in nature for its operation to be successful. These fuels must have a reasonably high energy value, yet be of such nature that they can be handled and transported easily and safely. These fuels must vaporize at least partially at fairly low temperatures and the vapors must ignite and burn readily when mixed with oxygen in correct proportions. These fuels must also be relatively safe for use and not too harmful or dangerous to human health and life.

Fuels for internal combustion engines may be classified as either gaseous or liquid according to the physical state before entering the engine cylinder. These fuels are also classified according to their origin as natural or artificial. The most common gaseous fuels derived from a natural origin is natural gas and LP gas. Natural gas, due to its properties, is used very limited for internal combustion engines. LP gases are used more frequently and are by-products of petroleum refining process.. LP gases are derived (1) from dry gas and gasoline as it is removed from crude oil, (2) from recycling plants from the wet gas drawn from natural gas wells, or (3) from the normal processing of crude oil into commercial gasolines and distillates.

The more common types of liquid fuels derived from petroleum are gasoline, kerosene, distillate and diesel. These fuels are more easily stored and transported than the gaseous fuels.

The above mentioned fuels are of a natural origin, orininating from petroleum. There are many variations in character of crude oil depending somewhat upon the location where it was obtained. In the refining process of crude oil it is converted into hundreds of commercial products by various distillation and refining processes. One of these products is gasoline. Today we have four grades of gasoline available. These are white or fourth grade, regular, premium, and super premium. Premium grade gasolines have the best anti-knock characteristics and are usually somewhat higher quality fuels. Although a person may use the highest quality fuel possible, there are still some impurities that may cause trouble. The two main natural impurities are gum and sulphur.

Fuels and Principles of Combustion
(Information Sheet continued)

Today the tendency toward higher compression rations have caused a need for some change in tractor and automotive fuels. This higher compression has resulted in a pronounced fuel knocking effect termed detonation. Often this is confused withpreignition, however, there is a distinctive difference. Detonation occurs during the process of combustion , whereas preignition occurs when the fuel change is fired too far ahead of the compression dead center position of the piston. Today anti-knock additives such as tetraethyl lead is being used in gasoline to assist in eliminating engine knocks.

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Material for this Information Sheet was taken from Farm Gas Engines and Tractors, Jones. Fourth Edition.

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Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Fuel Systems

TOPIC: Gasoline Systems

OBJECTIVE: To develop an understanding of the parts of a gasoline fuel system and their functions.

INTRODUCTION: We know that an engine utilizes air and fuel in its process of operation, but do you understand how these are utilized? Will an engine run on gasoline without air? Just how is the air and gasoline mixed?

In this topic we will study the function of the gasoline fuel system and its operation in relation to the whole engine.

REFERENCES: Required:

1. Modern Farm Power, Ch. 6
2. Machines for Power Farming, Stone and Gulvin, Ch. 4
3. "Farm Tractors, Basic Principles, Operation and Maintenance, " Humble Engineering Bulletin No. FT-53, pp. 10-18

Supplemental:

4. Service manual for make of tractor being studied.

QUESTIONS or ACTIVITIES:

1. What is the function of the carburetor?
2. How do air-fuel mixtures differ in cold or hot engines?
3. What are the four systems of a carburetor?

UNIT: Fuel Systems
TOPIC: Gasoline Systems
(Assignment Sheet continued)

4. What are two types of carburetors classified according to the direction of air travel through them?

5. Explain the function of the manifold heat control.

6. What is a simple type test a person can use to check the float level of a carburetor?

7. Explain how to adjust the idle screws of a carburetor?

8. Explain the adjustment of the load system of a carburetor.

9. What is the venturi? Explain its function in the carburetor.

10. What is responsible for maintaining a constant fuel level in the carburetor and why is it important to maintain a constant level?

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Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Fuel Systems

TOPIC: L. P. Gas Systems

OBJECTIVE: To develop an understnading of the operation, care, and utilization of liquefied petroleum gas on farm tractors.

INTRODUCTION: In what ways are LP Gas tractors like gasoline tractors? In what ways do they differ? Will they perform the same as a gasoline tractor? These questions and others will be studied in this unit and with careful reading and study you can make these comparisons.

REFERENCES: Required:

1. Tractor Maintenance Principles and Procedures, pp. 62-63.
2. Information Sheet, "Liquid Petroleum Systems"
3. Farm Tractors, Basic Principles, Operation and Maintenance, FT-53.
4. "Gulf Farm Tractor Guide".

Supplemental:

5. Modern Farm Power, Bishop and Promsberger.

QUESTIONS or ACTIVITIES:

1. Why is butane and propane mixed for tractor fuel purposes?
2. Why is butane and propane mixed for storage?
3. What are the primary differences between a gasoline and LP engine? Trace the LP gas through its fuel system.

UNIT: Fuel Systems
TOPIC: L. P. Gas Systems
(Assignment Sheet continued)

4. What are the advantages of LP gas over gasoline?

5. On a per gallon basis, which fuel, gasoline or LP gas, has the most power? Explain.

6. What are the disadvantages of LP gas?

7. Explain the differences in carburetors of gasoline and LP gas engines?

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Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Fuel Systems

TOPIC: Governors

OBJECTIVE: To develop an understanding of the purpose of an engine governor and to determine how it operates.

INTRODUCTION: In farm work it is almost essential that stationary engines maintain a constant speed whether under load or not. To do this the engines are equipped with governing devices.

In this lesson we will study the governing device, its construction, its operation, and how it will effect engine operation.

REFERENCES: Required:

1. Modern Farm Power, Promersberger and Bishop, Ch 8.

2. Tractor Maintenance Principles and Procedures, AAAE-VA, pp. 126-128.

Supplemental:

3. "Farm Tractors Basic Principles, Operation and Maintenance," Engineering Bulletin No. FT-53, pp. 18-20

QUESTIONS or ACTIVITIES:

1. What are the two types of governing systems?

2. What is the primary purpose of a governing system?

3. What is a governor hunting?

4. What is the cause of governor hunting?

UNIT: Fuel Systems
TOPIC: Governors
(Assignment Sheet continued)

5. What type governors do motor vehicles use?

6. Explain the method of operation of the hit and miss system of governing.

7. Explain the governing method of the throttle system.

8. What type governing system do all tractors have?

9. What is the main use of the hit and miss system?

10. Explain the method of operation of the vacuum system of governing.

11. How are diesel engines governed?

12. On what type engines is the vane-type governor used? Explain its method of operation.

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Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Fuel Systems

TOPIC: Diesel Fuel Systems - Principles of Operation, Combustion Chambers, Air Systems and Starting Aids

OBJECTIVE: To develop an understanding of the principle differences between the operation of a diesel and that of a gasoline engine.

INTRODUCTION: Basically we know that all internal combustion engines operate similarly but we need to have a working knowledge of the differences which exist in a diesel.

In this topic we will study some of these differences of operation and construction of combustion chambers and the air system.

REFERENCES: Required:

1. Modern Farm Power, Promersberger and Bishop, pp. 13, 29, 41-43.

2. Tractor Maintenance Principles and Procedures, pp 93, AAAE & VA.

3. Tractor Fuels and Lubricants, Selecting and Storing, page 11. AAAE & VA.

Supplemental:

4. Diesel and High Compression Gas Engines, Kates.

QUESTIONS or ACTIVITIES:

1. Review the principles of operation of a two and four stroke diesel engine. (Unit II Topic 1)

UNIT: Fuel Systems
TOPIC: Diesel Fuel Systems - Principles of Operation, Combustion Chambers, Air Systems and Starting Aids
(Assignment Sheet continued)

2. What causes combustion in a diesel engine?

3. How does the intake stroke of a diesel differ to that of a carburetor type engine?

4. When and how is the fuel added in a diesel engine?

5. After the fuel is added, when does ignition take place?

6. Why is it extremely important to keep the diesel engine fuel system clean?

7. Why is it necessary for the cylinder of a diesel engine to be more strongly constructed than that of a carburetor type engine?

8. On the two stroke diesel engine how is air furnished to the cylinder?

9. Due to the fact that diesel have such high compression ratio, they may be difficult to start. What are some starting aids to help start them?

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Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Fuel Systems

TOPIC: Diesel Fuel Systems, Injection Pump and Fuel Injectors

OBJECTIVE: To develop an understanding of the functions of the fuel system, injection pump and fuel injectors to the diesel engine.

INTRODUCTION: If you were asked to service the fuel system of a diesel tractor, could you do so? To be able to do this you would need to be familiar with the operation of a diesel fuel system, its parts and their function.

REFERENCES: Required:

1. Tractor Fuels and Lubricants, AAAE and VA, pp. 11-14
2. Tractor Maintenance, Principles and Procedures, pp. 93-99, AAAE & VA.
3. Modern Farm Power, Promersberger and Bishop, pp. 62-64

Supplemental:

4. "Gulf Farm Tractor Guide"
5. "Farm Tractors, Basic Principles, Operation and Maintenance", Engineering Bulletin No. FT-53

QUESTIONS or ACTIVITIES:

1. What is the most important thing to do when changing fuel filters on diesel engines?
2. What are the parts of a diesel fuel system?

UNIT: Fuel Systems
TOPIC: Diesel Fuel Systems, Injection Pump and Fuel Injectors
(Assignment Sheet continued)

3. What is the purpose of the injection pump on a diesel system?

4. What is the purpose of the extremely high pressure the injection pumps deliver?

5. For what purpose is the return fuel line?

6. What is the purpose of the first, second and third stage filter of the diesel fuel supply system?

7. What determines the number of filters used on an engine?

8. What other terminology is used for designating stages of filters?

9. What are the five kinds of filters that may be used on farm tractor diesel systems?

10. Why is it necessary to bleed fuel lines after changing a filter? What general procedure should be followed?

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Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Fuel Systems

TOPIC: Air Cleaners

OBJECTIVE: To develop an understanding of the function, kinds and systems of air cleaners on fuel systems of modern tractors.

INTRODUCTION: We would all agree that a tractor must "breathe". It is as true with a tractor as with a human that bad air opens the way for internal trouble.

In this lesson we will study how "bad" air can be filtered to produce clean air for the operation of the engine.

REFERENCES: Required:

1. Modern Farm Power, Ch. 9
2. "Farm Tractors", Engineering Bulletin No. FT-53, pp. 26-29

Supplemental:

3. Tractor Maintenance, page 16
4. "Gulf Farm Tractor Guide", pp. 34-35

QUESTIONS or ACTIVITIES:

1. What are the three common types of air cleaners?
2. According to test, what location of the intake stack proved to be the most efficient?
3. What are the four requirements of an air filter for it to be considered as a well designed unit?

UNIT: Fuel Systems
TOPIC: Air Cleaners
(Assignment Sheet continued)

4. Explain the principle of operation of a dry type air cleaner.

5. Explain the principle of operation of the oil bath unit.

6. Explain the principle of operation of the oil soaked unit.

7. What is the proper way to clean each type filter?

8. What other parts of the air intake system should be checked and cleaned regularly?

9. How often should an oil bath cleaner be serviced?

10. What are some places where dust can enter the engine other than through the normal air entries?

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Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Fuel Systems

TOPIC: Intake and Exhaust Manifolds and Pipes

OBJECTIVE: To develop an understanding of the importance of the intake and exhaust systems to the overall operation of the engine.

INTRODUCTION: Are intake and exhaust manifolds and pipes essential to engine operation? What is the reason for special designing of these parts? In this lesson we will study how each of these relate to engine operation and why they are designed as they are.

REFERENCES: Required:

1. "Farm Tractors Basic Principles, Operation and Maintenance", Engineering Bulletin No. FT-53, pp. 30, 53.

2. Machines for Power Farming, pp. 52-53, Stone-Gulvin.

Supplemental:

3. Service manual for make of tractor being studied

QUESTIONS or ACTIVITIES:

1. What is the purpose ~~of an~~ intake manifold?

2. Are gaskets necessary between the intake manifold and the cylinder head? If so, what kind are used?

3. What are the functions of a gasket on the intake manifold?

4. What are the functions of a gasket on the exhaust manifold?

UNIT: Fuel Systems
TOPIC: Intake and Exhaust Manifold and Pipes
(Assignment Sheet continued)

5. Why is the intake manifold on many engines designed so that two cylinders will not draw on one intake port in sequence?

6. What effect does backpressure , caused by the muffler, have on the engine operation?

7. When replacing mufflers, what factors must be kept in mind?

8. Define inertia as related to intake manifolds.

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Assignment Sheet
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UNIT: Cooling Systems

TOPIC: Liquid and Air Cooling Systems

OBJECTIVE: To develop an understanding of the operation and care of the cooling system of the modern farm engine.

INTRODUCTION: A tractor cooling system requires very little maintenance if it is given proper and regular care. Because of this fact, many cooling systems are neglected and can become a costly problem. In this study you will cover the function, operation, care and repair of liquid cooling systems.

REFERENCES: Required:

1. Modern Farm Power, Ch. 12 complete, Promersberger & Bishop.
2. Machines for Power Farming, Ch 5 complete, Stone&Gulvin

Supplemental:

3. Tractor Maintenance, Principles and Procedure, AAAE and VA, pp. 105-112
4. 'Farm Tractors Basic Principles, Operation and Maintenance", Engineering Bulletin No. FT-53, pp. 52-58

QUESTIONS or ACTIVITIES:

1. Gasoline burning engines usually have an operating temperature of how many degrees?
2. Trace the movement of the water in an engine.
3. What are two types of liquid cooling systems?
4. Explain how the radiator assists in cooling the engine.

UNIT: Cooling Systems
TOPIC: Liquid and Air Cooling Systems
(Assignment Sheet continued)

5. What is the function of the thermostat?

6. Do all liquid cooling systems utilize the water pump? Explain.

7. What is the purpose of the water pump?

8. What are the normal operating temperatures of tractor fuel and diesel fuel engines for the best efficiency?

9. What is the advantage of having a cooling system under pressure?

10. Some stationary engines are air cooled. Explain how that air alone is used to cool the engine.

11. What are some conditions that will cause an engine to run hot?

12. Why should antifreeze be drained out of the radiator for summer work?

13. Does a thermo-siphon system use a thermostat?

14. Where is the thermostat located in an engine?

15. How often should the radiator of a tractor be flushed?

16. What are three results one might expect from an engine running too hot?

17. What are three results one might expect from an engine running too cold?

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Assignment Sheet
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UNIT: Electrical Systems

TOPIC: Magneto System

OBJECTIVE: To develop an understanding of the operation, care, and required service of a magneto system on internal combustion engines.

INTRODUCTION: Do all tractors have starters? Generators? Batteries? To answer these questions we need to go back to our early tractor electrical system. The modern day tractor utilizes the battery ignition system, however, many of the smaller engines on balers, grain elevators, and such utilize the magneto system.

In this topic we will study the magneto system, its parts and method of operation.

REFERENCES: Required:

1. "Farm Tractors, Basic Principles, Operation and Maintenance", Engineering Bulletin No. FT-53, pp. 41-43

2. Modern Farm Power, pp. 106-110, Ch. 11 Promersberger & Bishop.

Supplemental:

3. Machines for Power Farming, Ch. 6, Stone & Gulvin.

4. "The Tractor Electrical System", AAAE & VA

QUESTIONS or ACTIVITIES:

1. What is the primary source of electrical current in the magneto system?

2. What are the advantages of having a magnetic rotor over a revolving armature?

UNIT: Electrical Systems
TOPIC: Magneto System
(Assignment Sheet continued)

3. When is electrical current produced by a magneto the greatest?

4. How is the current produced in the primary windings?

5. What is the purpose of the condenser?

6. How is the extremely high voltage of an electrical system produced?

7. On a six cylinder engine, what is the ordinary speed of the armature or rotor of the magneto?

8. What is an impulse starter on a magneto, and how does it work?

9. What maintenance is necessary on a magneto?

10. What precaution is necessary when removing the distributor rotor?

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Assignment Sheet
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UNIT: Electrical Systems

TOPIC: Introduction to the Battery Ignition System

OBJECTIVE: To develop an understanding of the purpose of the ignition system, the major components and the function of each.

INTRODUCTION: From the word "ignition" we would expect that the ignition system is designed to provide spark which ignites the fuel mixture in the cylinders. Since the spark plug extends into the combustion chamber, we know that the spark plug is one part of the ignition system. A "system" is defined as a number of things adjusted as a connected whole. The ignition system of a tractor is composed of a number of parts adjusted as a connected whole. In this assignment we will find out what these parts are, what they do, and how they are connected to the other parts to make a complete, functioning ignition system. In later assignments we will study each part of the ignition system in detail so that we will have the knowledge necessary to perform the services required of a tractor mechanic in maintaining a tractor engine at peak performance.

REFERENCES: Required:

1. Tractor Maintenance Principles and Procedures, pp. 78-80, AAAE - VA.
2. Modern Farm Power, pp. 102-106, Promersberger&Bisho
3. Machines for Power Farming, pp. 69-70;78-30; Stone-Gulv
4. "Farm Tractors-Basic Principles, Operation, and Maintenance", pp. 43-44
5. "Gulf Farm Tractor Guide", pp. 27-28

UNIT: Electrical Systems
TOPIC: Introduction to the Battery Ignition System
(Assignment Sheet continued)

QUESTIONS or ACTIVITIES:

1. What are the two functions performed by the ignition system?

2. What controls the primary circuit?

3. The cam rotates, thereby providing the motion for opening and closing the breaker points. How is the cam powered?

4. Trace the path of the current through the primary circuit.

5. What is the meaning of the word "ground"?

6. What is the only reason for the current flow of the primary circuit?

7. What operation is performed by the distributor in breaking the primary circuit, thereby making the secondary circuit possible?

8. Why is it necessary to have the high voltage that is developed in the secondary winding of the ignition coil?

9. Trace the path of the current of the secondary circuit from the ignition coil back to the coil.

10. What is the purpose of the condenser?

11. List the major components of a battery ignition system.

12. List the major parts of a functioning distributor.

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Assignment Sheet
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UNIT: Electrical System

TOPIC: The Battery

OBJECTIVE: To develop an understanding of the battery construction and its function to the electrical system.

INTRODUCTION: The source of power for the electrical system is the battery. The construction of the battery is important to the mechanic as it utilizes chemicals in the process of storage.

These chemicals, the construction, the function, and the care of the battery will be important to us in this study.

REFERENCES: Required:

1. Modern Farm Power, Promersberger & Bishop, pp. 112-114.
2. Machines for Power Farming, Stone & Gulvin, pp. 70-71;84-85.
3. "Farm Tractors, Basic Principles, Operation, and Maintenance", Engineering No. FT-53.

Supplemental:

4. Tractor Maintenance, AAAE-VA, pp. 51-53.
5. "Gulf Farm Tractor Guide", pp. 26-27.

QUESTIONS or ACTIVITIES:

1. What are the five main parts of a battery?
2. From what is the case of the battery made?
3. How does weather effect the efficiency of a battery?
4. How many volts does each cell of the battery have?

UNIT: Electrical System
TOPIC: The Battery
(Assignment Sheet continued)

5. What is the condition of the electrolyte in a discharged battery?

6. Explain the method whereby a battery becomes discharged.

7. How is a battery charged?

8. Explain how to easily clean a battery.

9. What safety precautions should be taken when charging a battery?

10. How is the charge of a battery checked?

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Assignment Sheet
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UNIT: Electrical System

TOPIC: Generators, Alternators, and Accessories

OBJECTIVE: To develop an understanding of how the generator and alternator operate, their function to the tractor as a whole and their care. Also, to study other accessories of the electrical system.

INTRODUCTION: The term generate makes us think of the production of power. In this case the production of electrical power. In our study of the electrical system we need to know how to maintain the electrical power necessary to operate the modern farm tractor. In this topic we will study how this is done through the use of the generator, alternator, and regulator.

REFERENCES: Required:

1. Machines for Power Farming, Stone & Gulvin, pp. 71-77;86-87.

2. Modern Farm Power, Promersberger & Bishop, pp. 122-125.

3. "Farm Tractors, Basic Principles, Operation, and Maintenance," Engineering Bulletin No. FT-53, pp. 46-47.

4. Tractor Maintenance, Principles and Procedures, page 90, AAAE&VA.

Supplemental:

5. Repair manual for make of tractor being studied.

QUESTIONS or ACTIVITIES:

1. What is the function of the generator?

2. What is the function of the alternator?

UNIT: Electrical System
TOPIC: Generators, Alternators, and Accessories
(Assignment Sheet continued)

3. What is the function of the regulator?

4. What is the function of the cut out relay?

5. What three ways can the charging rate of the generator be controlled?

6. How do the methods mentioned in question 5 actually control the rate of charging?

7. What is the operational difference between a generator and voltage regulator?

8. What is the function of the ammeter?

9. What minimum service is required by the generator?

10. When cleaning the commutator, why can emery cloth not be used?

11. How is the generator polarized after a battery or wire has been changed?

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Assignment Sheet
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UNIT: Electric System

TOPIC: Starters

OBJECTIVE: To develop an understanding of the operation and care of a starter on farm tractors.

INTRODUCTION: The term starters or starting motor leads a person to believe that something is beginning. The starter in this case is actually beginning the revolving process of the engine.

In this topic we will study the process of starting, the upkeep necessary and the differences between the starter and generator.

REFERENCES: Required:

1. Modern Farm Power, pp. 125-126, Promersberger&Bishop.
2. Machines for Power Farming, page 77, Stone & Gulvin.
3. Farm Tractors, Engineering Bulletin No. FT-53, pp. 47-48.

Supplemental:

4. Tractor Maintenance Principles and Procedures, AAAE&VA

QUESTIONS or ACTIVITIES:

1. In what ways are starters and generators similar?
2. How do starters and generators differ in construction?
3. How is the commutator on a starter cleaned?
4. When starting an engine how does the starter motor actually turn the tractor engine?
5. What is the result of continuous grinding in cold weather trying to start an engine?

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UNIT: Engine Testing and Tune Up

TOPIC: Timing the Ignition System

OBJECTIVE: To develop an understanding of the importance of a properly timed engine.

INTRODUCTION: Proper timing is essential to proper engine operation. All farmers are interested in the economy of their operation however many fail to realize how uneconomical a poorly timed engine is.

In this topic we will study the importance of proper timing and the method to follow in timing an engine.

REFERENCES: Required:

1. Farm Tractors Basic Principles, Operation and Maintenance, Engineering Bulletin No. FT-53, pp. 50-51.

2. Tractor Maintenance Principles and Procedures, pp. 86-89.

Supplemental:

3. Modern Farm Power, pp. 69-79, Promersberger&Bishop.

4. Machines for Power Farming, pp. 80-83, Stone & Gulvin.

QUESTIONS or ACTIVITIES:

1. What are the two methods of timing an engine?

2. What does timing actually mean?

3. Where may the timing marks of an engine normally be found?

UNIT: Engine Testing and Tune Up
TOPIC: Timing the Ignition System
(Assignment Sheet continued)

4. How is the two wire timing light attached?

5. How is the three wire timing light attached?

6. How can a person determine when the number one piston is up on the compression stroke?

7. Where should the timing light be held and why?

8. When timing an engine by the breaker point method what is the relative position of the breaker points and timing marks?

9. When timing an engine, what should a person always do regarding instructions, timing marks, and adjustments?

10. What is retarded and advanced timing?

11. How is the diesel engine timed?

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Assignment Sheet
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UNIT: Engine Testing and Tune-Up

TOPIC: Valve Clearance Adjustments

OBJECTIVE: To develop an understanding of the importance of valves and how to properly adjust them.

INTRODUCTION: Most people know that there are valves in an engine but few know their purpose or how to adjust them. If a valve is improperly adjusted the result is often serious trouble to the farmer.

In this study we will consider the valve adjustments and how they effect proper engine performance.

REFERENCES: Required:

1. Modern Farm Power, pp. 79-80, Promersberger&Bishop.
2. Tractor Maintenance, Principles and Procedures, pp. 34-42. AAAE - VA
3. Farm Tractors, Basic Principles, Operation, and Maintenance, Engineering Bulletin No. FT-53, pp. 31-38.

Supplemental:

4. Machines for Power Farming, pp. 28-35, Stone-Gulvin.

QUESTIONS or ACTIVITIES:

1. By what other names may valve clearance adjustments be called?
2. What is valve clearance adjustment?
3. What are the two kinds of valves?
4. Why should valves be properly adjusted?

5. Is valve adjustment made while the engine is hot or cold?

6. What tools are used to adjust valves?

7. At what point is the actual adjustment checked?

8. What is the purpose of the third racker arm per cylinder on a diesel engine?

9. Although valves are adjusted between the rocked arm and the valve stem where is the critical area of the valve?

10. How can valve springs be tested without a special testing device?

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Assignment Sheet
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UNIT: Hydraulics

TOPIC: Introduction

OBJECTIVE: To develop an understanding of how and why hydraulic principles operate, also to understand hydraulic theory and the basic systems involved in hydraulics.

INTRODUCTION: Hydraulics may be defined, in a strict sense, as the science of fluid forces. In modern usuage, hydraulics' has come to mean the use of fluid to transfer power, or to change a power source into useful force.

The use of hydraulic power on modern farm tractors and equipment is relatively new but the principle of hydraulic power dates back to early times. There are several branches of hydraulics, but the branch applicable to farm equipment deals with enclosed liquids under pressure.

REFERENCES: Required:

1. Tractor Hydraulics, American Association for Agricultural Engineering and Vocational Agriculture, pp. 1-8.

2. Farm Machinery and Equipment, Smith, Ch. 7, pp. 65-67.

Supplemental:

3. The Operation, Care, and Repair of Farm Machinery, Deere and Company, Ch. 6, pp. 56-66.

QUESTIONS or ACTIVITIES:

1. What is the definition of "hydraulics"?

2. Who discovered the fundamental law upon which modern machine hydraulics is based?

UNIT: Hydraulics
TOPIC: Introduction
(Assignment Sheet continued)

3. List the nine main features that make hydraulics so adaptable?

4. No mechanical device is perfect. What are two drawbacks of hydraulics?

5. Give the three basic theories of hydraulics?

6. Define: a. Hydrostatic Power
   b. Hydrodynamic Power

7. List the parts of a basic hydraulic system as illustrated on page 8, Tractor Hydaulics, AAAE&VA.

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Assignment Sheet
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AGRICULTURAL MACHINERY MECHANICS

UNIT: Hydraulics

TOPIC: Reservoir

OBJECTIVE: To develop an understanding of the purpose of a reservoir on hydraulic systems. To understand how to determine the size. Also to understand the parts of a reservoir.

INTRODUCTION: Every hydraulic system must have a reservoir. In most farm and industrial equipment applications, the reservoir is a built-in unit, although this may not be true in all cases. Due to compactness and convenient, compromise with ideal design is sometimes made.

REFERENCES: Required:

1. Tractor Hydraulics, American Association for Agricultural Engineering and Vocational Agriculture, pp. 9-10.

QUESTIONS or ACTIVITIES:

1. How is the size of reservoirs determined?
2. Give four reasons why the reservoir should be of adequate size.
3. List the parts of a reservoir as illustrated on page 9 of Tractor Hydraulics, AAAE&VA.

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Assignment Sheet
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AGRICULTURAL MACHINERY MECHANICS

UNIT: Hydraulics

TOPIC: Hydraulic Pumps

OBJECTIVE: To develop an understanding of the different types of pumps on hydraulic systems. Also to understand the parts of the pump and how it operates.

INTRODUCTION: The pump is the power supply of the hydraulic system and it is a percesion-built unit, of rugged design and high quality materials.

Pumps are commonly thought of as compressors, but this is not true of hydraulic pumps. Since fluids are virtually incompressible except at extremely high pressures, the pump serves only to transmit force.

REFERENCES: Required:

1. Tractor Hydraulics, American Association for Agricultural Engineering and Vocational Agriculture, pp. 10-17.

2. Farm Machinery and Equipment, Smith, Ch. 7, pp. 67-69.

QUESTIONS or ACTIVITIES:

1. Give the two classifications of pumps.

2. Which type of pumps does most farm and industrial equipment use?

3. Name the various types of pumps available on hydraulic systems.

4. Study the illustrations of the ten different types of pumps, pp. 11-16, Tractor Hydraulics, AAAE&VA.

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UNIT: Hydraulics

TOPIC: Hydraulic Valves

OBJECTIVE: It was mentioned earlier that hydraulic systems are basically simple and they are, if the presence of many valves, of several types, is not allowed to confuse understanding.

Until recently, valves were the only means of controlling fluids in a hydraulic system. With the advent of "variable delivery" pumps, certain values in systems having this type of pump may be eliminated. However, valves are still the most important method of controlling fluid pressure and flow, and obtaining wide flexibility in hydraulic systems.

REFERENCES: Required:

1. Tractor Hydraulics, American Association for Agricultural Engineering and Vocational Agriculture, pp. 17-24.

QUESTIONS or ACTIVITIES:

1. Nearly all the valves used in hydraulic systems may be classified into three categories. Name these three categories.

2. What are the five ways in which valves can be controlled?

3. Name the eleven specific-types of valves available for hydraulic systems.

4. Study the illustrations on page 17-23 in Tractor Hydraulics.

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Assignment Sheet
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UNIT: Hydraulics

T OPIC: Hydraulic Cylinders

OBJECTIVE: To develop an understanding of the cylinder and how it operates on hydraulic systems. Also to understand the different categaries of cylinders.

REFERENCES: Required:

1. Tractor Hydraulics, American Association for Agricultural Engineering and Vocational Agriculture, pp. 24-28.

2. Farm Machinery and Equipment, Smith, Ch. 7, pp. 69-73.

QUESTIONS or ACTIVITIES:

1. Cylinders may be classified into two general categories. Name these two categories.

2. Name five refinements found in the hydraulic cylinder.

3. Give the purpose of the hydraulic cylinder.

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UNIT: Hydraulics

TOPIC: Hydraulic Seals and Packing

OBJECTIVE: To develop an understanding of the different types of seals and packing used in hydraulic systems; also, to understand their general classification, and their functions.

INTRODUCTION: None of the components of a hydraulic system so far discussed would operate without proper seals and packings to hold the fluid under pressure in the system.

REFERENCES: Required:

Tractor Hydraulics, AAAE and VA, pp. 28-30

QUESTIONS or ACTIVITIES:

1. Give the two classifications of seals and packings according to their use.

2. List the ten different types of seals and packings according to their shape.

3. Study pictures of the different types of seals and packings and be able to identify each.

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Assignment Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Hydraulics

TOPIC: Hydraulic Lines and Fittings

OBJECTIVE: To develop an understanding of the different types of lines and fittings used in hydraulic systems.

INTRODUCTION: No hydraulic system can be expected to operate without proper connections for moving the fluid between the various units of the system. Hydraulic lines must be designed and installed with the same care applied to the other parts of the system. They should be leakproof and strong enough to stand the maximum pressure, temperature, and vibration of the system involved. They should not be constructed of materials, or designed in a way, that will cause restriction of flow and turbulence. They should be large enough to carry the maximum pump output without excessive friction losses or turbulence. They should be as short as possible and have as few bends as possible. Hydraulic lines may be off piping, tubing or flexible hose.

REFERENCES: Required:

Tractor Hydraulics, AAAE and VA, pp. 30-31

QUESTIONS or ACTIVITIES:

1. What are the different types of metals used in piping and tubing?

2. Why should one never use galvanized pipe in a hydraulic system?

3. Give the bending radius of piping and tubing and also flexible hose.

4. List the five various types of hydraulic line fittings as illustrated on page 31, Tractor Hydraulics.

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Assignment Sheet
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UNIT: Hydraulics

TOPIC: Hydraulic Systems

OBJECTIVE: To develop an understanding of the different types of hydraulic systems and how they operate. Also, to understand the application of these systems.

INTRODUCTION: In order to be able to fully understand the application of hydraulics to equipment, it is necessary to understand what is meant by the descriptive terms applied to various kinds of hydraulic systems.

Four components are all that are necessary to have a workable hydraulic system--A reservoir, a pump, a valve, and a motor (cylinder).

Descriptive titles for the various systems discussed in this topic are based on the type of valve used, or its operation.

REFERENCES: Required:

Tractor Hydraulics, American Association for Agricultural Engineering and Vocational Agriculture, pp 35-38

QUESTIONS or ACTIVITIES:

1. Name the four components which are necessary to have a workable hydraulic system.

2. List the five different hydraulic systems.

3. Study the five different hydraulic systems on page 36-38, Tractor Hydraulics and be able to describe the action of each.
   a. Follow the fluid through the block return line system naming the parts through which it goes, to raise the cylinder plunger in illustration 49.

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Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Introduction

TOPIC: Orientation

1. To be able to do their jobs with a high degree of speed and efficiency.

2. They provided the farmer with efficient production tools which has lowered the cost of production.

3. No

4. Produce food and fiber for twenty-nine others.

5. It has provided them more free time to devote to other activities.

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Answer Sheet to Test
on
ORIENTATION

1. T

2. F

3. F

4. T

5. T

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Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Introduction

TOPIC: Orientation

1. Through the branch house and a dealer.

2. Engineers employed by the manufacturer.

3. Through the branch house.

4. The dealer.

5. The branch house.

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Answer Sheet for Test
on
ORIENTATION

1. Manufacturer - Branch house - Dealers - Customers

2. Keeps in touch with machinery problems and develops new machines

3. To move the machinery from the factory to the dealers

4. a. Sales
   b. Clerical
   c. Parts
   d. Service

5. a. Set-Up Man
   b. Mechanic's Helper
   c. Service Supervisor
   d. Parts Man
   e. Delivery Man

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Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Introduction

TOPIC: Orientation

1. a. Management
   b. Sales
   c. Clerical
   d. Parts
   e. Service

2. a. Determine company policies
   b. Exercise financial control over the business
   c. Select, train and supervise employees
   d. Forcast and plan future company business
   e. Direct customer and employee relations
   f. Promote sales
   g. Coordinate jobs

3. a. Finds prospective buyers
   b. Conducts demonstrations
   c. Appraises used machinery
   d. Closes sales
   e. Makes financial arrangement for customer to purchase machinery
   f. Maintains sales room
   g. Follows up past sales

4. a. Dispenses shop parts
   b. Dispenses customer parts
   c. Maintains parts inventories
   d. Checks inventories
   e. Maintains price catalogue
   f. Constructs displays
   g. Maintains parts identification

5. a. Makes general repairs
   b. Handles field repairs
   c. Conducts special operations
   d. Reconditions trade-ins

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Answer Sheet for Test
on
ORIENTATION

1. (a) Management
2. (b) Sales
3. (b) Sales
4. (e) Service
5. (c) Clerical
6. (d) Parts
7. (e) Service
8. (b) Sales
9. (a) Management
10. (e) Service

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Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Introduction

TOPIC: General Shop Safety

1. You must understand the hazards of the job you are about to do and be willing to practice safety habits.

2. It distracts you from your work.

3. Can result in injury

4. Wash hands using soap

5. Place feet close to object, keep elbows straight, use large leg muscles, and keep back straight

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Answer Sheet for Test
on
GENERAL SHOP SAFETY

1. T

2. T

3. T

4. F

5. F

6. T

7. T

8. T

9. F

10. T

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Answer Sheet
for
INTRODUCTION

UNIT: Introduction

TOPIC: Hand Tools-Identification and Use of Metals and Layout Tools

1. a. Amount and kind of materials added to the pig iron
   b. Kind of heat treatment

2. Annealing

3. Long, bright, crackling

4. 12 inch

5. Scribing lines on metal

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Answers Sheet for Test
on
SELECTING AND USING METALS AND LAYOUT TOOLS

True or False:

1. True

2. False

3. True

4. True

5. False

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Answer Sheet
for
INTRODUCTION

UNIT: Introduction

TOPIC: Hand Tools-Cutting Cold Metal

1. Hard-back blades break more easily.

2. a. Flat
   b. Cape
   c. Diamond point
   d. Round

3. When cutting round stock, roll the metal and cut about one-third of the way through, all the way around;then break the metal over the anvil.

4. a. Wrought iron
   b. Low carbon steel

5. The cold chisel must be harder than the metal it is to cut.

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Answer Sheet for Test
on
HAND TOOLS-CUTTING COLD METAL

1. Lengths

2. Harder

3. Bolt cutters

4. Round

5. Split

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Answer Sheet for INTRODUCTION

UNIT: Introduction

TOPIC: Hand Tools-Shaping Stock and Filing

1. The metal is weakened.

2. a. Vise
   b. Wrench

3. High-carbon, specially hardened steel

4. a. Length
   b. Point
   c. Face
   d. Edge
   e. Heel
   f. Tang

5. The tang should be fitted into a handle.

6. a. Flat double cut
   b. Flat single cut
   c. Half Round
   d. Round
   e. Square
   f. Crosscut saw
   g. Triangular saw (tapered)
   h. Triangular saw (blunt)

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Answer Sheet for Test
on
HAND TOOLS-SHAPING STOCK AND FILING

1. Weaken

2. Hardened

3. Rough

4. Slower

5. Card

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Answer Sheet
for
INTRODUCTION

UNIT: Introduction

TOPIC: Hand Tools-Drilling

1. Power drill press

2. No. 80

3. 1/64 inch

4. The metal may spin and injure the operator.

5. V-shaped

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Answer Sheet for Test
on
HAND TOOLS-DRILLING

1. V

2. 1/64

3. Turn or spin

4. Letters, fractions

5. Harder

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Answer Sheet
for
INTRODUCTION

UNIT: Introduction

TOPIC: Hand Tools-Tapping and Threading

1. a. National Coarse
   b. National Fine

2. National Fine

3. a. Taper
   b. Plug
   c. Bottoming

4. a. Round split die
   b. Two-piece die
   c. Solid die

5. A screw plate is a bolt-threading set that contains dies, die stocks, taps, and tap wrenches.

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Answer Sheet for Test
on
HAND TOOLS-TAPPING AND THREADING

1. a. National Coarse
   b. National Fine

2. a. Taper
   b. Plug
   c. Bottoming

3. a. Roung split die
   b. Two-piece die
   c. Solid die

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Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Introduction

TOPIC: The Parts of Machines

1. The function and application of a cam is to produce intermittent motion. This is done by action of the lobe or nose as it turns by the shaft causing the tappet to raise and lower as the nose turns by it.

2. The difference between a friction and anti-friction bearing is that the the friction bearing is in direct contact with the shaft wheras the anti-friction bearing has rollers or balls placed between the shaft and the supporting bearing, thereby reducing the friction.

3. The function of a bearing is to hold the various power transmission parts in position.

4. Types of ball bearings:
   a. Internally self-aligning bearings
   b. Single row deep groove bearings
   c. Loading groove bearings
   d. Single row angular contact bearings
   e. Double row deep groove bearings
   f. Double row angular contact bearings
   g. Ball thrust bearings

5. Types of roller bearings:
   a. Spherical
   b. Straight
   c. Spherical thrust
   d. Tapered
   e. Needle
   f. Thrust

6. Roller bearings differ from ball bearings in that small cylindrical rollers are substituted for the balls which gives a much larger bearing surface.

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Answer Sheet for Test
on
THE PARTS OF MACHINES

1. The function of bearings in farm equipment is to hold the various power transmission parts in position.

2. Factors determining proper bearing selection are:
   a. Amount of wear
   b. Speed of turning shaft
   c. Load to be carried
   d. Amount of end thrust

3. Proper lubrication is essential to long life and service.

4. Bushings may be made from:
   a. Wood
   b. Babbitt
   c. Bronze
   d. Chilled iron

5. Two types of bearing bushings are:
   a. Straight bearings
   b. Graphited oiless

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Answer Sheet
for
FASTENING DEVICES

UNIT: Introduction

TOPIC: The Parts of Machines

PART I:

1. 2
2. 4
3. 1
4. 5
6. 1
7. 3
8. 2
9. 3

PART II: A

1. Flat head machine screw
2. Lock washer
3. Hex head cap screw
4. Cotter pin
5. Castellated nut
6. Hex head bolt
7. Jam (or lock) nut
8. Light nut

PART II: B

1. Phillips
2. Slotted
3. Hexagon recessed (or Allen)
4. Square
5. Hexagon
6. Clutch

UNIT: Introduction
TOPIC: The Parts of Machines
(Answer Sheet continued)

PART II: C

1. Round
2. Flat
3. Oval
4. Fillister

PART III:

1.	0	14.	0
2.	+	15.	+
3.	+	16.	+
4.	+	17.	+
5.	+	18.	0
6.	0	19.	+
7.	+*	20.	+
8.	0	21.	0
9.	0	22.	0
10.	+	23.	+
11.	0	24.	0
12.	+	25.	0
13.	+	26.	0

PART IV:

1. American Standard
2. Coarse and Fine
3. NC (or USS) and NF (or SAE)
4. The distance between corresponding points of adjacent threads.
5. 60
6. Flats (or faces)
7. Heavy (or standard), light, and jam (or lock)
8. 1 1/2
9. Under head to end
10. Wrenches
11. Self tapping
12. Sheet metal and Parker
13. Stud (or stud bolt)
14. Shakeproof
15. Jam (or lock) nut
16. Upsetting
17. Square, hex socket (or Allen), and headless
18. Ounce or pound

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Answer Sheet for Test
on
FASTENING DEVICES

PART I:

1. 2
2. 1
3. 1
4. 2

PART II:

1. Phillips
2. Slotted
3. Hexagon recessed (or Allen)
4. Square
5. Hexagon
6. Clutch

PART III:

1. +
2. 0
3. 0
4. 0

PART IV:

1. American Standard
2. Under head to end
3. Shakeproof
4. Jam (or lock) nut

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Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Introduction

TOPIC: Transmission of Power

1. Six methods of transmitting power of farm equipment are:
   a. Direct drive
   b. Pulleys and belts
   c. Sprocket wheels and chain
   d. Gears
   e. Shafts and universal joints
   f. Flexible shafting

2. The advantage of a V-belt over a flat belt is that the V-belt has less belt slippage due to greater tractional contact between the sides of the belt and sheave flanges.

3. To properly fit a V-belt it should run in the sheave groove with the top surface almost flush with the top of the groove and at least 1/8 inch clearance under the belt in the bottom of the groove.

4. Belt lengths can be determined in the case of a V-belt by using the formula $L-2c + 1.57(D+d) + \frac{(D+d)^2}{4c}$ where
   L = effective length of belt, inches
   d = distance between centers of sheaves, inches
   D = effective outside diameter of large sheave, inches
   d = effective outside diameter of small sheave, inches
   In the case of flat belts to find the length add the diameters of the two belts together, divide by 2 and multiply by 3. To this product add twice the distance between the centers of the two shafts.

5. To calculate this speed or size of the pulley use the formula 5 X D = 5 X D. Where three of the quantities are known the forth can easily be found. S = r.p.m. D = diameter.

6. The pitch of the sheave will vary the speed because as the pitch is widened the belt will be running on a smaller diameter there by causing the speed of the pulley being driven to slow down. The pitch of alternate sheaves should be changed to vary speeds.

UNIT: Introduction
TOPIC: Transmission of Power
(Answer Sheet continued)

7. When using pressed steel hook chains run the hook end forward and slot side out when the larger of the sprockets is the driver. When the smaller of the sprockets is the driver, the chain should run in reverse direction.

8. a. Spur
   b. Cluster
   c. Internal spur
   d. Herringbone
   e. Helical
   f. Worm and worm heel
   g. Straight level
   h. Straight level gear set
   i. Spiral-level set used in tractors
   j. Hypoid gear set
   k. Spline-shaft gear

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Answer Sheet for Test
on
TRANSMISSION OF POWER

PART I:

1. The six methods of transmitting power in farm equipment are:
   a. Direct drive
   b. Pulley and belts
   c. Sprocket wheels and chains
   d. Gears
   e. Shafts and universal joints
   f. Flexible shafting

2. To properly fit a V-belt it should ride about level with the top of the sheave flanges and clear the bottom of the pulley about 1/8.

3. The length would be calculated as follows:

$$L = 2C + 1.57\,(D + d) + \frac{(D + d)^2}{4c}$$

$$L = 2(24) + 1.57\,(8 + 4) + \frac{4^2}{4\,(24)}$$

$$L = 48 + 1.57\,(12) + \frac{16}{96}$$

$$L = 48 + 18.84 + .17$$

$$L = 67 \text{ inches}$$

4. The diameter would be calculated as follows:

$$S \times D = S \times D$$
$$1800 \times 6 = 2400 \times (X)$$
$$10800 = 2400X$$
$$2.5 = X$$

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Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Introduction

TOPIC: Tractor Design

1. a. Wheel types
   1. All-purpose, most all farm work especially row-crop work
   2. Atandard for general farmwork (open field work) but not major row crops
   3. Orchard
   4. Utility
   b. Crawler type or tracklayer
   c. Garden tractors

2. The all-purpose type is most popular because of its diversity of us. About 92% of all tractors sold for farm use are all-purpose and utility types (wheel type), 5% standard and 3% crawlers or tracklayers.

3. Tractors are rated according to horsepower and capacity meaning the width and number of moldboard plows the tractor can use.

4. All tractors are alike in the following ways:
   a. An internal-combustion engine as a source of power
   b. A clutch to connect and disconnect the engine power and the driven parts.
   c. A transmission system for conveying power to the driving members or to other points where applied

5. The basic elements of all farm tractors are:
   a. An engine
   b. A clutch
   c. A transmission
   d. A final drive

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Answer Sheet for Topic Test
on
TRACTOR DESIGN

1. a. Wheel type
   1. All-purpose
   2. Standard
   3. Orchard
   4. Utility
   b. Tracklaying or crawler type
   c. Garden

2. Tractors are also classified according to their adaptability to certain kinds of farm work such as field work, tilling, harvesting, haying, and etc.

3. The all-purpose type tractor is more widely used because of its versitility.

4. a. Tricycle
   b. Wide front axle
   c. One row or auxiliary

5. Features of an orchard or grove tractor:
   a. Narrow tread wheels and short wheel base
   b. Steering wheel and operators seat are lowered and protected by a cowl.
   c. Overall height of the tractor is reduced
   d. Projecting parts are covered
   e. Designed to give added stability and safety

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Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Internal Combustion Engines

TOPIC: Theory of Operation

1. A four cycle engine is one having four strokes or movements of the piston to complete the action necessary to produce power. Such an engine requires two complete revolutions of the crankshaft for each full cycle of events.

2. A two cycle engine is one having only two strokes or movements of the piston to complete the action necessary to produce power.

3. The four cycle carburetor type engine operates with four decisive strokes of the piston. The first stroke, known as the intake stroke, takes in a mixture of air and fuel through the intake valve which is open. The intake valve then closes and the piston begins its upward stroke or compression stroke until it reaches T. D. C. (Top Dead Center) of the crankshaft. This stroke has compressed the fuel-air mixture into a very small space between the piston and cylinder head. The third stroke then takes place when the spark from the spark plug ignites the compressed fuel and air causing a downward movement of the piston. This stroke is the power stroke causing the crankshaft to turn 180°. The fourth stroke is the upward movement of the piston while the exhaust valve is open driving out the burned gases.

4. The operation of a two cycle carburetor type engine is much the same as that of a four cycle engine. The main differences are that with each stroke of the piston two events take place rather than one, and the crankshaft makes only one revolution. This engine makes use of an air tight crankcase for partially compressing the fuel and air mixture. As the piston travels down the mixture previously drawn into the crankcase is partially compressed. As the piston nears the bottom of the stroke it uncovers the exhaust and intake parts. The exhaust then flows out reducing the pressure in the cylinder. This reduces the pressure in the cylinder lower than that in the crankcase allowing the new fuel charge to flow into the cylinder through the port openings. The incoming mix-

UNIT: Internal Combustion Engines
TOPIC: Theory of Operation
(Answer Sheet continued)

ture is deflected upward by a baffle on the piston. As the piston travels upward it compresses the mixture above and draws a new air-fuel mixture into the crankcase. The engine then fires,driving the piston down and thereby beginning another stroke.

5. Lubrication in a two-cycle engine is provided for by mixing the oil and fuel.

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Answer Sheet for Test
on
THEORY OF OPERATION

1. Intake: Air and fuel mixed in the carburetor are drawn into the cylinder through the open intake valve by the downward action of the piston.
   Compression: Both valves are closed and the air-fuel mixture is compressed in the upper part of the cylinder by the upward motion of the piston.
   Power: An electrical charge is produced by the spark plug igniting the compressed air-fuel mixture. The expansion of the fuel drives the piston down turning the crankshaft. Both valves are closed.
   Exhaust: The exhaust valve opens and the burned fuel fumes are driven out by the upward movement of the piston.

2. Intake and Exhaust: At the bottom of the power stroke the piston travels below the port openings and allows the fuel previously partially compressed in the crankcase to flow into the cylinder. This drives the fumes of the burned fuel out the exhaust port on the opposite side of the cylinder. The fresh fuel is deflected upward by a baffle on the piston.
   Compression and power: As the piston travels up, it closes the intake and exhaust ports and compresses the fuel-air mixture in the top of the cylinder. As the piston reaches the top of its travel, a spark is injected by the spark plug igniting the compressed fuel, thereby forcing the piston back down.

3. Equipment requiring small power requirements such as garden tractor, power lawn mowers, outboard engines, etc.

4. Mixing oil with fuel

5. A stroke is the movement of the piston from top of the stroke or T. D. C. (Top Dead Center) to the bottom of the stroke of C. D. C. (Crank Dead Center).

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Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Internal Combustion Engines

TOPIC: Engine Types

1. Gasoline, L. P. (liquid petroleum) and Diesel.

2. Fuel system
   Lubrication system
   Ignition and electrical system
   Cooling system

3. Cylinders
   Pistons
   Valves and valve opening parts
   Piston rings
   Cylinder head
   Piston Pin
   Connecting rod
   Crankshaft
   Flywheel
   Crankcase (block)

4. The block of a diesel must be designed to withstand more pressure per square inch and a higher operating temperature.

5. Engines are classified according to cylinders by numbers. An engine may have one, two, four, six or eight cylinders and up. They are also classified according to horizontal or vertical cylinders.

6. An engine is classified as a straight block meaning all pistons fall in a straight line. A vee (V) block indicating that the pistons are in two rows opposite each other.

7. In most engines each cylinder has two valves; one intake and one exhaust. In a two cycle engine the cylinder does not have any valves. The piston acts somewhat like a valve by passing over port holes in the cylinder wall allowing the movement of air and fuel.

UNIT: Internal Combustion Engines
TOPIC: Engine Types
(Answer Sheet continued)

8. Diesel engines differ from carburetor type engines in many ways and yet they are alike in many ways. In the carburetor type engine the air and fuel are mixed before they enter the cylinder on the intake stroke whereas in the diesel engine only air is taken in on the intake stroke. When the air has been compressed by the compression stroke it causes a rise in temperature. At just the right time for firing a fine mist of fuel is forced into this highly compressed air and ignition takes place. The air is so hot that it automatically ignites the fuel without a spark.

   In a gasoline carburetor type engine compression ratios range between 5.5 to 1 to 8.5 to 1 while diesels range between 15 to 1 to 19 to 1.

   The operating temperature of a diesel is much higher than that of a gasoline carburetor type engine.

VOCABULARY:

1. Bore - the size of the cylinder
2. Stroke - The distanced traveled by the piston from its extreme upper position in the cylinder to its extreme lower position
3. Piston displacement - is a measure of volume displaced by the piston during one complete stroke.
4. Intake valve - the valve through which fresh air-fuel mixtures in four cycle carburetor type engines or fresh air in diesel engines enters the cylinder.
5. Exhaust valve - the valve through which fuel gases are expelled in a four cycle engine
6. Piston - the cylindrical vessel moving within the cylinder

UNIT: Internal Combustion Engines
TOPIC: Engine Types
(Answer Sheet continued)

7. Crankshaft - the longest shaft in the engine which transforms the reciprocating action of the pistons into a rotary motion.

8. Spark plug - a part fitting into the head of a cylinder which has two electrodes separated by an air gap across which the current from the ignition system discharges to form a spark thereby igniting the fuel present in the cylinder

9. Cylinder - often called the heart of the engine. With in the cylinder the process of combustion takes place.

10. Connecting rod - the rod which transmits the pressure of the piston to the crankshaft

11. Fuel injector - a pump-like device used to inject fuel under pressure into the cylinder of a diesel engine.

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Answer Sheet for Test
on
ENGINE TYPES

1. a. Cooling system
   b. Fuel system
   c. Lubrication system
   d. Ignition and electric system

2. a. Cylinders
   b. Pistons
   c. Piston rings
   d. Valves
   e. Valve opening parts
   f. Cylinder head
   g. Piston pin
   h. Connecting rod
   i. Crankshaft
   j. Flywheel
   k. Crankcase (block)

3. Diesel and carburetor type engines differ in the following ways:
   a. Block construction
   b. Compression ratios
   c. Method of igniting fuel
   d. Method of fueling cylinder
   e. Operating temperature or cooling system

4. a. The size of the cylinder is known as the bore.
   b. Piston stroke is the distanced traveled by the piston moving from its extreme upper positions to its extreme lower position as expressed in inches.
   c. Piston displacement is a measure of the volume displaced by the pistons during one complete stroke, as expressed in cubic inches.
   d. Fuel injector is a pump like device used to inject fuel under pressure into the cylinder of a diesel engine.
   e. The crankshaft is the largest shaft in the engine which transforms the reciprocating action of the pistons into a rotary motion.

5. The advantage of a sleeve type cylinder is that when the cylinder walls become severely worn that sleeve may be removed and a new sleeve installed thereby giving new cylinder walls.

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Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Internal Combustion Engines

TOPIC: Power Measurement

1. Horsepower is the rate of doing work equivelent to raising 33,000 lbs. one foot in one minute.

2. A btu is defined as a British thermal unit. To convert heat to power,tests have been conducted which show that 42. 44 btu per minute is equivelent to one horsepower.

3. In itself, the tractor is of little good to the farmer because it does not put the horsepower to work. Until some source of outlet for power is attached to the tractor, the horsepower is confined in the tractor. The attachment of a plow or such supplies a source of outlet.

4. a. Draw bar
   b. P. T. O.
   c. Driving members
   d. Hydraulic system

5. Indicated horsepower differs to brake horsepower because it does not take into consideration friction or other mechanical loss.

6. Conditions affecting the calculation of draw-bar horsepower are:
   a. Condition of ground
   b. The adhesion of the driving wheels to the ground
   c. The size of the driving wheels
   d. The packing of the ground

7. Indicated horsepower

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Answer Sheet for Test
on
POWER MEASUREMENT

1. a. Indicated horsepower
   b. Brake horsepower
   c. Drawbar horsepower

2. Btu stands for British Thermal Unit and is used to measure heat.

3. The drawbar horsepower will generally be from 1/2 to 2/3 of the brake horsepower.

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Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Internal Combustion Engines

TOPIC: Power Plant Construction and Terminology

1. Heart

2. Cylinder head, piston

3.
1. Compression rings
2. Scraper rings
3. Oil ring
4. Piston
5. Piston pin
6. Lock screw
7. Connecting rod and cap
8. Cap bolt
9. Bearings
10. Cap bolt nut
11. Shim (if used)
12. Cylinder liner
13. Packing rings

4. The purpose of a cylinder liner is to prolonge the block life by making it possible to replace it when too worn to be rebored. This will cut down expenses.

5.
1. Core hole cover gasket
2. Core hole plug
3. Cap screw long
4. Core hole cover
5. Cap screw short
6. Nut 3/8" diameter
7. Washer 3/8" diameter
8. Nut 1/2" diameter
9. Intake valve guide
10. Exhaust valve guide
11. Exhaust valve seat
12. Stud 1/2" diameter
13. Stud 3/8" diameter
14. Head gasket
15. Cylinder head

6.
1. Flywheel
2. Crankshaft
3. Setscrew
4. Pulley
5. Front seal
6. Timing gear
7. Front bearing (half)
8. Center bearing (half)
9. Rear bearing (half)
10. Rear seal (half)
11. Oil wick
12. Ring gear
13. Cap Screw

7.
1. Bushing
2. Rear plug
3. Camshaft
4. Tappet
5. Push rod
6. Front plug
7. Timing gear
8. Gear cap screw
9. Thrust screw

UNIT: Internal Combustion Engines
TOPIC: Power Plant Construction and Terminology
(Answer Sheet continued)

8. 1. Cam
2. Valve tappet
3. Valve tappet guide
4. Tappet adjusting screw
5. Valve spring
6. Valve
7. Valve guide
8. Water jacket

9. 1. Rocker arm
2. Oil line
3. Spring
4. Cotter

10. 1. Transfer
2. Drain cock
3. Cylinder block
4. Oil gage rod
5. Bushing
6. Relief valve plunger
7. Relief valve spring
8. Relief valve plug
9. Gasket
10. Front bearing cap
11. Center bearing cap
12. Front shim
13. Shim
14. Bolt
15. Rear bearing cap
16. Seal half
17. Gasket
18. Cap screw
19. Seal retainer
20. Expansion plug
21. Bushing

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Answer Sheet for Test
on
POWER PLANT CONSTRUCTION AND TERMINOLOGY

1. Piston and parts, connecting rod and bearings, cylinder liner

2. Cylinder head, gasket and related parts

3. Crankshaft, flywheel, and related parts

4. Camshaft and related parts

5. The L-head valve assembly

6. Rocker arm assembly

7. Cylinder block and related parts

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Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Internal Combustion Engines

TOPIC: Power Plant Disassemble, Assemble, and Repair

1. Steam cleaning

2. a. Remove engine accessories
   b. Drain radiator and block
   c. Remove all radiator clamps and bases
   d. Remove radiator holding volts and radiator
   e. Remove external engine parts

3. Fuel pump and fuel injector

4. Observation of worn parts and broken or excessively worn parts

5. By cutting halfway through with a torch and splitting the remainder with a chisel; or cutting halfway through with a 1/4" drill and splitting the remainder with a chisel.

6. Some rods and rod caps are numbered, however, if they are not a center punch may be used to number each corresponding part alike.

7. Camshaft bushings

8. Twenty

9. The space or gap between the ends of the rings after they have been inserted into the cylinder.

10. The oil ring should be installed first with the level toward the top. The scraper ring should be installed in the second groove with the outside notch down, and finally the compression ring should be installed in the top groove with the inside notch up.

11. Toward the front of the block.

UNIT: Internal Combustion Engines
TOPIC: Power Plant Disassemble, Assemble, and Repair
(Answer Sheet continued)

12. The cylinders are numbered beginning with the one nearest the radiator and counting back.

13. a. Grawler test
    b. Induction test
    c. Light short test

14. Place the thermostat in a pan of water and heat the water until the thermostat opens. Note the temperature at which the thermostat opens and compare it to manufacturer's specifications.

15. With the coil toward the block.

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Answer Sheet for Test
on
POWER PLANT DISASSEMBLE, ASSEMBLE, AND REPAIR

1. Remove spark plug in the number one cylinder and rotate the crankshaft until the piston almost reaches the top of the compression stroke. Insert the plug. Install the wire on the plug and in the distributor cap opening which the rotor in the distributor points to. Install the remaining wires in rotation and running them to the plugs according to the firing order.

2. With the socket end up.

3. To follow manufacturer's recommendations on sequence and torque pounds.

4. Oil

5. Rotate engine to bring number one cylinder to the top of its compression stroke and line up crankshaft pulley on flywheel timing marks. Turn the injector pump to proper timing mark and slide it into the block meshing the gears on the pump with those on the crankshaft.

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Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Lubricants and Lubricating Systems

TOPIC: Lubricants (Engine oils and their functions)

1. Body or viscosity is the thickness or resistance to flow.

2. It must be heavy enough at operating temperature to prevent metal to metal contact. If it is too heavy, it cannot penetrate close clearances.

3. Viscosity is the body of an oil or its resistance to flow. It is expressed as the number of seconds required for a certain quantity (60ml.) of the oil to flow through a hole of a specified size in a special instrument known as a viscosity meter.

4. Viscosity decreases as the oil is heated.

5. Oxidation resulting from the exposure of the hot oil to air in the crankcase.

6. Thinning effect of fuel dilution.

7. Main and connecting rod bearings, and wrist pins and pistons.

8. The bearings will "burn out" or seize.

9. Viscosity.

10. Prevent deposits of oil contaminants as they are formed and by holding them in minute dispersion (suspension) in the oil so that they are eliminated when the crankcase is drained.

11. Short periods of operation, light loads, rich mixtures, or excessive idling.

UNIT: Lubricants and Lubricating Systems
TOPIC: Lubricants (Engine oils and their functions
(Answer Sheet continued)

12. Low engine temperature and/or poor combustion.

13. Some oils do not have adequate quantities of properly selected additives having effective rust and corrosion preventing properties.

14. They are "used up."

15. (1) Dust and dirt
    (2) By-products of combustion such as soot, carbon, acidic by-products and condensed water vapor.
    (3) Unburned fuel from blow-by or fuel leaks
    (4) Wear metals and rust
    (5) Water or antifreeze solution from internal leaks in the cooling system

VOCABULARY:

1. Viscosity - the body of an oil or its resistance to flow. It is expressed as the number of seconds required for a certain quantity (60ml.) of the oil to flow through a hole of a specified size in a special instrument known as a viscosity meter.

2. Oxidation - a chemical change in oil causing it to thicken. This is caused by hot oil being exposed to air in the crankcase.

3. Dilution - the thinning of an oil caused by the fuel mixing with the oil.

4. Oil contaminants - foreign matter in the oil solution.

5. Detergent - dispersant - additives to oil which keep foreign matter in suspension.

6. Additive - chemicals added to oils for various reasons.

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Answer Sheet for Test
on
LUBRICANTS (ENGINE OILS AND THEIR FUNCTIONS)

PART I:

1. F

2. F

3. T

4. T

5. F

PART II:

1. Cooling

2. Viscosity

3. (1) Build up of dust and dirt.
   (2) By-products of combustion such as soot, carbon, acidic by-products and condensed water vapor.
   (3) Unburned fuel from blow-by on fuel leaks. Wear metals and rust
   (4) Water or antifreeze solution from internal leaks in the cooling system.

4. Dilution effect of fuel

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Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Lubricants and Lubricating Systems

TOPIC: Lubricants: Crankcase-Oil Viscosity (Grade) and Crankcase-Oil Type (Service Classification)

1. Society of Automotive Engineers

2. More fluid

3. Adapted to winter use

4. SAE: 5W, 10W, 20, 20W, 30, 40 and 50

5. Design of the lubrication system, clearances of moving parts, and loads the engine may be expected to handle.

6. Oil may be forced out from between the bearing surfaces allowing metal to metal contact, resulting in very rapid wear. High oil consumption may also result.

7. Hard cold weather starting, extra power required for oil circulation, poor lubrication of tight fitting bearings.

8. They are broad viscosity range oils which have been prepared from special base oils and an additive called a viscosity-index improve. They are not as readily affected by temperature changes as single-grade oils.

9. Four

10. American Petroleum Institute

11. ML - Motor Light
MM - Motor Moderate
MS - Motor Severe
DG - Diesel General
DM - Diesel Moderate
DS - Diesel Severe

12. ML

UNIT: Lubricants and Lubricating Systems
TOPIC: Lubricants: Crankcase-Oil Viscosity (Grade) and Crankcase-Oil Type (Service Classification)
(Answer Sheet continued)

13. SPARK IGNITION

a. SAE 20W or SAE 10W-30; API-MS
b. SAE 30 or SAE 20W-40; API-MM

DIESEL

a. SAE 30 or SAE 20W-40; *API-DM
b. SAE 30 or SAE 20W-40; *API-DS

*Note: Sulphur content of fuel will also affect the type to use.

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Answer Sheet for Test
on
LUBRICANTS: CRANKCASE-OIL VISCOSITY (GRADE) AND
CRANKCASE-OIL TYPE (SERVICE CLASSIFICATION)

PART I:

1. (3)

2. (4)

3. (4)

4. (2)

5. (4)

PART II:

1. Lower

2. a. Motor Light
   b. Motor Moderate
   c. Motor Severe
   d. Diesel General
   e. Diesel Moderate
   f. Diesel Severe

3. American Petroleum Institute

4. Four

5. Decreases

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Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Lubricants and Lubricating Systems

TOPIC: Lubrication: Gear Oils, Hydraulic Oils, and Lubricating Greases

1. Some crankcase and gear oils are of the same viscosity, therefore it was necessary to number them differently to avoid confusion.

2. SAE 75, SAE 80, SAE 90, SAE 140, SAE 250.

3. a. Regular Type Gear Lubricant
   b. Warm Type Gear Lubricant
   c. Mild Type Extreme Pressure (EP) Gear Lubricant
   d. Multi-purpose Type Gear Lubricant (API Service GL4)

4. Regular type and multi-purpose type.

5. Tractor manufacturers sometimes provide a special oil that is different from those available under API Classification.

6. a. Operating the hydraulic implement control system
   b. Operating the hydraulic steering mechanism

7. a. Single-grade and multi-grade crankcase oils of various types
   b. Gear oils
   c. Hydraulic oil
   d. Special oils-supplied by tractor manufacturers for use with their particular tractors.

8. a. Anti-oxidants that keep the oil from thickening
   b. Rust and corrosion inhibitors
   c. Prevent foaming
   d. Mild extreme pressure (EP) additives prevent rapid wear and scoring of the hydraulic pump and gears.

9. Multi-purpose grease

10. a. Rust inhibitors
    b. Anti-oxidants

UNIT: Lubricants and Lubricating Systems
TOPIC: Lubrication: Gear Oils, Hydraulic Oils, and Lubricating Greases
(Answer Sheet continued)

11.	Power Steering	Implement Control	Trans-mission	Differ-ential
WD Allis-Chalmers Gasoline	None	20W ML	80EP	80EP
John Deere 2010 Gasoline	John Deere 303	John Deere 303	John Deere 303	John Deere 303
Ford 501 Gasoline	* Ford M-2C41	Ford M-2C41	80EP	80EP
Oliver 1800 Diesel	*	** 10W ML	80	80

	Power Take-off	Pulley Housing	Final Drive
WD Allis-Chalmers Gasoline	80EP	20W ML	80EP
John Deere 2010 Gasoline	John Deere 303	80	80
Ford 501 Gasoline	80EP	90EP	80EP
Oliver 1800 Diesel	80	** 10W-30 SAE	80

*Automatic Transmission Fluid--Type A.

** Mix Oliver 102 082-A oil additive with the recommended oil ratio of 16 parts oil to 1 part additive.

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Answer Sheet for Test
on
LUBRICATION: GEAR OILS, HYDRAULIC OILS AND LUBRICATING GREASES

PART I:

1. Gear oils

2. Regular
   Multi-purpose

3. Implement
   Power steering

4. Multi-purpose

5. Rust inhibitors
   Anti-oxidants

PART II:

1. True

2. True

3. False

4. True

5. False

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Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Lubricants and Lubricating Systems

TOPIC: Lubricating Systems

1. a. Efficient in operation
   b. Reliable
   c. Trouble-proof
   d. Simple

2. a. Good quality lubricant
   b. Correct grade of lubricant

3. a. Cylinder walls and piston
   b. Piston pin
   c. Crankshaft and connecting rod bearing
   d. Valves and valve-operating mechanism
   e. Other moving parts such as fan, water pump, ignition mechanism, etc.

4. a. Simple circulating splash
   b. Internal force feed and splash
   c. Full internal force feed

5. A relief valve

6. Gear driven

7. a. An oil level indicator
   b. An oil pressure or circulation indicator

8. a. Bayonet type-stick type
   b. Test cocks, one for high level and one for low level

9. a. Too thin oil
   b. Lack of oil
   c. Oil too cold or too heavy to flow
   d. Broken pump parts or oil lines
   e. Clogged oil screen or oil lines

UNIT: Lubricants and Lubricating Systems
TOPIC: Lubricating Systems
(Answer Sheet continued)

10. Piston pumping action creates an uneven pressure in the crankcase, therefore some means must be present to keep the oil from being forced out of the crankcase joints or past pistons and into the combustion chamber. The breather may also serve as the oil-filler opening.

11. a. Poor carburetor settings
    b. Excessive chocking
    c. Loose, badly worn piston rings

12. Controls and eliminates trouble caused by water and fuel vapors.

13. Reduce engine wear by removing foreign particles from the oil.

14. a. General operation
    b. Filtering principle
    c. Size
    d. Direction of flow
    e. Type of element

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Answer Sheet to Test
on
LUBRICATING SYSTEMS

PART I:

1. False

2. False

3. False

4. False

5. False

PART II:

1. Bayonet (stick) and test cocks

2. Gear

3. Circulating splash
   Combined splash and force feed
   Full internal force feed

4. Cotton wastes
   Cellulose
   Replaceable elements

5. Relief valve

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Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Fuel Systems

TOPIC: Fuels and Principles of Combustion

1. a. Reasonably high energy value
   b. Vaporize at comparatively low temperatures
   c. Fuel vapor must ignite and burn readily when mixed in the proper proportions with oxygen.
   d. Not unduly harmful or dangerout to human health or life
   e. Can be handled and transported with comparative ease and safety.

2. a. According to physical state before entering engine cylinder, either gasious or liquid
   b. According to origin of fuel either natural origin or artificial

3. a. Gasoline
   b. Diesel
   c. Liquefied petroleum

4. a. From dry gases and gasoline as it is removed from crude oil
   b. From recycling plants from the wet gas
   c. From the normal processing of crude oil into commercial gasoline and distillates

5. a. Gasoline
   b. Kerosene
   c. Distillate
   d. Diesel fuels

6. The ability of a liquid to change to a vapor

7. a. White or fourth grade
   b. Regular
   c. Premium
   d. Super-premium

UNIT: Fuel Systems
TOPIC: Fuels and Principles of Combustion
(Answer Sheet continued)

8. Detonation is the "knock" caused by higher compression pressures, whereas preignition is the firing of the fuel change too far ahead of the compression dead center position of the piston.

9. Combustion is the chemical union of the fuel with oxygen. In an internal combustion engine this union gives off intensive heat and produces an oxide. These gases being confined in a very small place, produce high pressures and consequently exert a great force on the piston and thus generate power.

10. The ability of a gasoline to resist detonation.

11. Diesel fuels are graded by the American Society for testing materials into two grades. Number 1 Diesel Fuel (NO. 1-D) and number 2 Diesel Fuel (NO. 2-D). They are graded on the basis of the centane number, and the maximum limits of impurities such as water sulfur, sediment, etc.

12. Centane rating is a measure of the self ignition and burning qualities of diesel fuel of which anti-knock is one quality.

13. The two worst enemies of diesel fuel is sulphur and water.

Vocabulary:

Destillate = crude oil products greatly resembling kerosene but having a different color and odor.

LP gas = liquedified petroleum so named because they turn to gas at atmospheric pressure and temperature. More or less a by-product of the petroleum refining process.

Detonation = the "knocking" effect caused by fuel in high compression engines after ignition has taken place.

Preignition = the noise made when fuel is ignited too far ahead of compression dead center of the piston.

Combustion = the chemical union of fuel and oxygen causing force to be applied to the piston thereby producting power.

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Answer Sheet for Test
on
FUELS AND PRINCIPLES OF COMBUSTION

1. a. Gasoline
   b. Kerosene
   c. Distillate
   d. Diesel

2. a. Sulphur
   b. Gum

3. 10 parts air to 1 part fuel, to 20 parts air to 1 part fuel

4. 2:1

5. 15:1

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Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Fuel Systems

TOPIC: Gasoline Systems

1. Mix and deliver the proper air-fuel mixture to the engine.

2. In a cold engine the air-fuel ratio should be about 9 to 1, whereas the ratio in a hot engine should be about 15 to 1. In extremely cold engines the choke may provide a mixture as rich as 2 to 1.

3. a. The fuel sypply system
   b. The idling system
   c. The load system
   d. The choke or starting system

4. Updraft and downdraft

5. To deflect hot exhaust gases around the intake manifold to assist in vaporizing the fuel droplets entering the engine

6. Place a small rubber and glass tube device to the bottom of the carburetor and then run it upright along the side of the carburetor float bowl. The liquid in the tube will then seek the same level as that in the float bowl. Engines having fuel pumps should be running when this test is made.

7. First, you would adjust the idle speed adjustment screw. This is done by closing the throttle until the engine runs at a fast idle. Then turn in the idle speed adjustment screw until the engine begins to increase speed. Close the throttle completely and re-adjust the needle turning it out until engine reaches the idle speed you want. (approximately 425 rpm).

8. First, bring the engine to normal operating temperature and then by turning the adjustment screw counterclockwise set the carburetor for the type work to be done--light or heavy. It is always best to consult the operator's manual for exact settings.

UNIT: Fuel Systems
TOPIC: Gasoline Systems
(Answer Sheet continued)

9. The venturi is a narrowing of the throat of the carburetor causing somewhat of a restriction. Its purpose is to increase the velocity of the air entering the carburetor. This is to create a partial vacuum at the discharge nozzle in order to get better fuel to air mixture

10. A float and needle value is used to maintain a constant fuel level. This is important in order to obtain a uniform discharge of fuel.

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Answer Sheet for Test
on
GASOLINE SYSTEMS

1. Updraft and downdraft refer to the direction of wind travel through the carburetor whether up or down.

2. A venturi is a narrowing of the carburetor throat causing somewhat of a restriction.

3. a. Fuel supply system
   b. Idling system
   c. Load system
   d. Choke or starting system

4. Bring the engine to normal operating temperature and then close the throttle to cause the engine to run at a slow idle. Turn the idle adjustment screw in until the engine begins to increase speed. Close the throttle completely, and then turn the idle adjustment screw out until the engine slows to the desired speed. (approximately 425 RPM)

5. a. Quicker engine warm up
   b. Increased fuel economy
   c. Reduction of cylinder wall wear

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Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Fuel Systems

TOPIC: LP Gas Systems

1. Because, propane has a lower boiling point than butane and thereby insures vaporization at extremely low temperatures.

2. In the winter straight butane will loose its pressure at 32° F. whereas propane will retain approximately 54 pounds pressure at 32° F. In the summer butane will have only 32 pounds pressure at 100° F., whereas propane will have 195 pounds pressure at 100° F. For these reasons a mixture of the two fuelsranging from high propane concentration in winter to high butane concentration in summer is used to maintain a fairly constant pressure.

3. They are of the same general type and make-up, however, the LP may have a slightly higher compression ratio ranging up to 9:1. The big difference is in the handling and utilization of the fuel. In this type engine the fuel goes from the storage tank through a filter to the high pressure regulator. Here, the pressure is reduced to about 8 pounds per square inch and partial expansion and vaporization begins. The fuel then enters the vaporizer coils, which is surrounded by heated water from the engine cooling system, and further expansion and vaporization occur. This vapor then passes through the low pressure regulator which reduces the pressure slightly below atmospheric. From here the fuel goes to the carbruetor where it is mixed with air before entering the cylinder. It also takes a different type carburetor.

4. Less wear due to burning clean,leaving no deposits
A high anti-knock characteristic

5. Gasoline has the greatest potential power having a heat value of 124,000 btu's per gallon compared to 91,500 to 103,500 btu's per gallon on propane and butane respectively. Assuming that the engine will have the same thermal efficiency when using either fuel, we will see that gasoline will have the greater horsepower hour out put.

UNIT: Fuel Systems
TOPIC: LP Gas Systems
(Answer Sheet continued)

6. Storage problems and costs
   Lower btu rating

7. a. The LP gas engine carburetor has no fuel float and storage chamber since the fuel enters the carburetor as a gas.
   b. There is no venturi since LP gas and air mix readily
   c. The choke on some models works opposite to that on the gasoline engine. Rather than shutting off the air, it shuts off fuel.

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Answer Sheet for Test
on
L. P. GAS SYSTEM

1. F

2. T

3. T

4. F

5. T

6. F

7. F

8. T

9. T

10. T

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Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Fuel Systems

TOPIC: Governors

1. a. Hit and miss system
   b. Throttle system

2. To maintain constant engine speed whether under load or running free.

3. The fluctuating of engine speeds caused by the governor.

4. It is caused by incorrect carburetor settings or by the governor being too stiff or by striking or binding so that it fails to act freely.

5. A vacuum or automatic type

6. The hit and miss system is adapted only to slow speed engines. It keeps all explosions alike and at the maximum intensity, but varies the number per time interval depending upon the power out put required. This is achieved by weights on the flywheel which tend to spread apart as speed increases. This expansion slides a collar on the shaft which reacts on one end of the pivoted detent arm causing the opposite end to catch in a notch on the exhaust valve holding it open. This valve being held open will not allow a fuel charge to be drawn in, compressed and fired, thereby slowing the engine down.

7. The principle of the throttle system of governing is to permit the engine to fire the maximum number of times but to regulate the fuel charge per cycle thereby slowing the engine down. This is done by a set of weights on the shaft which are held together by springs. As the engine builds up RPM's the weights fly apart, moving a sliding collar and actuating a throttle connecting rod causing the throttle butterfly to partly close thereby cutting off the fuel mixture. As the fuel mixture is decreased the engine slows down.

8. The throttle governing system.

9. For slow speed single cylinder engines.

UNIT: Fuel Systems
TOPIC: Governors
(Answer Sheet continued)

10. The vacuum type governor is located between the carburetor and intake manifold. It consists of a housing and a throttle-butterfly valve mounted off center and connected to a spring controlled cam and lever mechanism. As the pressure of the gas being drawn into the engine increases the off center mounted butterfly tends to close, thereby maintaining a constant speed.

11. Diesel engines are governed by the weight or fly ball system. As the weights on the governor begin to change positions it moves a geared rack which rotates the scroll and supplies the correct amount of fuel.

12. On air cooled engines the vane-type method of governing is used. As the engine speed increases, the vane is forced by air toward a closed position. The throttle spring then takes over holding the valve at whatever position the throttle is set.

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Answer Sheet for Test
on
GOVERNORS

1. F
2. T
3. T
4. T
5. F
6. F
7. F
8. T
9. T
10. F

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Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Fuel System

TOPIC: Diesel Fuel Systems - Principles of Operation, Combustion Chamber, Air Systems, and Starting Aids

1. Review taken from required texts.

2. Combustion is caused by the rising temperature of the compressed air which reaches a temperature of 1000° F. to 1100° F.

3. On the intake stroke of a diesel only air is brought into the combustion chamber whereas both fuel and air is drawn into the carburetor type engine.

4. The fuel is injected under pressure by the fuel injector into the pre-compressed air.

5. Ignition takes place immediately upon injection due to the temperature of the air.

6. Cleanliness is extremely important due to the extremely precisioned machined parts in the injection system.

7. In the diesel engine the compression ratios range up to twice that of the gasoline or LP gas engines. Also, the heat range is much higher making it necessary to increase the amounts and materials of construction.

8. On a two stroke, diesel air is pumped into the cylinder by a blower mounted in line with the intake port.

9. A diesel may be started by the following ways:
   a. A small auxiliary engine may be used
   b. A dual fuel system may be used
   c. Direct starting on diesel fuel by use of 24 volt electrical system to turn motor.

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Answer Sheet for Test
on
DIESEL FUEL SYSTEMS-PRINCIPLES OF OPERATION, COMBUSTION CHAMBER, AIR SYSTEMS AND STARTING AIDS

1. 14:1 to 20:1

2. 1200° F. - 1500° F.

3. It is more important because the fuel injection nozzle has very small openings to allow the fuel to enter the cylinder. These are machined to as small as .0003 inch and will stop up very easily.

4. No

5. Heat from compressed air.

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Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Fuel Systems

TOPIC: Diesel Fuel Systems, Injection Pump and Fuel Injectors

1. Always work in extremely clean conditions and avoid getting any foreign material in a filter unit.

2. a. Fuel tank
   b. Low pressure line where filters are located
   c. Injection pump
   d. High pressure line (on some)
   e. Injectors
   f. Return fuel line (on some)

3. To apply very high pressure to the fuel from 2400 psi to as high as 20,000 psi.

4. This high pressure is used by the injector nozzles to make a fine mist of the fuel as it is sprayed into the cylinders. This provides for an immediate and even mixture with air in the cylinder for even burning.

5. The return fuel line returns excess fuel from the injectors or from the injection pump or both to the fuel tank depending upon the design of the injectors.

6. A filter is for the purpose of removing moisture and dirt particles from the fuel. The first stage filter removes most of the water and coarse material, the second stage filter removes the finer particles and a small amount of water. If a third stage is used, it is intended to remove any remaining smaller particles.

7. The number of filters used is a matter of judgement on the part of the manufacturer.

8. First stage may be called the primary or auxiliary filter, the second stage may be called the intermediate and the final stage is known as the final filter.

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Answer Sheet for Test
on
DIESEL FUEL SYSTEMS, INJECTION PUMP AND FUEL INJECTORS

1. T

2. T

3. T

4. T

5. T

6. F

7. F

8. T

9. F

10. F

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Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Fuel Systems

TOPIC: Air Cleaners

1. a. The dry type
   b. The oil soaked element type
   c. The oil bath type

2. One located 30" above the dash of the tractor

3. a. It must effectively remove dust, but not restrict unduly the carburetor intake
   b. Must work successfully in all climates
   c. Require only minimum attention from the operator
   d. Sturdily built

4. The dry type oil filter utilizes two principles; one being a rapid change in direction to cause large particles of air to fallout and another the swirling of the air to cause large particles to be thrown out by centrifugal force. After the air is cleaned in this manner, it then passes through a pleated paper filter designed to allow the air to pass through but stop dust particles. This paper is often chemically treated to aid in the filtering of the air. This system is 99% effective and is often used as a pre-cleaner.

5. The oil bath unit also utilizes the principle of reversing the direction of air travel. The air is drawn down a tube until it strikes oil held in a small reservoir at the bottom. As the air strikes the oil, the impact causes a mixture of oil spray and air to be carried upward into a separating element consisting of a system of baffels and metal mesh. The separating elements cause the dust laden air to be broken into fine air streams and change directions many times. Dust will be trapped by the oil film and gradually returned to the reservoir.

UNIT: Fuel Systems
TOPIC: Air Cleaners
(Answer Sheet continued)

6. The oil soaked element is very simple in operation. The element is placed in the path of travel of the air and as the air strikes it the oil on the filter element holds the dust and allows the clean air to continue its travel.

7. a. The oil bath filter is cleaned by removing the bowl and washing it in a good solvent, replacing the oil with correct grade and amount according to the operator's manual directions.

   b. The oil soaked element is cleaned by removing the element, wash-it in tractor fuel, drying it and then dip it in fresh oil. Also, wipe all dust out of the filter itself.

   c. The dry filter is cleaned by removing the element and tapping it gently to remove the remaining particles. In the case of a pre-cleaner, empty all loose dust particles and wipe the container clean with a clean rag.

8. The air intake tube, all pre-cleaner's and screens and engine breather caps.

9. Daily or more often in extremely heavy dusty work.

10. a. Around worn parts of the carburetor
    b. Places where gaskets are missing
    c. In drain holes in carburetors
    d. Damaged filter elements
    e. Loose connections

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Answer Sheet for Test
on
AIR CLEANERS

1. A farm tractor requires about 9000 gallons of air for each gallon of fuel burned. If this air is not clean the engine will wear out in a very short time, approximately, a few hundred hours.

2. It is too flammable

3. No, because the engine may have some gaskets, connections or mising parts which will allow dust to enter.

4. The use of an air cleaner will lengthen the life of the engine as well as provide for better performance.

5. The service manual will give you information as to how often the filters should be changed, how specific brands should be cleaned and the replacement unit identification numbers.

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Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Fuel Systems

T OPIC: Intake and Exhaust Manifold and Pipes

1. The purpose of the intake manifold is to conduct the fuel and air mixture from the carburetor to the engine cylinders.

2. Yes, copper-asbestos gaskets are necessary because of the extreme heat.

3. The intake manifold gasket seals out air impurities and seals in the fuel air mixture so that the engine will perform properly.

4. To help eliminate a fire hazard, cut down on noise and assist in removing exhaust fumes.

5. The intake manifold is designed to prevent the inertia of the mixture from loading up one cylinder and to give equal mixture in each cylinder.

6. Back pressure in the engine reduces performance and may cause valve trouble.

7. Replace mufflers with factory recommended units and be sure all connections are tight.

8. Inertia is the movement of the air-fuel mixture in a uniform motion in the same straight line going to the same cylinder unless acted upon by outside forces.

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Answer Sheet for Test
on
INTAKE AND EXHAUST MANIFOLDS AND PIPES

1. The purpose of the intake manifold is to bring the fuel air mixture from the carburetor to the cylinder, keeping it mixed.

2. Inertia is the movement of the air-fuel mixture in a uniform motion in the same straight line going to the same cylinder unless acted upon by forces.

3. Back pressure in the engine will cause lower engine performance.

4. Gaskets are necessary in the manifold system to keep down fire hazards and hazardous fumes of the exhaust system and to prevent improper fuel-air mixture and foreign matter from entering the engine.

5. The exhaust manifold supplies hot fumes to preheat the air-fuel mixture entering the cylinder from the intake manifold.

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Answer Sheet
for
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UNIT: Cooling Systems

TOPIC: Liquid and Air Cooling Systems

1. 175°

2. From water jacket to radiator, down radiator to bottom and back up through the water jacket from bottom to top.

3. Thermo-siphon and forced circulation

4. As the water flows down through the radiator, the heat is transferred from the water to the metal in the radiator. The fan pulls air through the radiator thereby transferring the heat into the air stream.

5. The thermostat blocks the flow of water into the radiator thereby allowing the engine to heat up to normal operating temperature more rapidly. When the normal operating temperature is reached, the thermostat will open allowing the water to pass on through the opening and into the radiator.

6. No. The thermo-siphon system operates on the principle that as water is heated, it becomes lighter and as it moves up, cooler air from the radiator will take its place. This hot air will rise and finally enter the top of the radiator. As it does the air will cool, thereby becoming heavier and settle to the bottom of the radiator thereby completing a cycle.

7. The water pump is to speed up cooling by speeding up circulation.

8. Diesel 145°-165°
   Tractor fuel 190°

9. With each pound of pressure the boiling point is increased 3° F.

UNIT: Cooling Systems
TOPIC: Liquid and Air Cooling Systems
(Answer Sheet continued)

10. This system forces air past the hottest part of the engine block and cylinder head. Sheet metal shrouds are often used to direct the flow of air. The air is usually forced through the system by a fan which is usually a part of the fly wheel.

11. a. An accumulation of leaves or chaff on the radiator
    b. An overload on the engine
    c. Insufficient water in the cooling system
    d. Excessive lime deposits in the cooling system
    e. Carburetor out of adjustment (usually too lean)
    f. Ignition out of time
    g. Loose fan belt
    h. Use of a fuel too low in anti-knock quality for the engine

12. Bacause, it does not have the heat carrying capacity that water has.

13. No

14. Near the outlet of the cylinder head.

15. 300 hours

16. a. Excessive wear
    b. Warpage and cracking of engine parts (particularly heads)
    c. Burning of valves

17. a. Increase fuel consumption
    b. Excessive wear (due to inadequate oiling)
    c. Lower horsepower

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Answer Sheet for Test
on
LIQUID AND AIR COOLING SYSTEMS

1. Air and liquid

2. Thermo-siphon and forced circulation

3. a. Excessive wear
   b. Excessive fuel utilization
   c. Loss of power
   d. Burning of valves
   e. Warpage and possible cracking of engine parts

4. Gasoline - 175°
   Diesel - 145°-165°
   Tractor fuel - 190°

5. Near the outlet of the cylinder head

6. The air is forced around the fins of the engine by use of a sheet metal shroud and a fan made on the flywheel. This air takes the heat from the hot engine parts, thereby cooling them.

7. The boiling point of water is raised 3° F for every pound of pressure.

8. It will cause bearings to wear out quicker causing the water pump to leak.

9. Every 300 hours

10. Remove it from the engine, place it in water 20° hotter than the temperature marked on the thermostat. The valve should open at this temperature. Then place it in water 10° cooler than the temperature marked on the thermostat and it should close. If it doesn't open or close properly, discard it and install a new one.

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Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Electrical Systems

TOPIC: Magneto System

1. The rotation of the armature of the magneto

2. This construction simplifies design, reduces size, and lowers the cost.

3. Just before a reversal of the magnetic flux

4. Rotation of the magnetic rotor causes the magnetic flux to flow through the frame laminations and induces a flow of current in the primary windings.

5. To absorb the surging current when the points are opened and thus prevent arcing and burning of the points.

6. The storage action of the condenser is followed by a quick and complete collapse of the magnetic field then existing in the coil. This collapse induces a secondary current which is much higher voltage due to the more turns of a wire in the secondary circuit.

7. One and one-half times the engine speed.

8. A device used to give the magneto a quick flip to assist in starting. It consists of weighted pawls and a spring arrangement which wind up as the cranking begins. The spring gives the armature or rotor a quick flip which produces a hot spark.

9. On non-sealed units a very small amount of light machine oil may be used as recommended by the manufacturer or bearings or gears. If the impulse coupling becomes sluggish, it should be flushed with kerosene and reoiled. The distributor should be kept as clean as possible and the points should be regapped or replaced ever 200-300 hours.

10. One must be careful not to rotate the distributor arm because on many late models the gear case can be replaced with the distributor arm rotated one-half turn.

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Answer Sheet for Test
on
MAGNETO SYSTEMS

1. T
2. F
3. F
4. T
5. T
6. T
7. T
8. F
9. T
10. T

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Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Electrical Systems

TOPIC: Introduction to the Battery Ignition System

1. Provides a hot spark at the spark plug--the job of the ignition coil

   Times the spark so that it occurs at the right instant to ignite the fuel in the cylinder--the job of the distributor

2. The opening and closing of the breaker points in the distributor

3. The rotating cam is powered by the engine cam shaft to which it is geared.

4. It flows from the battery through the primary winding of the ignition coil, to the distributor and to the ground connection where it returns to the battery.

5. A "ground" provides a path for the current to return to its source. In the case of the ground for the primary circuit the current is conducted through the metallic parts of the engine back to the battery ground connection.

6. Energizes the ignition coil

7. The cam lobe in the distributor turns enough to open the breaker points which breaks the primary circuit.

8. To jump the spark plug gap

9. Ignition coil through the distributor rotor, along the wire leading to the spark plug, where it jumps the gap and ignites the fuel in the cylinder. It then passes through the ground electrode of the spark plug, back through the shell of the engine to the ground connection of the ignition coil.

10. The condenser prevents sparking by providing a place where the current can flow until the points are safely separated. The condenser also helps collapse the flux lines more quickly, thus causing a higher secondary voltage.

UNIT: Electrical Systems
TOPIC: Introduction to the Battery Ignition System
(Answer Sheet continued)

11. Battery, ignition coil, distributor, spark plugs, along with necessary wiring.

12. Distributor cap, rotor, distributor shaft, cam, breaker points, and the condenser which is housed in the distributor

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Answer Sheet for Test
on
BATTERY IGNITION SYSTEMS

1. 1/000 TW of a second

2. a. Generator circuit
   b. Starting circuit
   c. Lighting circuit
   d. Ignition circuit

3. a. 3600
   b. 900
   c. 5400
   d. 324,000

4. Easier starting

5. Electromagnetic induction

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Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Electrical System

TOPIC: The Battery

1. a. Positive plates
   b. Negative plates
   c. Separators
   d. An electrolyte
   e. Case or container

2. Hard rubber or bituminous composition

3. At 0° F. a charged battery will be about 40% efficient whereas the same battery at 80° F. will be about 100% efficient.

4. About 2 volts per cell

5. It is weak, very diluted, almost water

6. As the current is used, both the lead spouge and lead peroxide are covered with lead sulphate by chemical action.

7. A battery is charged by reversing the chemical action by passing a direct current of proper voltage through the battery. This current removes the sulphate from the plates returning it to the acid electrolyte.

8. Mix soda and water into a thick paste and spread on corroded parts. Let this solution stand on the parts for a few minutes, then wash with clear water.

9. When charging a battery, it will give off a highly explosive gas; therefore, it is necessary to keep all spark or open flames away from the battery.

10. The charge is checked by the use of an hydrometer which tells the specific gravity of the electrolyte. This specific gravity should be 1.285 for a full charged battery.

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Topic Test
on
THE BATTERY

1. T

2. T

3. F

4. F

5. F

6. T

7. F

8. T

9. T

10. T

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Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Electrical System

TOPIC: Generators, Alternators, and Accessories

1. To supply enough current to take care of all electrical equipment and to keep the battery fully charged.

2. The same as that of the generator.

3. To regulate the current entering the battery so that the battery will remain fully charged but will not overcharge.

4. To keep the battery from discharging back through the generator.

5. a. Voltage regulator
   b. Manual switch
   c. Use of the third brush

6. The manual switch is used to insert or remove an electrical resistance in the generator field circuit. When the resistance is in the field, the rate of charging is reduced. When the switch is closed, the resistance is by-passed and the charging rate is increases.

   The third brush is often used to regulate the generator output. As the third brush is moved toward the main brush in the direction of travel of the armature, the output is increased. As it moves toward the main brush against the direction of travel of the armature, the output is reduced.

   The voltage regulator is used on most modern farm tractors today. It controls the generator output by automatically opening and closing the contact points within the regulator. As the current flows from the generator to the battery, the contact approaches full charge and the voltage increases causing the points of the regulator to open. This action causes the generator field current to flow to the ground through increased resistance, lowering its voltage.

UNIT: Electrical System
TOPIC: Generators, Alternators, and Accessories
(Answer Sheet continued)

7. A generator develops direct current where an alternator develops alternating current which is rectified or changed into direct current in the alternator by use of diodes.

8. The ammeter is used to indicate the flow of current from the generator to the battery on the flow side or the flow of current from the battery to lights and other electrical accessories on the discharge side. It also indicates whether or not the generator is functioning properly.

9. The bearings may need oiling with a light oil several times during the year; however, oil should be used sparingly because excessive amounts may get into the windings and cause damage. Also, the commutator may become corroded. To do this, No. 00 sandpaper may be held against it as the engine turns slowly.

10. It will serve as a conductor and might short the commutator segments.

11. Ground across the battery and generator terminal post on the voltage regulator momentarily.

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Answer Sheet for Test
on
GENERATORS, ALTERNATORS AND ACCESSORIES

1. Brush seating stone or sandpaper No. 00

2. Repolarize it

3. a. Automatic voltage regulator
   b. Third brush
   c. A manual switch

4. That it has been overheated and may need attention

5. Direct
   Diodes

6. The generator produces electrical energy to run the engine, charge the battery and take care of all the electrical needs of the tractor

7. Remove the drive belt and hold the cutout points closed. If the generator is still in working order, it will turn slowly like an electric motor. During this test the ammeter should not read over 2-4 amps discharge.

8. The brushes pick up the current from the commutator.

9. The ammeter

10. That the brushes should never be set closer than 3. 2 commutator bars.

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Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Electrical System

TOPIC: Starters

1. Both have commutators, both are constructed very much alike having an armature, field coil, brushes, and bearings.

2. The starter has heavy wiring so it can draw a large amount of current for short periods of time where the generator uses smaller wire. It also has a special gear drive, cushioned with a spring to engage the flywheel.

3. It may be cleaned exactly like a generator with No. 00 sandpaper or a brush seating stone.

4. The starter motor is equipped with a bending drive which moves against the flywheel ring gear and engages the teeth on the gear and thus turns the engine. When the engine turns faster than the starter armature the bendix automatically disengages.

5. The starter draws a very heavy currect and will discharge the battery very quickly.

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Answer Sheet for Test
on
STARTERS

1. Heavy

2. Flywheel ring gear

3. Electric

4. The speed of the flywheel exceeds that of the starter.

5. No. 00 sandpaper or a brush seating stone

6. Burning up

7. Solenoid

8. Clean and tight

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Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Engine Testing and Tune Up

TOPIC: Timing the Ignition System

1. a. The breaker point method
   b. The timing light

2. Proper timing means that the ignition is set so the distributor will supply a spark to each cylinder at a time when the fuel will burn with the greatest efficiency.

3. On the flywheel or fan pulley

4. One lead goes to the number one pulg wire while the other goes to a good ground.

5. One lead goes to the No. 1 spark plug wire while the other two go to the battery cables.

6. Loosen the plug pull the center wire out of the soil, and turn the engine over and listen for a hissing sound. This will indicate the compression stroke.

7. The timing light should be held directly over the timing marks because holding it at an angle can cause the timing to be off.

8. When the timing marks are on TDC (top dead center) the breaker points should be just beginning to open

9. Always go to the service manual of the make and model of that engine and get the correct information.

10. Retarded timing is the setting of the breaker points so that the spark reaches the spark plug after top dead center whereas advanced timing is the spark reaching the plug just ahead of top dead center.

UNIT: Engine Testing and Tune Up
TOPIC: Timing the Ignition System
(Answer Sheet continued)

11. A diesel is timed by adjusting the injection pump to start the injection at just the right time. In most cases this is so that the full pressure of the fuel charge exerts its pressure in the first 90° of crank travel.

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Answer Sheet for Test
on
TIMING THE IGNITION SYSTEM

1. F

2. T

3. T

4. F

5. F

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Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Engine Testing and Tune-Up

TOPIC: Valve Clearance Adjustments

1. a. Tappet adjustment
   b. Valve adjustment
   c. Valve spacing
   d. Valve lash

2. The provision for proper clearances between the ends of the rocker arms and the ends of the valve stems during the time that the valves are not being depressed.

3. Exhaust and manifold or intake

4. a. To give longer service
   b. Better engine efficiency
   c. Easier starts
   d. Maximum power
   e. Cooler engine operation
   f. Smooth engine operation

5. Some valves are adjusted with the engine hot while others are adjusted with the engine cold. Always check the operators manual to see how the engine should be adjusted.

6. a. Proper sized hex end wrench
   b. Proper sized open end wrench
   c. Leaf tickness gage (feeler gage)
   d. Screw driver

7. Between the rocker arm and the valve stem

8. This rocker arm is for fuel injection.

9. The critical area is between the valve seat and the face of the valve.

UNIT: Engine Testing and Tune-Up
TOPIC: Vavle Clearance Adjustments
(Answer Sheet continued)

10. By turning them up on a smooth surface and checking the height of each. Those that are weak will be shorter.

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Answer Sheet for Test
on
VALVE CLEARANCE ADJUSTMENTS

1. Exhaust

2. Rocker arm and valve stem

3. Performance

4. Tappet adjustments, valve lash, tappet, valve spacing or valve adjustments.

5. Operators manual

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Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Hydraulics

TOPIC: Introduction

1. Hydraulics may be defined, in a strict sense, as the science of fluid forces.

2. Pascal

3. a. Simplicity in design
   b. Extreme flexibility as regards to location of components
   c. Complete automation of sequence is possible
   d. Simplicity of speed control
   e. Limitless variety of speeds, controls, and forces
   f. Reduction of wear on moving parts by:
      1. Controlled acceleration and deceleration
      2. Automatic release of pressure at overload
      3. Absence of vibration
      4. Automatic lubrication
   g. Efficient and economical to operate
   h. Large forces can be controlled by much smaller ones
   i. Power and friction losses are comparably small

4. a. Pressures often are very high. Two or three thousand pounds per square inch is not uncommon. High pressures require heavy tubing, tight joints, and intelligent maintenance.
   b. Operating efficency can be severely reduced, or operation halted, by rust, corrosion, high temperatures, dirt, and the products of fluid deterioration. Cleanliness is all-important.

5. a. The fluid is incompressibility
   b. Multiplication of forces
   c. Hydrostatic and hydrodynamic power

6. Define: a. Hydrostatic Power - is where the potential (static) energy of fluid under pressure is used to perform work.

UNIT: Hydraulics
TOPIC: Introduction
(Answer Sheet continued)

b. Hydrodynamic - where the Kinetic (dynamic) energy of fluid in motion is used to perform work.

7. a. Reservoir
   b. Pump
   c. Return line
   d. Pressure line
   e. Relief valve
   f. Directional control valve
   g. Cylinder

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Answer Sheet for Test
on
INTRODUCTION

1. a. Reservoir
   b. Pump
   c. Return line
   d. Pressure line
   e. Relifel Valve
   f. Directional control valve
   g. Cylinder

2. Pascal's law states that pressure applied at any point in a static fluid is the same in all directions and acts with equal force on equal areas.

3. Hydraulics many be defined, in a strict sense, as the science of fluid forces.

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Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Hydraulics

TOPIC: Reservoirs

1. The size of the reservoir depends on the amount of fluid required to operate the system. An ideal size is two or three times the capacity per minute of the pump.

2. a. So it can hold all the fluid that drains back into the reservoir by gravity flow.
   b. So it can maintain the fluid level above the opening of the suction line at all times.
   c. So it can dissipate excess heat generated during normal operation.
   d. So it can allow air and foreign matter to separate from the fluid.

3. a. Filler strainer
   b. Return line
   c. Air filter
   d. Outlet to pump
   e. Dipstick
   f. Drain plug
   g. Cleanout opening
   h. Pump intake filter
   i. Baffle

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Answer Sheet for Test
on
RESERVOIRS

1. T

2. F

3. F

4. T

5. T

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Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Hydraulics

TOPIC: Hydraulic Pumps

1. a. Fixed delivery when running at a given speed.
   b. Variable delivery when running at a given speed.

2. Fixed delivery

3. a. Reciprocating pumps
   b. External gear pumps
   c. Internal gear pumps
   d. Gear-like pumps
   e. Screw pumps
   f. Vane pumps
   g. Radial piston pumps
   h. Axial piston pumps
   i. Centrifugal pumps
   j. Combination pumps

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Answer Sheet for Test
on
HYDRAULIC PUMPS

1. T

2. T

3. T

4. F

5. T

6. F

7. T

8. T

9. F

10. T

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Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Hydraulics

TOPIC: Hydraulic Valves

1. a. Directional control
   b. Volume control
   c. Pressure control

2. a. Mechanical
   b. Electrical
   c. Pneumatic
   d. Hydraulic
   e. Manual

3. a. Cock valve
   b. Glove valve
   c. Gate valve
   d. Flapper valve
   e. Ball valve
   f. Needle valve
   g. Spool valve
   h. Rotary valve
   i. Directional poppet valve
   j. Comernition of valves
   k. Flow control and flow divides valve

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Answer Sheet for Test
on
HYDRAULIC VALVES

1. T

2. T

3. F

4. T

5. T

6. T

7. F

8. T

9. T

10. T

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Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Hydraulics

TOPIC: Hydraulics Cylinders

1. a. Single action
   b. Double action

2. a. A thermal safety valve, set far higher than system pressure, to relieve any pressures caused by thermal expansion while the system is at rest.
   b. Using a double-walled cylinder.
   c. Stroke control valves which are adjustable to stop the cylinder at any point in its travel, by shutting off the flow of fluid to the cylinder, or otherwise closing a valve.
   d. In some cases, the cylinder moves, and the piston is fastened to the base.
   e. Another refinement is the telescoping piston.

3. The hydraulic cylinder turns fluid under pressure into a work force.

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Answer Sheet for Test
on
HYDRAULIC CYLINDERS

1. T

2. T

3. T

4. T

5. T

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Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Hydraulics

TOPIC: Hydraulic Seals and Packings

1. a. Static-Used as a gasket to seal non-moving parts
   b. Dynamic-Used to seal moving parts

2. a. Cup packing
   b. Flangs packing
   c. U-packing
   d. V-packing
   e. Expanding metallic seal
   f. Non-expanding metallic seal
   g. Mechanical seal
   h. Compression packing
   i. Spring-loaded lip seal
   j. O-Ring

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Answer Sheet for Test
on
HYDRAULIC SEALS AND PACKINGS

1. a. Cup packing
   b. Flange packing
   c. U-packing
   d. V-packing
   e. Expanding metallic seal
   f. Non-expanding metallic seal
   g. Mechanical seal
   h. Compression packing
   i. Spring-loaded lip seal
   j. O'Ring

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Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Hydraulics

TOPIC: Hydraulic Lines and Fittings

1. a. Copper
   b. Steel
   c. Standard iron

2. Galvanized pipe should never be used, as it is likely to "flake" and these metal chips will cause serious damage.

3. The bending radius of tubing and pipe is ideally not less than three times the I. D. of the tube.

   The bending radius of flexible hose should not be less than six times the inside.

4. a. Sleeve coupling for flexible hose
   b. Flexible hose coupling
   c. Flareless (Bite-type) coupling
   d. O-Ring sealed Flareless type
   e. Threaded coupling for Flared tubing

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Answer Sheet for Test
on
HYDRAULIC LINES AND FITTINGS

1. T

2. F

3. T

4. T

5. F

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Answer Sheet
for
AGRICULTURAL MACHINERY MECHANICS

UNIT: Hydraulics

TOPIC: Hydraulic Systems

1. a. Reservoir
   b. Pump
   c. Valve
   d. Motor (cylinder)

2. a. Blocked return line system
   b. Basic open center system
   c. Tandem open center system
   d. Through flow system
   e. Closed center system

3. a. (1) Reservoir
      (2) Pump
      (3) Ball valve
      (4) Pressure line
      (5) Cylinder

   b. (1) Cylinder
      (2) Return line
      (3) Ball valve
      (4) Reservoir

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Answer Sheet for Test
on
HYDRAULIC SYSTEMS

1. T

2. T

3. F

4. T

5. T

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Topic Test
on
ORIENTATION

Student: _____ School: _____

Date: _____ Score: _____

Indicate by each statement True or False.

_____ 1. The number of farm workers during the past 30 years is down 44%, however, farm production is up 75%.

_____ 2. Wages paid by the farm machinery industry has been equal to wages paid to iron and steel workers.

_____ 3. Figures show that the increase cost of farm machinery has increased the cost of production.

_____ 4. The use of modern agricultural machinery has helped raise the farmers standard of living.

_____ 5. In areas where the farmers standard of living is high, the investment in agricultural machinery is also high.

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Topic Test
on
ORIENTATION

Student: _____ School: _____

Date: _____ Score: _____

1. What is the route taken in the distribution of agricultural machinery?

   _____.

2. What does the manufacturer do in addition to supplying the machinery needed? _____

   _____.

3. What is the function of the branch house? _____

   _____.

4. Into what 4 areas is the Local Dealership divided?

   a. _____

   b. _____

   c. _____

   d. _____

5. What 5 occupations are usually found in the service department?

   a. _____ c. _____

   b. _____ d. _____

   e. _____

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Topic Test
on
ORIENTATION

Student: _____ School: _____

Date: _____ Score: _____

The agricultural machinery dealership is usually divided into the following areas:

a. Management
b. Sales
c. Clerical
d. Parts
e. Service

Indicate in the blank by each of the following specific responsibilities the area in which they belong:

_____ 1. Determine company policies

_____ 2. Conducts demonstrations

_____ 3. Promotes sales

_____ 4. Makes general repairs

_____ 5. Writes contracts

_____ 6. Maintains catalogues and price lists

_____ 7. Pick-up and delivers new machinery

_____ 8. Appraises used machinery

_____ 9. Directs customer and employee relations

_____ 10. Handles field repairs

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Topic Test
on
GENERAL SHOP SAFETY

Student: _____ School: _____

Date: _____ Score: _____

Indicate before each statement whether it is true or false:

_____ 1. The proper attitude is a most important consideration in safety.

_____ 2. You must know what dangers are present to avoid accidents.

_____ 3. WALK - avoid running is a good safety habit.

_____ 4. Store sharp-edge tools in drawers to avoid cuts.

_____ 5. If something gets in your eye, rub it very gently.

_____ 6. The largest single cause of disability from all accidents is the improper handling of materials.

_____ 7. Keep your back straight when lifting heavy objects.

_____ 8. Over 60% of all injuries in the shop was caused by the misuse of hand tools according to a one year study.

_____ 9. Light hammering on a wrench does not place excessive strain on it.

_____ 10. It is best to use a file with a handle on the tang.

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Topic Test
on
SELECTING AND USING METALS AND LAYOUT TOOLS

Student: _____ School: _____

Date: _____ Score: _____

True or False:

T F

____ 1. All iron is made from iron ore, which is mined from the earth.

____ 2. Low carbon steels are more expensive to produce than high carbon steels.

____ 3. The heating and cooling process used to make cast iron into malleable iron is called annealing.

____ 4. The twelve inch blade of the combination square is most suitable for general work.

____ 5. The cross peen hammer is the most frequently used of the three types of peen hammers.

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Topic Test
on
HAND TOOLS-CUTTING COLD METAL

Student: _____ School: _____

Date: _____ Score: _____

Fill un the blanks:

1. Most hacksawframes can be adjusted to fit blades of various_____.

2. The cold chisel must be _____ than the metal it is to cut.

3. _____ are made for cutting wrought iron and low carbon steel only.

4. When cutting _____stock, roll the metal and cut about one-third of the way through; then break the metal over the anvil.

5. When removing the nut from a rusty bolt, in most cases it is easier to _____ the nut.

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Topic Test
on
HAND TOOLS-SHAPING STOCK AND FILING

Student: _____ School: _____

Date: _____ Score: _____

Fill in the blanks:

1. Sharp corner bends _____ the metal.

2. Files are made from high-carbon, specially _____ steel.

3. Straight filing generally is used for _____ work and sharpening.

4. When file teeth become clogged with metal chips, filing is _____.

5. The best way to clean a file is to rub the file _____ across the file.

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Topic Test
on
HAND TOOLS-DRILLING

Student: _____ School: _____

Date: _____ Score: _____

Fill in the blanks:

1. The ___ shaped vise is used for holding round stock.

2. Fractional size drills start at _____ of an inch in size.

3. The metal must be clamped tightly to the drill press table so that it will not _____ with the drill.

4. Size of twist drills are designated by numbers, _____, or _____.

5. A high-speed drill will cut _____ metal than a carbon-steel drill will cut.

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Topic Test
on
HAND TOOLS-TAPPING AND THREADING

Student: _____ School: _____

Date: _____ Score: _____

List the following:

1. Two common types of bolt and nut threads:

   a. _____

   b. _____

2. Three types of taps:

   a. _____

   b. _____

   c. _____

3. Three common types of dies:

   a. _____

   b. _____

   c. _____

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Topic Test
on
THE PARTS OF MACHINES

Student: _____ School: _____

Date: _____ Score: _____

Answer the following questions:

1. What is the function of bearings in farm equipment? _____

_____.

2. What factors determine the proper bearing to use?

   a. _____.

   b. _____.

   c. _____.

   d. _____.

3. Explain why proper lubrication is essential. _____

_____.

4. Of what may bushings be made?

   a. _____.

   b. _____.

   c. _____.

   d. _____.

5. Two types of bearing bushings are:

   a. _____.

   b. _____.

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Topic Test
on
FASTENING DEVICES

Student: _____ School: _____

Date: _____ Score: _____

PART I: Place in the blanks in the margin the number of the answer which you think makes a correct statement of the following:

1. ____ The pitch of a screw is (1) the number of threads on the screw; (2) the distance between threads; (3) the angle between thread faces; (4) the diameter of the threads; (5) none of these.

2. ____ Most of the new-type fasteners now on the market came from (1) the aircraft industry; (2) confiscated German patents; (3) the building trades; (4) the shipbuilding industry.

3. ____ To find the length of flat head wood screws, one measures (1) overall length; (2) from bottom of slot to point; (3) the shank; (4) none of these.

4. ____ A flat head cap screw 1/4 inch in diameter and 1 1/2 inches long with coarse series threads will usually be described:

   (1) 1/4" CAP SCREW 1 1/2 - 20NC - FLT. HD.
   (2) 1/4" x 1 1/2" - 20 NC - FLT. HD. CAP SCREW
   (3) 1/4" FLT. HD. CAP SCREW 1 1/2" - 20NC.

UNIT: Introduction
TOPIC: The Parts of Machines
(Topic Test continued)

PART III: Print + for TRUE or 0 for FALSE opposite the following statements:

1. _____ The distance across the flats of a standard bolt head determines its wrench size.

2. _____ Square headed bolts are used extensively in automobiles.

3. _____ All bolts and screws tighten by turning clockwise.

4. _____ The thread standards used in this country also apply to foreigh countries.

5. _____ Machine screws ordinarily have threads the entire length of the shank.

6. _____ Hanger bolts are used to fasten metal to metal.

PART IV: Fill in the blanks with a word or words to make, a true, complete sentence:

1. The new standard system governing the manufacture of fastening devices used in this country is called the _____.

2 The length of bolts is measured from _____ to _____.

3. Thin washers with teeth around the inside or outside edges or both are called, _____.

4. A thin nut which is used with a thicker one to keep it from loosening on the bolt is called _____.

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Topic Test
on
TRANSMISSION OF POWER

Student: _____ School: _____

Date: _____ Score: _____

PART I: Answer the following questions:

1. List the six methods of transmitting power in farm equipment.

2. Explain how to properly fit a V-belt.

3. Determine the length of a V-belt using the following facts:

   Formula: $L = 2C + 1.57(D + d) + \frac{(D - d)^2}{4c}$

   C = 2.4 inches
   D = 8 inches
   d = 4 inches

4. Calculate the diameter of the pulley needed to turn a shaft 1800 Rpm's when the driven is a 6 inch pulley turning 2400 Rpm's.

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Topic Test
on
TRACTOR DESIGN

Student: _____ School: _____

Date: _____ Score: _____

Answer the following questions:

1. What are the major types of tractors?

2. In what other way may tractors be classified?

3. Why is the all-purpose type tractor more widely used?

4. What are the three types of row crop wheel tractors?

5. What are the features of an orchard or grove tractor?

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Topic Test
on
THEORY OF OPERATION

Student: _____ School: _____

Date: _____ Score: _____

1. Explain briefly what happens during each stroke of a four cycle carburetor type engine. _____

_____

_____

_____.

2. Explain briefly what happens during each stroke of a two cycle carburetor type engine. _____

_____

_____

_____.

3. On what kind of machinery is a two cycle carburetor type engine used? _____

_____.

4. How is a two cycle engine lubricated? _____

5. Explain the stroke of an engine. _____

_____.

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Topic Test
on
ENGINE TYPES

Student: _____ School: _____

Date: _____ Score: _____

1. What are the systems of an engine?

   a. _____

   b. _____

   c. _____

   d. _____

2. What are the principal engine parts?

   a. _____ f. _____

   b. _____ g. _____

   c. _____ h. _____

   d. _____ i. _____

   e. _____ j. _____

   k. _____

3. List 5 ways diesel and carburetor type engines differ:

   a. _____

   b. _____

   c. _____

UNIT: Internal Combustion Engines
TOPIC: Engine Types
(Topic Test continued)

d. _____

e. _____

4. Define:

a. Bore - _____.

b. Piston Stroke - _____

_____.

c. Piston displacement - _____

_____.

d. Fuel injection - _____.

e. Crankshaft - _____

_____.

5. What advantage is a sleeve type cylinder ? _____

_____

_____.

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Topic Test
on
POWER MEASUREMENT

Student: _____ School: _____

Date: _____ Score: _____

Answer the following questions:

1. Name three ways that tractor horsepower is measured.
   a. _____

   b. _____

   c. _____

2. Define btu. What is btu used for? _____

   _____.

3. Compare draw-bar horsepower and brake horsepower. _____

   _____.

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Topic Test
on
POWER PLANT CONSTRUCTION AND TERMINOLOGY

Student: _____ School: _____

Date: _____ Score: _____

Gasoline engines are composed of many small parts. These parts are grouped into a number of systems or assemblies. List the seven groups or systems that have been studied and illustrated in this topic:

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

7. _____

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Topic Test
on
POWER PLANT DISASSEMBLE, ASSEMBLE AND REPAIR

Student:_____ School:_____

Date:_____ Score:_____

1. Explain how to check the spark plug firing order. _____

_____

_____

_____

_____

_____

2. Which end of the push rod should be up when it is properly installed? _____.

3. When installing head bolts what important factor should always be remembered? _____.

4. All through the reassembling process there is one thing that should be done. This is to _____ the parts as they are installed.

5. On a diesel tractor what is the proper order of installation? _____

_____

_____

_____

_____

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Topic Test
on
LUBRICANTS (ENGINE OILS AND THEIR FUNCTIONS)

Student:_____ School:_____

Date:_____ Score:_____

PART I: Place a check under T for true or F for false in each of the following statements:

T	F	
____	____	1. Viscosity increases as the oil is heated.
____	____	2. Oxidation results from cold engine operation.
____	____	3. For periods of short operation, light load, rich mixtures or excessive idling; a detergent-dispersant oil should be used.
____	____	4. Oil additives are used up as the engine operates.
____	____	5. Viscosity refers to the thickness of the oil.

PART II: Fill in the blanks:

1. Main bearings, rod bearings, wrist pins and pistons depend almost entirely upon the circulation of oil for _____.

2. _____ is the most important characteristic of an oil if it is to seal properly.

3. Three reasons why it is advisable to change oil regularly are: 1. ___ _____, 2. _____,

   3. _____.

4. In gasoline or diesel engines the thickening effect of oil is not apparent because of the _____ effect of the _____.

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Topic Test
on
LUBRICANTS: CRANKCASE-OIL VISCOSITY (GRADE)AND
CRANKCASE-OIL TYPE (SERVICE CLASSIFICATION

Student: _____ School: _____

Date: _____ Score: _____

PART I: Underline the most appropriate answer:

1. The type of oil not recommended by any farm tractor manufacturer for crankcase oil is (1) MS, (2) DS, (3) ML, (4) MM.

2. The results which may be expected from using a SAE grade that is too heavy is (1) hard cold weather starting, (2) extra power required for oil circulation, (3) poor lubrication of tight fitting bearings, (4) all of these.

3. A substance which prevents deposits of oil contaminants by holding them in suspension is called (1) viscosity, (2) oxidation, (3) dilution, (4) detergent-dispersants.

4. A higher SAE grade number indicates that the oil is (1) more fluid, (2) less fluid, or (3) has no effect as fluid.

5. The only way to be sure that you are using the proper oil in crankcase is to (1) use a multiple grade oil, (2) ask your neighbor what he used, (3) ask your dealer what to use, (4) look it up in the operator's manual.

PART II: Complete the following:

1. The _____ viscosity grade number indicates that the oil is more fluid.

2. What do the following letters mean?
   a. ML
   b. MM
   c. MS
   d. DG
   e. DM
   f. DS

UNIT: Lubricants and Lubricating Systems
TOPIC; Lubricants: Crankcase-Oil Viscosity (Grade) and
Crankcase-Oil Type (Service Classification)
(Topic Test continued)

3. The letters API mean _____ _____ _____.

4. A multiple grade oil may replace _____ grades of single grade oil.

5. What happens to oil viscosity when it is heated?

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Topic Test
on
LUBRICATION: GEAR OILS, HYDRAULIC OILS AND LUBRICATING GREASES

Student: _____ School: _____

Date: _____ Score: _____

PART I: Fill in the blanks:

1. SAE 75, SAE 80, SAE 90, SAE 140, SAE 250 are numbers used for _____.

2. Transmission and differentials may use _____ or _____ _____.

3. Hydraulic oil may be used in a tractor for operating the hydraulic _____ or _____.

4. _____ grease is recommended for jobs which require a lubricating grease.

5. _____ and _____ are two common additives used in lubricating grease.

PART II: True or False:

_____ 1. Crankcase oils are sometimes recommended by manufacturers to be used in hydraulic systems.

_____ 2. Multi-purpose grease is recommended for most jobs which require a lubricating grease.

_____ 3. LPG is a type of crankcase oil which is not recommended for tractors.

_____ 4. Tractor manufacturers sometimes provide a special oil that is different from those available under API Classifications.

_____ 5. There are three kinds of oils that may be used in hydraulic systems

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Topic Test
on
LUBRICATING SYSTEMS

Student: _____ School: _____

Date: _____ Score: _____

PART I: True or False:

_____ 1. All engines have oil filters.

_____ 2. All oil must pass through the filter system.

_____ 3. A breather is not necessary on an enclosed crankcase engine.

_____ 4. There are two general classifications of engine lubricating systems.

_____ 5. A good lubricating system is always complicated.

PART II: Fill in the following blanks:

1. Two types of oil indicators are _____ and _____.

2. The most used type oil pump is the _____ pump.

3. Engine oil systems are classified into three major groups. These are:

   a. _____

   b. _____

   c. _____

4. Oil filters may be filled with _____, _____ or _____.

5. In order to maintain the correct pressureand control the quantity of oil circulated in an engine a _____ is used.

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Topic Test
on
FUELS AND PRINCIPALS OF COMBUSTION

Student: _____ School: _____

Date: _____ Score: _____

Answer the following questions:

1. Name the four common liquid fuels:

   a. _____

   b. _____

   c. _____

   d. _____

2. What are the two chief impurities in gasoline that may cause trouble?

   a. _____

   b. _____

3. What is the range of fuel to air mixtures on which an engine will operate? _____

4. Often times it is necessary to lower the fuel to air ratio to ___ : ___ in order to start the engine in extremely cold weather.

5. What is the ideal ratio of fuel to air for an engine to operate with greatest efficiency and horsepower? __:__.

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Topic Test
on
GASOLINE SYSTEMS

Student: _____ School: _____

Date: _____ Score: _____

Answer the following questions:

1. Explain what is meant by updraft and downdraft systems. _____

_____.

2. What is a venturi? _____.

3. What are the four systems of a carburetor?

a. _____

b. _____

c. _____

d. _____

4. Explain how to properly set the idle valve in a carburetor. _____

_____

_____.

5. What are three reasons for servicing and maintaining the manifold heat control?

a. _____

b. _____

c. _____

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Topic Test
on
L. P. GAS SYSTEM

Student: _____ School: _____

Date: _____ Score: _____

Place a T by the correct statements and F by the false:

_____ 1. In all cases LP gas is cheaper to operate.

_____ 2. Butane will "freeze" before propane.

_____ 3. Gasoline has a higher btu rating than LP gas.

_____ 4. LP gas leaves a carbon build up in engines.

_____ 5. Butane has a greater btu rating per gallon than propane.

_____ 6. LP gas is stored in a gaseous form.

_____ 7. Gasoline and LP carburetors are very similar.

_____ 8. LP gases are heavier than air.

_____ 9. LP gases have a high octane rating.

_____ 10. The boiling point of LP fuels is below the freezing point of water.

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Topic Test
on
GOVERNORS

Student: _____ School: _____

Date: _____ Score: _____

Place a T by the true statement and F by the false statement.

_____ 1. The vane-type governor can be used on tractors.

_____ 2. The fly ball governor depends upon centrifugal force for its operation.

_____ 3. An engine with no speed control mechanism would continue to increase in speed until it would fly apart.

_____ 4. The most common way to control the speed of an engine is to regulate its fuel intake.

_____ 5. LP gas engines require a different type governor than a gasoline engine.

_____ 6. Governors will function only at higher engine speeds.

_____ 7. The fly ball type governor requires special lubrication.

_____ 8. The driver of a vehicle by adjustment of a hand lever may control the governors speed.

_____ 9. The parts of a governor are: a shaft, weights, springs and sliding collar.

_____ 10. The only purpose of a governor is to regulate engine speed to insure constant belt speed.

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Topic Test
on
DIESEL FUEL SYSTEMS-PRINCIPLES OF OPERATION, COMBUSTION CHAMBER, AIR SYSTEMS AND STARTING AIDS

Student: _____ School: _____

Date: _____ Score: _____

Answer the following questions:

1. What is the range of compression ratios of a diesel engine? _____ _____.

2. What is the temperature range of the compressed air in diesel engines? _____.

3. Is it anymore important to keep a diesel fuel system clean than it is to keep a gasoline system clean? _____ Explain. _____ _____ _____.

4. Do all diesel engines require a special forced air system for operation? _____.

5. What do diesel engines depend upon to ignite the fuel? _____ _____.

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Topic Test
on
DIESEL FUEL SYSTEMS, INJECTION PUMP AND FUEL INJECTORS

Place a T by the true statements and an F by the false statements:

____ 1. The injection pump may develop as much as 20,000 psi pressure in diesel fuel system.

____ 2. If two or more filters are used, the second filter will not require attention as often as the first.

____ 3. Some tractors have special gages connected to the fuel line which show when filters need to be changed.

____ 4. If the injection pump consists of both pump and injector nozzle, there is no high pressure line.

____ 5. On engines having no high pressure line each cylinder will have three rocker arms.

____ 6. All diesel engines have a return fuel line for excess fuel to return to the storage tank.

____ 7. The fuel filters are always located on the high pressure line.

____ 8. The injection pump is responsible for timing the fuel injection, acting somewhat like a distributor on a spark-ignited engine.

____ 9. When changing the filter elements, it is not always necessary to turn off the fuel supply.

____ 10. If air enters the fuel system, it will automatically bleed back through the system into the fuel system.

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Topic Test
on
AIR CLEANERS

Student: _____ School: _____

Date: _____ Score: _____

Answer the following questions:

1. Why is it important to use air cleaners on farm engines? _____

_____

_____.

2. Why is gasoline not recommended for cleaning air cleaners? _____

_____.

3. Does the use of a good air cleaner always mean that no dust will enter the engine? _____ Explain. _____

_____

4. How will the use of an air cleaner effect the service life of an engine?

_____.

5. Why is it important to refer to the operator's manual for information on servicing air cleaners? _____

_____.

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Topic Test
on
INTAKE AND EXHAUST MANIFOLDS AND PIPES

Student: _____ School: _____

Date: _____ Score: _____

Answer the following questions:

1. Explain the function of the intake manifold. _____

_____.

2. Define inertia as related to the intake manifold. _____

_____.

3. What effect will back pressure have upon an engine? _____

_____.

4. Explain why gaskets are necessary in the manifold system and what kind is used. _____

_____

_____.

5. What is the relationship of the exhaust manifold to the intake manifold?

_____

_____.

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Topic Test
on
LIQUID AND AIR COOLING SYSTEMS

Student: _____ School: _____

Date: _____ Score: _____

1. What are the two main types of cooling systems? _____
   and _____.

2. What are the two main types of liquid systems? _____

   and _____.

3. When a cooling system is operating in-effectively, what results may a person expect from the engine that is running either too hot or too cold?

   a. _____

   b. _____

   c. _____

   d. _____

   e. _____

4. What are the normal operating temperatures of diesel, gasoline, and tractor fuel engines?
   Diesel _____

   Gasoline _____

   Tractor _____

5. Where should the thermostat be placed in a liquid cooled engine? _____

   _____.

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Topic Test
on
MAGNETO SYSTEMS

Student: _____ School: _____

Date: _____ Score: _____

Place a T by the true statements and an F by the false statements:

____ 1. Magneto systems require little attention.

____ 2. Magneto systems are completely different to the battery system.

____ 3. All tractor magnetos use a novel device to five the armature or rotor a quick flip when cranking.

____ 4. When changing points on a magneto system, the condenser should also be replaced.

____ 5. Magneto points can be filed or honed to recondition them.

____ 6. Keeping the magneto clean and the points properly adjusted are two items essential to proper functioning of this unit.

____ 7. The magneto has some of the most finely finished and closely fitted bearings in the tractor.

____ 8. Points are always in need or repair after 200-300 hours of operation.

____ 9. The impulse coupling will only operate under 300 RPM.

____ 10. A magneto system has a coil, breaker points, condenser, distributor, rotor, wires, and spark plugs.

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Topic Test
on
BATTERY IGNITION SYSTEMS

Student: _____ School: _____

Date: _____ Score: _____

Answer the following questions:

1. What length of time is required for the primary and secondary circuits to function? _____.

2. Name the principal circuits in a battery ignition system?
   a. _____
   b. _____
   c. _____
   d. _____

3. If a four cycle engine turning at 1800 RPM requires 60 sparks per second, calculate the following:
   a. How many sparks are required per minute? _____
   b. How many sparks are required per minute per cylinder? _____
   c. How many aparks would be required for a 6 cylinder engine @ 1800 RPM per minute? _____
   d. How many sparks would be required for 1 hour for a cylinder engine running at 1800 RPM? _____

4. What is the advantage of a 12 volt electrical system? _____.

5. What does the electric ignition system depend upon to do its work? ____ _____.

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Topic Test
on
THE BATTERY

Student: _____ School: _____

Date: _____ Score: _____

Place T by the true statements and F by the false statements:

____ 1. A light grease film will aid in keeping battery terminals free from corrosion.

____ 2. Battery cells are connected in series in order to combine to make up the total voltage of the battery.

____ 3. A battery is so designed that they will operate under rough field conditions with no harm.

____ 4. The best way to be sure that the terminals are on tight is to tap them with a hammer.

____ 5. The hydrometer tells us the voltage of each cell so that we can tell the state of charge of the battery.

____ 6. The electrolyte level should be at least 3/8" above the plates.

____ 7. Poor battery connections will not effect the operation of the vehicle.

____ 8. Plate separators may be made of wood, rubber, or glass fibers.

____ 9. If a battery has a specific gravity reading of 1.130 or below, it is discharged.

____ 10. A battery having a specific gravity reading of 1.280 will withstand greezing weather down to -90° F.

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Topic Test
on
GENERATORS, ALTERNATORS AND ACCESSORIES

Student: _____ School: _____

Date: _____ Score: _____

Answer the following questions and fill in the blanks:

1. To clean the commutator, what one of two items should be used?
_____.

2. When a battery has been replaced, it is necessary to do what to the generator? _____.

3. What are 3 methods used to regulate current flow to the battery?
a. _____

b. _____

c. _____

4. If the strap of a generator has lead deposits on it, what does this indicate? _____.

5. The alternator current must be changed into _____ current before it can be used by the battery. This is done in the alternator by _____.

6. What is the job of the generator? _____
_____.

7. What is a simple test to tell if a generator is burned out? _____
_____.

8. What is the purpose of the brushed in a generator? _____
_____.

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Topic Test
on
STARTERS

Student: _____ School: _____

Date: _____ Score: _____

Complete the following statements:

1. A starting motor draws _____ current.

2. The bendix pinion engages the _____ to start the engine.

3. The starting motor is a small but powerful _____ motor.

4. The bendix pinion disengages when _____.

5. The commutator may be cleaned by _____.

6. The starter is wound with heavy wire so it can withstand the heavy draw of currect without _____.

7. Some starters use an electric _____ to engage the starting gear.

8. It is necessary to keep all wires _____ and _____ to receive best service from your starter.

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Topic Test
on
TIMING THE IGNITION SYSTEM

Student: _____ School: _____

Date: _____ Score: _____

Place a T in front of the true statements and an F in front of the false statements.

_____ 1. The breaker point method of timing is as accurate as timing by a light.

_____ 2. The spark should occur at the time the piston reaches TDC or just slightly before.

_____ 3. Power is lost, engine temperature increases, and efficiency is lowered by incorrect timing.

_____ 4. Installation of new points should not effect the engine timing.

_____ 5. An ignition system will not spark unless the engine is running.

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Topic Test
on
VALVE CLEARANCE ADJUSTMENTS

Student: _____ School: _____

Date: _____ Score: _____

Complete the following statements:

1. Two kinds of valves are _____ and _____.

2. Adjustments are made between the _____ and _____.

3. Valve condition and operation are most important to engine _____.

4. Two other names under which valve clearance adjustments may be known are _____ and _____.

5. Always check the _____ for proper valve adjustment information.

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Topic Test
on
INTRODUCTION

Student: _____ School: _____

Date: _____ Score: _____

Answer the following questions:

1. What are the basic parts of a hydraulic system?

2. Hydraulic theory is based on Pascal's law. What is the law?

3. Give a simple definition of hydraulics.

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Topic Test
on
RESERVOIRS

Student: _____ School: _____

Date: _____ Score: _____

Place a T in front of the true statements and F in front of the false statements.

_____ 1. On most farm and industrial equipment applications, the reservoir is a built-in-unit.

_____ 2. The size of the reservoir depends on the locality, and where the system is to be used.

_____ 3. An ideal size is the capacity per minute of the pump.

_____ 4. The dipstick shows the proper level of fluid.

_____ 5. The reservoir should be free of dirt, moisture, and other contaiminating materials at all times.

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Topic Test
on
HYDRAULIC PUMPS

Student: _____ School: _____

Date: _____ Score: _____

Place a T in front of the true statements and F in front of the false statements.

_____ 1. The pump is the power supply of the hydraulic system.

_____ 2. External gear pumps are of the constant delivery type.

_____ 3. External gear pumps are used principally where relatively low pressures, volumes, economy of cost, and restricted space are factors.

_____ 4. Vane pumps cannot handle a large volume of fluid at high pressure.

_____ 5. Radial pumps are compact and rugged.

_____ 6. Centrifugal pumps deliver a pulsating flow of fluid.

_____ 7. Multi-stage pumps are used to provide fluid at more than one pressure.

_____ 8. Clearances are extremely critical in hydraulic pumps.

_____ 9. Hydraulic pumps can be thought of as compressors.

_____ 10. Pumps with reciprocating piston are useful in extremely high pressure application.

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Topic Test
on
HYDRAULIC VALVES

Student: _____ School: _____

Date: _____ Score: _____

Place a T in front of the true statements and F in front of the false statements.

_____ 1. Nearly all the valves used in hydraulic systems may be classified in three categories: Directional, Volumes, or Pressure.

_____ 2. Until "variable delivery" pumps were put on the market, valves were the only means of controlling fluids in a hydraulic system.

_____ 3. Control of valves is either manual or electrical.

_____ 4. Globe valves offer some restriction to flow, and may cause turbulence in the fluid.

_____ 5. Gate valves offer no resistance to flow.

_____ 6. Flapper valves are essentially check valves in that they permit flow in only one direction.

_____ 7. Ball valves permit flow in either direction.

_____ 8. Needle valves are usually manually operated.

_____ 9. Spool valves are very popular in hydraulic equipment because of quick, positive action.

_____ 10. There are two basic types of spool valves; the open center and the closed center.

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Topic Test
on
HYDRAULIC CYLINDERS

Student: _____ School: _____

Date: _____ Score: _____

Place a T in fron of the true statements and F in front of the false statements.

_____ 1. The double acting cylinder is called a differential type cylinder.

_____ 2. The "stepped piston" provides a means for a rapid approach stroke at low pressure and a slower, more powerful work stroke.

_____ 3. An important refinement of the hydraulic cylinder provides a "cushion" for the end of the stroke of the piston.

_____ 4. Cylinders may be classified into two general categories; single action and double action.

_____ 5. The hydraulic cylinder is by far the most popular method of turning fluid under pressure into a work force.

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Topic Test
on
HYDRAULIC SEALS AND PACKINGS

Student: _____ School: _____

Date: _____ Score: _____

1. Identify the different types of seals and packings in the illustration that follows: Write the names in the blanks that correspond to the letters below:

a. _____ f. _____

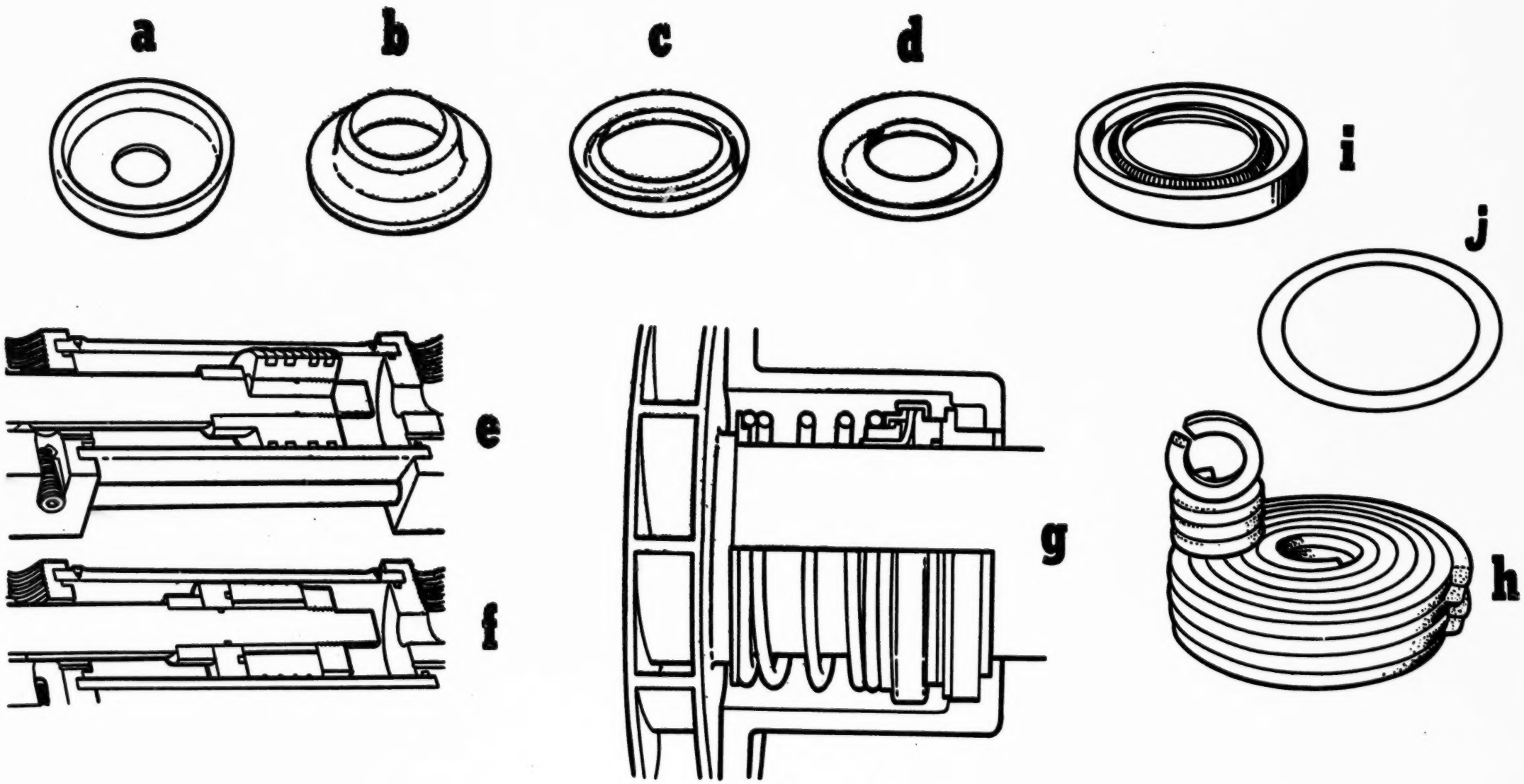
b. _____ g. _____

c. _____ h. _____

d. _____ i. _____

e. _____ j. _____

SEALS AND PACKING



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Topic Test
on
HYDRAULIC LINES AND FITTINGS

Student: _____ School: _____

Date: _____ Score: _____

Place a T in front of the true statements and an F in front of the false statements:

____ 1. In a hydraulic system piping is usually measured according to its inside diameter.

____ 2. Galvanized pipe is highly recommended for use in hydraulic systems.

____ 3. In piping and tubing the bending radius is ideally not less than three times the I. D. of the tube.

____ 4. Due to the possibility of leakage, threaded connections are avoided as much as possible.

____ 5. Flange fittings cannot be welded to the pipe ends.

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Topic Test
on
HYDRAULIC SYSTEMS

Student: _____ School: _____

Date: _____ Score: _____

OPEN BOOK TEST

Place a T in front of the true statements and an F in front of the false statements:

____ 1. The blocked return line system uses a lever operated check valve, and will operate a single acting cylinder only.

____ 2. The tandem open center system uses a center spool type valve.

____ 3. Three components are necessary to have a workable hydraulic system--a reservoir, a valve, and a cylinder.

____ 4. A ball valve is used in the block return line system.

____ 5. The basic open center system has a double action cylinder.

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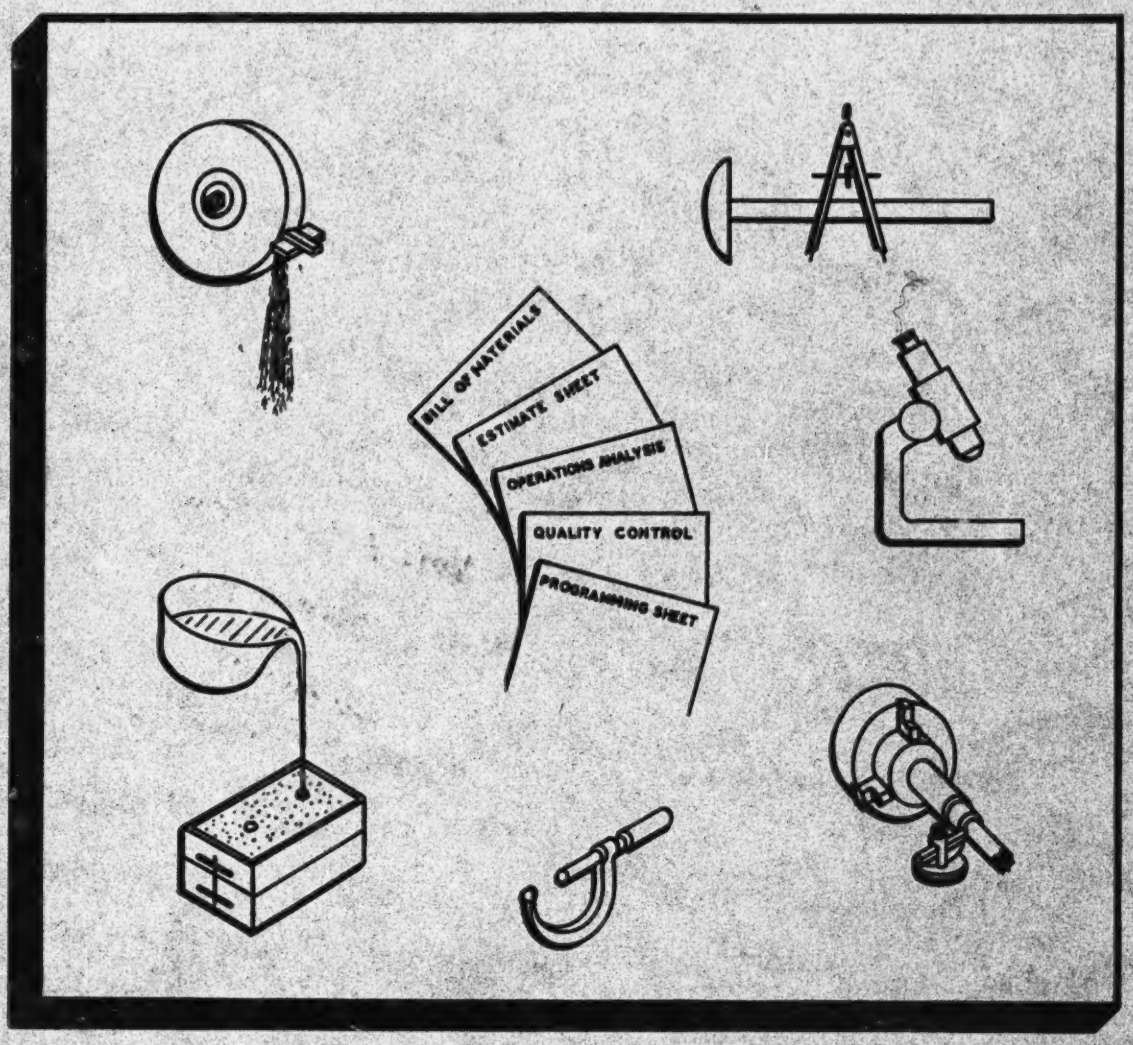
For Use in Developing Training Programs

in

MECHANICAL TECHNOLOGY



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A GUIDE

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in

MECHANICAL TECHNOLOGY

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(Address) P. O. Drawer NU, State College, Mississippi 39762

DATE: August 1, 1967

RE: (Author, Title, Publisher, Date) Mississippi Curriculum Laboratory. A Guide for Use in Developing Training Programs in Mechanical Technology. State College, Mississippi: Curriculum Laboratory of the State Department of Vocational and Technical Education, Mississippi State University, 1966.

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FOREWORD

The Curriculum Materials Laboratory is an instrument of the State Department of Vocational Education, Trade and Technical Section. Located in the Department of Industrial Education on the campus of Mississippi State University, the Laboratory maintains a working liaison with Mississippi industry and education. Activities of the Laboratory are focused on the development of curriculum materials with the purpose of encouraging statewide unity in the quality and scope of instruction in trade and technical education.

A workshop, sponsored by the Laboratory, was held on the campus of Mississippi State University on March 3, 4, and 5, 1965, to initiate development of curriculum materials in mechanical technology. Those participating in the workshop included instructors and directors of presently operating programs in mechanical technology. These men, who comprise the Curriculum Committee, and the institutions they represent are as follows:

Mr. Charles Ainsworth . . . . . Northwest Mississippi Junior College
Mr. Albert Campbell . . . . . Jones County Junior College
Mr. Luther Garrett. . . . . Copiah-Lincoln Junior College
Mr. Bob Laster. . . . . Hinds Junior College
Mr. Larry Otis. . . . . Itawamba Junior College
Mr. Hugh Statham. . . . . Copiah-Lincoln Junior College

During the workshop, major technical areas were identified, and courses indicated for training in these areas were planned. The curriculum that developed included courses in technology, courses in general education, and other courses necessary to support the technical program. The curriculum, as proposed, was approved by the group. A careful balance of semester hours for each of these areas was effected in accordance with recommendations of the engineering societies. Initial detailing of a topical outline of instruction for the technical and the supporting courses was begun.

After returning to their institutions, these instructors and directors continued to collaborate in the strengthening of course content and the development of laboratory activities. The Laboratory assembled, compiled, and edited these materials. Several of the men were called in for further conference; others were visited by a Laboratory staff member. All of the men and the institutions they represent are commended for their cooperation and their worthy contribution to the development of this curriculum.

On September 22 and 23, 1965, an Industrial Evaluation Committee convened on the campus of Mississippi State University. The content of each of the courses included in the curriculum was examined in detail, and the appropriateness of each course as it relates to the curriculum as a whole was determined. In the final editing, the recommendations of the Committee were weighed carefully and followed at every opportunity. A statement of authentication by the Committee and the membership are found on the second page following.

The Curriculum Materials Laboratory is indebted to Mr. E. P. Sylvester, Vocational-Technical Education, Junior Colleges, State Department of Education, for participating in the Industrial Evaluation Conference; to the State Department of Vocational Education, Trade and Technical Section, for its continuing support, which has been invaluable; to Mr. Ralph Caldwell, Assistant State Supervisor, for his contributions to the Curriculum Conference and to the Industrial Evaluation Conference; to Mr. Meade Eastland, Professor of Mechanical Engineering, Mississippi State University, for his assistance in reading the evaluation draft of this publication, and for his valuable comments while participating in the Industrial Evaluation Conference; to Mr. Eugene Earp, Mr. Art Wiselogel, and the members of the Mississippi Chapter, American Society of Safety Engineers, for their contribution in developing safety references for inclusion in this publication; and to Mr. Rex Deghuee, Product

Engineer, Rockwell Manufacturing Company, for construction of the sample problem in the appendix.

This publication incorporates the thinking and the contributions of all of the men listed above. It should be examined in light of this fact and should be used as a guide in the manner prescribed in the introductory chapter. It should not be inferred that this publication is a reflection of the practice of any given institution or that it is completely endorsed by any one institution, agency, or person.

AUTHENTICATION COMMITTEE

The material in this publication was reviewed and endorsed as being appropriate and adequate for the training of Mechanical Technicians by the following Industrial Committee:

Mr. Rex Deghuee, Product Engineer, Rockwell Manufacturing Company, Tupelo, Mississippi.

Mr. Robert V. Delcuze, Mechanical Engineer, General Electric Co., Mississippi Test Facility, Bay St. Louis, Mississippi.

Mr. James A. Hutchison, Project Engineer, Tyrone Hydraulics, Corinth, Mississippi.

Mr. Robert B. Jewell, General Machinery Coordinator, Ingalls Shipbuilding Corporation, Pascagoula, Mississippi.

Mr. Stuart L. Jones, Supervisor, North American Aviation, Inc., Mississippi Test Facility, Bay St. Louis, Mississippi.

Mr. Sam Manos, Works Inspector, Babcock & Wilcox Company, West Point, Mississippi.

Mr. Roy R. Ross, Technical Supervisor, Olin Mathieson Corporation, Gulfport, Mississippi.

Mr. John R. Ware, Education and Training Director, Taylor Machine Works, Louisville, Mississippi.

Endorsement by this committee in no way obligates the individual organizations that are represented by the committee membership.

The Curriculum Materials Laboratory wishes to commend these men for their efforts in the review of this publication and the constructive manner in which suggested changes were offered. We are further indebted to the companies represented for their interest in Mississippi education as evidenced by their cooperation and participation.

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INTRODUCTION TO TECHNOLOGY

The growth of our nation in size and complexity has caused the creation of new concepts, products, and opportunities. A case in point is the growth of industry. As the research of the scientist and of the engineer has separated them even more from the craftsman with his high degree of manipulative skills, the broadened middle ground has created the technician. As he has evolved, the technician has accepted the responsibility for interpretation and application of design, for installation and maintenance of complex equipment, and for supervisory activities.

Educators have recognized their responsibility in this area and have developed technical curricula to meet the new needs. These curricula provide certain basic education for a wide variety of entry jobs in support of engineering and scientific personnel. These supporting technicians require an understanding of engineering principles basic to the field of technology. Graduates entering the field will become responsible members of a team--the scientist who is engaged in research at the fringe between theory and knowledge, the engineer who develops and designs practical applications of theory and knowledge, and the technician who may be involved in one or more activities, such as converting the design into a working model or testing and evaluating its effectiveness. With this done, the skilled craftsman converts raw materials into finished products. The technician re-enters the picture as he supervises production or directs installation and maintenance.

No description of the place of the technician would be complete without outlining his responsibilities in the area of safety. This responsibility may lie in his incorporating safety features as he develops the first working models.

In testing such models, he employs safe practices and studies operations for inherent features requiring special procedures, guarding, or protective clothing. Perhaps the most significant contribution to industrial safety comes as the technician supervises production. It is here that a working knowledge of safe practices assists him in analyzing habits of those under his direction and in promoting those practices designed to minimize job hazards.

It is obvious, then, that the training of the technician is not of a limited-or single-skill type. Rather, his training should equip him with basic qualifications and the ability to accept broad responsibilities that will prepare him for entry into multiple employment areas within a field.

Having accepted this training responsibility and having identified objectives, educators have established the technical program. Examination of successful programs reveals certain definite characteristics.

The caliber of the technical instructor is of major importance. While there is no guaranteed method of selection, there is general agreement that the level of formal training should be no less than that of a technical-school graduate. Broad job experience for all teachers has long been a basic requirement in occupational training. It is valid here. Therefore, a teacher must have sufficient industrial experience to be familiar with applications and processes. Additional study would include philosophy, methods, and procedures of technical teaching. In given instances, it has been found advantageous to use engineers as teachers in technical programs.

A second characteristic of the program involves physical facilities, equipment, and supplies. These items must simulate up-to-date industrial conditions. The emphasis here is on quality and variety rather than quantity.

Student admission policy and program flexibility, the third and fourth characteristics, must be considered together. Modern educational practice dictates a comprehensive guidance and testing program for the selection and/or admission of students. These potential technicians should be secondary-school graduates from the upper one third of the class or the equivalent, have an interest in technical work, and possess the necessary aptitudes for achievement in the program. For a variety of reasons, they may be unable to become involved in a longer, more expensive course of study. Ideally, the beginning technical student should have had two years of algebra, a year of geometry, a half year of trigonometry, and three years of science, preferably biology, chemistry, and physics. At this point, flexibility becomes important. Schools involved in technical training have found it necessary to make adjustments in their curriculum to take into account the deficiencies of those desiring such training. In some cases, it may be necessary to require students to take remedial or preparatory courses before entering the technical curriculum. Or the level of subject matter in beginning courses must be keyed to the mathematics-science background and the readiness of the students. Perhaps other ways can be found to prevent the closing of doors to likely prospects. The important consideration is the establishment of enrollment requirements which are high, yet realistic in their application. Realistic adjustment to local physical facilities, industrial requirements, staff competencies, and student capabilities should be considered carefully. Indiscriminate or seemingly endless compromise results in a collapse of standards. Such adjustments are best left to the judgment of state and local officials.

The content, variety, and timing of courses in the curriculum are essential. A strong technical program has breadth and depth in fundamentals, which will allow the graduate technician to qualify for and choose from multiple employment

alternatives, to advance professionally with occupational experience, and to keep abreast of new developments throughout his career. The acquisition of these fundamentals will require two years brimming with activities. Specialization in a given area can be gained only by relegating fundamentals in other areas to rapid, superficial treatment. For the graduate technician, therefore, specialization and specific job information come through experience, a company-training program, or the pursuit of higher education.

The most knowledgeable technicians are those involved in mathematical analysis, construction of design apparatus, and experimental testing and verification. The requirement here is a knowledge of the application of physical science principles and of mathematical formulas. These abilities are the distinguishing characteristics of the technician. In addition to strong general courses in physical sciences, the training of the technician goes into even greater depth in the given area of his specialty; for example, electricity and electronics for the electronics technician, properties of materials, heat, and mechanics for the mechanical technician, chemistry for the chemical technician, etc. Experience has shown that technical and supporting courses must be initiated immediately to successfully complete training in the allotted time. Inasmuch as technical and supporting courses comprise approximately two thirds of the total semester hours, they cannot be postponed until the second year or even the second semester.

Facility in the use of algebra and trigonometry is mandatory, and in no instance should the training of the technician require less than mastery in their use. An understanding of applicable sections of analytical geometry and calculus peculiar to the given technology will serve to enrich the student's background. Therefore, a minimum of six to nine semester hours of mathematics, which may be expanded to twelve semester hours in stronger programs, is recommended.

The technician must command a degree of manipulative skill. This degree is not nearly so high as that of the craftsman; and while it varies among technologies, in most instances it must be of sufficient height to assist him in the fabrication of design models. A comparison of training hours devoted to skill development in the curriculum verifies this assumption.

Sufficient general education must be included to assist in the development of a good citizen. The curriculum assumes an effective secondary-school program of general education. Building on this foundation, 17 to 22 additional semester hours in general education are scheduled.

Effective instruction is another essential in a technical program. Routine textbook teaching is entirely inadequate. The work of the technician, characterized earlier, is of a practical and applied nature. It follows that his training should be of this nature. The key words here are "practical" and "application", and the inference is that extensive periods of time would be spent in realistic experimentation in up-to-date, well-equipped laboratories. Careful coordination between lecture topics and laboratory experiments makes best use of both periods and promotes high-level learning. The most desirable situation is one in which the same instructor teaches principles in the lecture period, then supervises application in the laboratory. Experience has shown that this practice yields maximum motivation and learning. Failure to proceed in accordance with this practice means sacrificing time or retention in an already busy, demanding curriculum.

Studies of industrial procedures and effective technical training reveal many instances of report preparation. Information is gathered and organized, implications are drawn, and a report is submitted by the technician as the last step in his undertaking.

The selection of a text is of paramount importance to most instructors.

Realistically speaking, the content and presentation of many courses are influenced to a lesser or greater degree by the texts available. Rarely does a single volume contain all the essential technical information in a given area. For these reasons most instructors find it necessary to review available materials in their field and related fields and to select additional volumes as reference. In many technical programs, separate library facilities are developed apart from the main library. Here materials are gathered, catalogued, and placed in class or laboratory so as to be readily accessible to instructors and students. This approach is recommended by accrediting agencies.

The preceding statements briefly describe the most widely accepted characteristics of technical education namely, faculty background; student enrollment; the overall curriculum including a balance between technical and non-technical courses; plants and equipment; and library facilities. The institutions of which these technical programs are a part may look forward to the time when they will submit their programs for accreditation. If this is to be the case, careful consideration should be given, in the beginning, to the above criteria, which have been developed by the engineering societies.

The format of this publication is designed to lend itself to use in occupational training and in teaching by the "tell-show-do-check" method, a technique long used to good advantage. Briefly, this method requires that the instructor should present or explain the principle, show how it operates or applies, have the student put his learning to practical use, and check his newly acquired knowledge or skill. In support of this technique, two parallel columns have been developed. On the left will be an OUTLINE OF INSTRUCTION. This is the "tell" and "show" column. In it will be the theories and principles of the subject field. Some effort has been made to clearly identify the

mathematics and science involved in each unit. Conventional methods, such as question-answer periods, discussion, demonstrations, and audio-visual aids, are to be used. In the "do" column entitled LABORATORY ACTIVITIES, the spotlight is on student activities. Experiments are designed to involve the student in the practical application of principles set forth in the classroom. In most exercises, the student will set up the equipment, go through outlined procedure while taking measurements and making cogent observations, and record findings. In attempting to simulate industrial conditions, the technical program requires that data be obtained during laboratory activities. Outside the laboratory, data are organized, implications are drawn, and a report is submitted at some assigned date. No laboratory experiment is complete until a report is written and submitted. In many cases, a mathematical analysis and design will precede the experimental verification, and this practice is indicated by many references such as "mathematically compute...experimentally verify...and graphically represent...." This is the technical approach of the design technician and is one example of the scientific method employed by all.

The RECOMMENDED TEXT or texts listed, following each course, have been selected by the curriculum committee, partly on the basis of their experience, partly from additional volumes secured by the Curriculum Materials Laboratory. Although some of these books may be inadequate; they are--in the opinion of the committee and within the confines of their experience--the best available. Also listed are SUGGESTED REFERENCES which strengthen and broaden the instructional base. Many of these were strongly recommended by the industrial committee. Those desiring to build a library will find these books worthy of examination. It may be that one of these would serve as a text.

Formal education justifies its existence with the supposition that information imparted to students will increase their knowledge and skill and enable

them to make headway in new areas, either in the pursuit of a livelihood or in advanced study. It follows that future progress is dependent to some degree on the grasp of earlier courses. With this contingent in mind, each of the courses has a REVIEW scheduled as its last major division. At this time the instructor will review the key points and determine student command of the important knowledges and skills. Deficiencies in basics must be retaught until such time as the student, in the judgment of the instructor, has demonstrated a mastery of these essentials.

The Curriculum Materials Laboratory at Mississippi State University has been designed to serve as a means of promoting and assisting in the development and sharing of ideas and techniques in Mississippi junior colleges and secondary schools. Preparation of this publication is the first step. It is not an attempt at a "breakthrough" or "rediscovery" or "pioneering". Rather, major areas of the technology have been identified and subdivided into logical, teachable units. Suitable texts and references have been listed. The content has been agreed upon by Mississippi junior college technical instructors and a representative industrial committee as being those minimums deemed basic and essential to a technical program.

A second step must be taken by the technical instructor. He should give this publication his best efforts after carefully studying the ideas set forth in the first part of this chapter. Examination, evaluation, and recommendation during preparation of instructional materials and while teaching from them will assist in continued program development. Using this publication as a guide, the instructor should make lesson plans for lectures and demonstrations and should prepare laboratory experiments. In some instances, the instructor will likely find more information and greater detail than he is presently using.

There may be more than one laboratory experiment in the application of a principle. In other instances, the development of an idea may appear too shallow or laboratory application may be absent. It is at this time that the instructor can be most helpful in the following ways: (1) by suggesting which areas can be effectively covered in a shorter time, (2) by identifying areas requiring greater emphasis, which would involve additional detail and an extended-time allocation, (3) by extending the instructional content to reinforce or clarify ideas, (4) by preparing additional or alternate experiments in applying principles, (5) by listing references, texts, and instructional aids at appropriate places, and (6) by suggesting additions and deletions. Some of the suggestions listed above may require only marginal notes; others may call for development of completely new and more comprehensive materials. The result will be realistic evaluation of content, organization, and time allotment for each unit.

This initial effort on the part of the Curriculum Materials Laboratory is meant to encourage greater unity of offerings among the various programs. Two factors will dictate the revision of this publication--the dynamic state of industry and the development of improved teaching methods by technical instructors. The use and evaluation of this publication by people in the field will lay the necessary ground work for future editions.

In addition, recent vocational-technical legislation contains provision for follow-up and program evaluation. The day is coming when vocational-technical education will be held accountable for its actions in training youth and adults and for the millions of dollars it has spent. The Curriculum Materials Laboratory will, no doubt, be involved in developing suitable instruments and evaluative criteria at that time. This publication, representing the combined efforts of Mississippi education and industry and containing the material these groups feel is appropriate, may well serve as one basis for making such a study.

MECHANICAL TECHNOLOGY CURRICULUM

COURSE IDENTIFICATION

The coded symbols listed below are suggested as being applicable to all technical, supporting, and general education courses. Should the institutions involved adopt some mutually acceptable system, it would greatly aid in interpretation of course offerings, transcripts, and catalogs.

T - Technical Courses

- Au - Automotive
- Bc - Building and Construction
- Ch - Chemical
- Ci - Civil
- Dd - Drafting and Design
- El - Electricity
- Er - Electronics
- Me - Mechanical

S - Supporting Technical Courses

- Gr - Graphics (Art, Freehand and Mechanical Drawing, Blueprint Reading)
- Ma - Mathematics (Algebra, Trigonometry, Calculus, Analytical Geometry, Slide Rule)
- Pr - Shop Processes (Metal Processing, Materials and Methods)
- Sc - Science (Physics, Chemistry)

G - General Education Courses

- Bu - Business (Business Principles, Accounting, Bookkeeping)
- En - English (Composition, Technical Writing, Business Correspondence)

Mg - Management (Industrial Relations, Plant Layout and Materials Handling, Time and Motion Study)

Or - Orientation

Ps - Psychology (General, Industrial, Social)

Pe - Physical Education (Health, Hygiene)

Ss - Social Studies (History, Sociology, Government)

The preceding letter coding of courses is further developed here by the addition of three-place numbering. The first-place number designates the semester in which the given course is normally offered. The second-place number designates the position of the course in sequence. The third-place number designates the semester hour(s) credit that the given course carries.

The following is a suggested curriculum with courses identified by letter and number and with a balance of courses in technical subjects, in related or supporting subjects, and in general education subjects.

PROPOSED
MECHANICAL TECHNOLOGY CURRICULUM

		Semester Hours
First Semester		
TMe 114	Manufacturing Processes I	4
TMe 123	Materials of Industry	3
SGr 113	Mechanical Drafting I	3
GSs 413	Social Science (Economics)	3
SMa 113	Technical Math I (Algebra)	3
GEn 113	English (Composition)	3
		19
Second Semester		
TMe 234	Manufacturing Processes II	4
SGr 223	Mechanical Drafting II and Tool Design	3
SSc 213	Physics I (Properties of Matter & Mechanics)	3
SMa 223	Technical Math II (Trigonometry)	3
GEn 222	English (Technical Writing)	2
GSs 213	Social Science (History)	3
		18
Third Semester		
TMe 343	Hydraulics & Pneumatics	3
TMe 353	Metallurgy	3
TMe 362	Inspection Techniques	2
SSc 323	Physics II (Heat, Light, & Sound)	3
SMa 333	Technical Math III (An. Geometry & Calculus)	3
GMg 313	Industrial Organizations & Institutions	3
		17
Fourth Semester		
TMe 473	Strength of Materials	3
TMe 483	Motion & Time Study	3
TMe 494	Production Planning and Problems	4
SSc 433	Physics III (Electricity & Magnetism)	3
GEn 432	English (Speech)	2
GPs 413	Industrial Psychology	3
		18

TMe 114

MANUFACTURING PROCESSES I

4 Semester Hours

INTRODUCTION

Manufacturing Processes I and II have as their objective the survey of modern methods of industrial materials formation and fabrication. Regardless of the teaching technique employed, instruction is designed to develop familiarity in setup and operation; tools and equipment; nomenclature; handbooks, charts, and tables; safety procedures and guarding methods; and calculations necessary to determine machine or process capabilities in production.

TMe 114. Manufacturing Processes I. Two lectures. Four hours laboratory. (4 semester hours credit). Survey of modern industrial practices and procedures in the forming and fabricating of metals and non-metals.

MAJOR DIVISIONS

		Class Hours	Laboratory Hours
I.	Introduction to Production Processes	2	2
II.	Metals and Non-Metals	2	2
III.	Simple Measuring Tools	1	2
IV.	Metal and Plastic Forming	3	5
V.	Foundry Practices	1	2
VI.	Foundry Equipment	1	2
VII.	Patterns	1	2
VIII.	Sands	1	2
IX.	Molds	1	3
X.	Cores	1	3
XI.	Post-Casting Processes	2	4
XII.	Welding Processes	4	2
XIII.	Welded Joint	2	4
XIV.	Arc Welding Machines and Accessories	1	4
XV.	Procedures in Arc Welding	2	12
XVI.	Oxy-acetylene Welding Equipment and Accessories	1	4
XVII.	Procedures in Oxy-acetylene Welding	2	6
XVIII.	Oxy-acetylene Cutting	2	3
XIX.	Submerged Melt and Inert Gas Shielded	2	4
XX.	Methods of Inspection	2	4
XXI.	Welding Economy	2	0
XXII.	Review	—	—
		Total Class Hours 36	Total Laboratory Hours 72

Total Suggested Clock Hours 108

I. INTRODUCTION TO PRODUCTION PROCESSES

A. OUTLINE OF INSTRUCTION
Class Hours 2

1. Course objectives

2. General class procedure

3. Course requirements

B. LABORATORY ACTIVITIES
Laboratory Hours 2

Laboratory orientation. Tour of facilities.

II. METALS AND NON-METALS

A. OUTLINE OF INSTRUCTION
Class Hours 2

1. Ferrous metals

   a. Iron
   b. Steel
   c. Others

2. Non-ferrous metals

   a. Aluminum
   b. Copper
   c. Alloys
   d. Others
   e. Fire and health hazards of non-ferrous metals[1]

3. Plastics

   a. Thermosetting
   b. Thermoplastic

B. LABORATORY ACTIVITIES
Laboratory Hours 2

Make laboratory inspections of samples of ferrous and non-ferrous metals and plastics. Note distinguishing characteristics of weight, color, hardness, etc. Use standard handbooks to examine different forming, fabricating, and machining rates.

III. SIMPLE MEASURING TOOLS

A. OUTLINE OF INSTRUCTION
Class Hours 1

1. Types of instruments

   a. Steel rule
   b. Vernier

B. LABORATORY ACTIVITIES
Laboratory Hours 2

Make basic measurements with tools indicated. The following should be involved:
reading of steel rule to 1/64";

[1] Industrial Hygiene (Chicago: Kemper Insurance, n.d.), Bulletins 91 and 210. Accident Prevention Manual for Industrial Operations (Chicago: National Safety Council, 1964), Chapter 27, page 25; Chapter 40, page 39; Chapter 40, page 56; Chapter 40, page 59; Chapter 41, page 59.

c. Micrometer
d. Dial indicator
e. Calipers--inside and outside
f. Others

2. Care and calibration of instruments

outside micrometer to 1/1000"; inside and outside calipers to transfer measurements to micrometer; direct inside and outside measurements with vernier caliper; other measuring-tool practice aimed at practice in skill development in this area.

IV. METAL AND PLASTIC FORMING

A. OUTLINE OF INSTRUCTION
Class Hours 3

1. Processes

a. Hot
b. Cold

2. Operations

a. Stamping
b. Upsetting
c. Forging
d. Bending
e. Drawing
f. Rolling
g. Spinning
h. Extruding

(1) Hot
(2) Impact

i. Explosive forming

3. Equipment

a. Types

(1) Press
(2) Rolling mills
(3) Brakes
(4) Drawing dies
(5) Hotspin

b. Safety practices[2]

B. LABORATORY ACTIVITIES
Laboratory Hours 5

NOTE: The nature of the following forming processes does not lend itself to student laboratory activities. It is recommended that extensive use be made of demonstrations, movie films, and field trips.

[2] Engineering Consultation Service (Chicago: Kemper Insurance, n.d.), Bulletins 400, 424, 802, 344, 534.
Accident Prevention Manual for Industrial Operations (Chicago: National Safety Council, 1964), Chapter 22, page 25 through Chapter 23, pages 36-44.

V. FOUNDRY PRACTICES

A. OUTLINE OF INSTRUCTION
Class Hours 1

1. Melting methods

   a. Historical

      (1) Blast furnace
      (2) Others

   b. Modern

      (1) Open hearth
      (2) Bessemer
      (3) Electric
      (4) Induction
      (5) Others

2. Casting methods

   a. Sand
   b. Investment
   c. Sandless or permanent mold
   d. Continuous
   e. Die casting
   f. Centrifugal
   g. Injection
   h. Precision

3. Basic foundry process

   a. Prepare pattern
   b. Prepare mold
   c. Prepare metal
   d. Pour
   e. Remove pattern
   f. Clean casting

4. Health hazards[3]

B. LABORATORY ACTIVITIES
Laboratory Hours 2

NOTE: Make a field trip to an operating foundry in relation to all work included in the foundry sections.

SAFETY INSTRUCTION
While statistics indicate that the foundry accident rate is lower than other divisions, the nature and severity of occurring accidents dictate special attention. The conscientious instructor will explain, employ, and encourage these procedures at the appropriate times.

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[3] Industrial Hygiene (Chicago: Kemper Insurance, n.d.), Bulletins 45, 129, 130, 131, 103.

Engineering Consultation Service (Chicago: Kemper Insurance, n.d.), Bulletins 509 and 711.

Accident Prevention Manual for Industrial Operations (Chicago: National Safety Council, 1964), Chapter 27, page 1 through Chapter 27, page 25, Chapter 28.

VI. FOUNDRY EQUIPMENT

A. OUTLINE OF INSTRUCTION
Class Hours 1

1. Melting equipment

2. Molding equipment

   a. Riddle
   b. Rammer
   c. Bellows
   d. Trowel
   e. Slick

3. Sand preparation equipment

   a. Sand mixer
   b. Shake out
   c. Mullers
   d. Conveyors
   e. Storage hoppers
   f. Testers

4. Casting equipment

5. Foundry accessories

6. Protective clothing[4]

B. LABORATORY ACTIVITIES
Laboratory Hours 2

VII. PATTERNS

A. OUTLINE OF INSTRUCTION
Class Hours 1

1. Introduction

2. Types with regular parting lines

B. LABORATORY ACTIVITIES
Laboratory Hours 2

Make a laboratory examination of the most common types of patterns. Examine characteristics common to all and distinguishing characteristics of each including parting lines, draft, fillets, rounds, and colors. Practice measurements with various scales on shrinkage rule.

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[4] Engineering Consultation Service (Chicago: Kemper Insurance, n.d.), Bulletins 637, 629, 709.

3. Types with irregular parting lines

Prepare the mold and metal for a casting with an irregular parting line. Note characteristics which distinguish this technique from regular processes such as the need for and nature of mold repairs.

4. Core, core prints, core boxes

5. Draft and shrinkage

6. Fillets and rounds

7. Identifying colors

VIII. SANDS

A. OUTLINE OF INSTRUCTION
Class Hours 1

1. Types and characteristics

   a. Light
   b. Medium
   c. Heavy
   d. Core

2. Health hazards[5]

B. LABORATORY ACTIVITIES
Laboratory Hours 2

Prepare several samples, using available sands, emphasizing distinguishing features such as weight, grain size, color, and molding characteristics. Add bonding compounds and cure to usable state.

IX. MOLDS

A. OUTLINE OF INSTRUCTION
Class Hours 1

1. Types

   a. Bench
   b. Floor
   c. Pit
   d. Machine
   e. Green sand
   f. Skin dried
   g. Dry sand
   h. Loam
   i. Shell

B. LABORATORY ACTIVITIES
Laboratory Hours 3

Using regular mold sand, prepare a small bench-type or floor-type mold, following all described procedures.

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[5] Industrial Hygiene (Chicago: Kemper Insurance, n.d.), Bulletin 103. Accident Prevention Manual for Industrial Operations (Chicago: National Safety Council, 1964), Chapter 39, pages 6-8.

2. Permanent molds

3. Applications

X. CORES

A. OUTLINE OF INSTRUCTION
Class Hours 1

1. Types

a. Green sand
b. Dry sand
c. Drop
d. Vertical
e. Balanced
f. Hanging

2. Mixtures and binders

3. Core finishing

B. LABORATORY ACTIVITIES
Laboratory Hours 3

Prepare proper sand mixture using core box, then submit to baking heat to dry as determined by technical material. Make a simple casting of a pipe using a core and mold. Wear protective clothing, such as goggles or face shield, gloves, apron, safety shoes, etc.[6]

XI. POST-CASTING PROCESSES

A. OUTLINE OF INSTRUCTION
Class Hours 2

1. Cleaning

2. Seasoning

3. Annealing

4. Normalizing

5. Case hardening

6. Homogenizing

B. LABORATORY ACTIVITIES
Laboratory Hours 4

Make comparative hardness tests of casting before and after artificial aging (seasoning) by holding at elevated temperature, but below critical temperature, for given periods. Wear protective clothing during quenching process.

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[6] Engineering Consultation Service (Chicago: Kemper Insurance, n.d.), Bulletins 637, 629, 709.

XII. WELDING PROCESSES

A. OUTLINE OF INSTRUCTION
Class Hours 4

1. Processes

   a. Arc

   b. Gas

   c. Inert

   d. Brazing

   e. Carbon arc

   f. Submerged arc

   g. Forge

   h. Semi-automatic

   i. Automatic

   j. Resistance

      (1) Spot
      (2) Seam

   k. Others

      (1) Laser
      (2) Airchromatic
      (3) Plastic
      (4) Dry flux

2. Safety practices[7]

B. LABORATORY ACTIVITIES
Laboratory Hours 2

Tour welding area. Make examination and inspection of all equipment. Especially note grounding of welding units.

Use standard equipment to make soft solder joints in sheet and tubing by brazing.

XIII. WELDED JOINT

A. OUTLINE OF INSTRUCTION
Class Hours 2

B. LABORATORY ACTIVITIES
Laboratory Hours 4

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[7] Industrial Hygiene (Chicago: Kemper Insurance, n.d.), Bulletins 197 and 540.
Accident Prevention Manual for Industrial Operations (Chicago: National Safety Council, 1964), Chapter 30.
Engineering Consultation Service (Chicago: Kemper Insurance, n.d.), Bulletins 608 and 634.

1. Type

   a. Butt
   b. Lap
   c. Corner
   d. Pipe and tube
   e. Fillet
   f. Sheet metal

2. Application

   a. Vertical
   b. Flat
   c. Horizontal
   d. Overhead

Fabricate several joint types in different positions using oxy-acetylene welding equipment. Point out safe practices and importance of protective clothing.

3. Welding symbols

   a. Bead
   b. Fillet
   c. Square
   d. Bevel
   e. Weld all around
   f. Other special

Practice reading welding symbols from blueprints.

XIV. ARC WELDING MACHINES AND ACCESSORIES

A. OUTLINE OF INSTRUCTION
Class Hours 1

B. LABORATORY ACTIVITIES
Laboratory Hours 4

1. Welder's tools and accessories

   a. Electrode holders
   b. Ground lead
   c. Hammers and brushes
   d. Protective garments
   e. Others

Make careful examination of standard oxy-acetylene welding equipment. Give special attention to the safety practice in its use as well as proper care and maintenance. Take special note of protective garments for various parts of welder's anatomy such as eyes, hands, arms, legs, and feet.

2. Electrodes

   a. Mild steel
   b. Low hydrogen
   c. All position
   d. Alloy
   e. Iron powdered
   f. AWS numbering system
   g. NEMA color coding

Strike an arc and maintain the proper arc length. Run beads in several directions in a flat position using mild steel plate and small electrode.

3. Base metal

   a. Position
   b. Thickness

c. Type of metal

4. Machine power--input-output

a. AC input, AC output
b. AC input, AC or DC output
c. Motor-generator

5. Drive systems

a. Mechanical
b. Electrical

XV. PROCEDURES IN ARC WELDING

A. OUTLINE OF INSTRUCTION
Class Hours 2

1. Types (position)

a. Horizontal
b. Vertical
c. Flat
d. Overhead

2. Applications

a. Mild steel
b. Tool steel
c. Stainless steel
d. Hard surfacing
e. Build-up
f. Pipe welding
g. Pressure welding
h. Exotic metals[8]
i. Others

3. Standards for welder qualifications

a. Navy
b. AWS
c. ASME
d. U. S. Coast Guard
e. Others

B. LABORATORY ACTIVITIES
Laboratory Hours 12

Make a butt joint by arc welding two horizontal plates.

Use specified rods for hard surfacing, build-up, etc.

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[8] Accident Prevention Manual for Industrial Operations (Chicago: National Safety Council, 1964), Chapter 29, page 24.
Industrial Hygiene (Chicago: Kemper Insurance, n.d.), Bulletin 197.

XVI. OXY-ACETYLENE WELDING EQUIPMENT AND ACCESSORIES

A. OUTLINE OF INSTRUCTION
Class Hours 1

1. Welders tools and accessories

   a. Torches and tips
   b. Tanks
   c. Hoses
   d. Gages
   e. Protective garments
   f. Others

2. Gas rods

   a. Steel
   b. Bronze
   c. Aluminum
   d. Other

3. Base materials

   a. Cast iron
   b. Aluminum
   c. Stainless

B. LABORATORY ACTIVITIES
Laboratory Hours 4

Make careful examination of standard oxy-acetylene-welding equipment. Give special attention to the safety practice in its use as well as proper care and maintenance. Take special note of protection garments for various parts of welder's anatomy such as eyes, hands, arms, legs, and feet.

XVII. PROCEDURES IN OXY-ACETYLENE WELDING

A. OUTLINE OF INSTRUCTION
Class Hours 2

1. Welding positions

   a. Flat
   b. Vertical
   c. Horizontal
   d. Overhead

2. Applications

   a. Sheet metal

   b. Cast iron

B. LABORATORY ACTIVITIES
Laboratory Hours 6

Light and adjust torch; run a fusion bead in a straight line without filler rod.

Run beads on mild steel plate using a filler rod.

XVIII. OXY-ACETYLENE CUTTING

A. OUTLINE OF INSTRUCTION Class Hours 2	B. LABORATORY ACTIVITIES Laboratory Hours 3
1. Manual	Follow proper techniques to light and adjust manual torch.
a. Cutting	Cut specified shape, using a cutting torch after practice in selecting tip and adjusting torch for varying metal thicknesses.
b. Beveling c. Grooving d. Flux cutting	Make straight cuts, curved cuts, beveled cuts, and grooves as assigned.
2. Machine	
a. Straight line b. Shape c. Circular d. Precision e. Pipe f. Special	Using manufacturer's chart, determine cutting tip, acetylene and oxygen pressures, and cutting rate for oxy-acetylene cutting of materials assigned by instructor.

XIX. SUBMERGED MELT AND INERT GAS SHIELDED

A. OUTLINE OF INSTRUCTION Class Hours 2	B. LABORATORY ACTIVITIES Laboratory Hours 4
1. Positions	
a. Flat b. Vertical c. Horizontal d. Overhead	
2. Applications	Use inert gas processes to weld typical joints of aluminum and of stainless steel in each position.
a. Aluminum b. Titanium c. Stainless steel d. Alloys	

XX. METHODS OF INSPECTION

A. OUTLINE OF INSTRUCTION Class Hours 2	B. LABORATORY ACTIVITIES Laboratory Hours 4
1. Visual	

Inspection Techniques:
Make visual inspections of all welds to identify defects such as flux trapping, spatter, poor penetration, gas pockets, protrusion, etc.

Use a welding micrometer to determine size, convexity, concavity, and reinforcement of various welds. Compare measurement with standard tables for given joints and plate thickness.

2. Pressure

3. Ultrasonic

4. Die penetrant

5. X-Ray

6. Magnaflux

NOTE: X-ray and Magnaflux inspection will be covered in detail in a later course.

XXI. WELDING ECONOMY

A. OUTLINE OF INSTRUCTION
Class Hours 2

1. Welding design

a. Freedom of design
b. Ease of change

2. Casting vs. welding

a. Strength
b. Weight
c. Uniformity
d. Ductility
e. Machinability
f. Cost

3. Manual vs. semi-automatic vs. automatic welding

a. Number of repetitive welds
b. Length of weld
c. Location
d. Duty cycle
e. Shape

B. LABORATORY ACTIVITIES
Laboratory Hours 0

NOTE: Instructor is to supply necessary details to set up problem solving sessions for students.

ACETYLENE CUTTING

Determine from a blueprint the joint types, metal thickness, and running feet to be cut. Assume a 100% duty factor and select tip size. Use a handbook to estimate oxygen and acetylene requirements, cutting speeds, gas-consumption rates, and job-time estimate.

SUBMERGED ARC

Use a blueprint to determine plate thickness and running feet of each weld in an estimate of welding time and material requirements for inert gas welding (TIG) of various ferrous and non-ferrous metals. Use a handbook to determine number of passes, current required, electrode diameter, gas volume and pressure, filler-wire diameter and length.

XXII. REVIEW

A. OUTLINE OF INSTRUCTION
Class Hours __

1. Review key areas.

2. Evaluate student's command of material.

3. Give additional emphasis to weak areas.

B. LABORATORY ACTIVITIES
Laboratory Hours __

Assign additional laboratory applications for reinforcement.

SUGGESTED TEXTS:

Either

Rusinoff, S. E. Manufacturing Processes--Materials and Production. 3rd ed. Chicago, Illinois: American Technical Society, 1962.

or

Lindberg, Roy A. Processes and Materials of Manufacture. Boston, Massachusetts: Allyn and Bacon, Inc., 1964.

SUGGESTED REFERENCES:

Accident Prevention Manual for Industrial Operations. 5th ed. Chicago, Illinois: National Safety Council, 1964.

Althouse, Andrew, Carl H. Turnquist, and William A. Bowditch. Modern Welding. Homewood, Illinois: Goodheart-Willcox Company, 1965.

Begeman, Myron L. and B. H. Amstead. Manufacturing Processes. 5th ed. New York: John Wiley & Sons, Inc., 1963.

Campbell, James S., Jr. Principles of Manufacturing Materials and Processes. New York: McGraw-Hill Book Company, Inc., 1961.

Carson, Gordon B. Production Handbook. 2nd ed. New York: The Ronald Press Company, 1964.

Doyle, Lawrence E. Manufacturing Processes and Materials for Engineers. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1961.

Engineering Consultation Service. Chicago, Illinois: Kemper Insurance, (n.d.).

Giachino, J. W. and Henry J. Beukema. Welding Skills and Practices. 2nd ed. Chicago, Illinois: American Technical Society, 1965.

Industrial Hygiene. Chicago, Illinois: Kemper Insurance, (n.d.).

Jefferson, T. B. and Gorham Woods. Metals and How to Weld Them. Cleveland, Ohio: The James F. Lincoln Arc Welding Foundation, 1962.

Jefferson, Theodore B. (editor in chief). The Welding Encyclopedia. 15th ed. Morton Grove, Illinois: Welding Engineers Publications, Inc., 1964.

Ludwig, O. A. Metalwork Technology and Practice. 4th ed. Bloomington, Illinois: McKnight & McKnight Publishing Company, 1962.

Maynard, H. B. Industrial Engineering Handbook. 2nd ed. New York: McGraw-Hill Book Company, Inc., 1963.

Metals Handbook. 8th ed. Cleveland, Ohio: American Society for Metals, 1961.

Oxy-Acetylene Handbook, The. 2nd ed. New York: Union Carbide Corporation, Linde Division, 1965.

Procedure Handbook of Arc Welding Design and Practice. 11th ed. Cleveland, Ohio: Lincoln Electric Company, 1957.

Rusinoff, S. E. Foundry Practices. Chicago, Illinois: American Technical Society, 1955.

Schaller, Gilbert S. Engineering Manufacturing Methods. 2nd ed. New York: McGraw-Hill Book Company, Inc., 1959.

Smith, Robert E. Bench-Metal Work. Bloomington, Illinois: McKnight & McKnight Publishing Company, 1961.

_____. Forging and Welding. Bloomington, Illinois: McKnight & McKnight Publishing Company, 1956.

Welding and Cutting Manual. New York: Linde Air Products, 1963.

Williams, R. S. and V. O. Homerberg. The Principles of Metallography. 5th ed. New York: McGraw-Hill Book Company, Inc., 1948.

Wilson, Frank W. (editor in chief). Manufacturing Planning and Estimating Handbook. New York: McGraw-Hill Book Company, Inc., 1963.

_____. Tool Engineers Handbook. 2nd ed. New York: McGraw-Hill Book Company, Inc., 1959.

TMe 123

MATERIALS OF INDUSTRY

3 Semester Hours

INTRODUCTION

Materials of Industry concerns itself with elements, their compounds, and their properties, beginning with extraction and following through finishing. The teaching approach largely involves classroom presentation with outside reading assignments. Sufficient individual student examination of the materials is involved to develop the ability to recognize the materials in their raw form and during processes of manufacture. The use of handbooks is employed to assist in the identification of suitable processing techniques.

TMe 123. Materials of Industry. Three lectures. (3 semester hours credit). A study of the origin, extraction, processing, and application of modern industrial materials.

MAJOR DIVISIONS

		Class Hours
I.	Ferrous Metals	18
II.	Non-Ferrous Metals	15
III.	Wood Products	6
IV.	Plastics	12
V.	Additional Materials	3
VI.	Review	
	Total Class Hours	54

I. FERROUS METALS

A. OUTLINE OF INSTRUCTION
Class Hours 18

1. Extraction processes

a. Mining
b. Smelting

2. Major types

a. Cast iron and its properties

(1) Ductile
(2) Gray
(3) Malleable

b. Steel and its properties

(1) Cast
(2) Low carbon
(3) Low alloy
(4) Tool

c. Stainless steel and its properties

(1) Austenitic
(2) Ferritic
(3) Martensitic

3. Forming and fabricating characteristics

a. Forgeability
b. Machinability
c. Weldability
d. Castability

4. Special processes

II. NON-FERROUS METALS

A. OUTLINE OF INSTRUCTION
Class Hours 15

1. Elements and their properties

a. Aluminum
b. Lead
c. Zinc

d. Copper
e. Magnesium
f. Titanium
g. Exotic metals[1]
h. Precious metals
i. Others

2. Extraction processes

a. Mining
b. Smelting

3. Alloys and their properties

4. Forming and fabrication characteristics

a. Forgeability
b. Castability
c. Weldability
d. Machinability

5. Special processes

III. WOOD PRODUCTS

A. OUTLINE OF INSTRUCTION
Class Hours 6

1. Classification

a. Hard woods
b. Soft woods

2. Processes and products

a. Cutting and transporting
b. Milling
c. By-products

3. Applications

a. Structural
b. Packaging

4. Fabricating

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[1] Accident Prevention Manual for Industrial Operations, 4th ed. (Chicago: National Safety Council, 1964), Chapter 28, page 2; Chapter 29, page 24. Industrial Hygiene (Chicago: Kemper Insurance, n.d.), Bulletin 197.

a. Permanent
b. Temporary

IV. PLASTICS

A. OUTLINE OF INSTRUCTION
Class Hours 12

1. Types and composition

a. Thermoplastic
b. Thermosetting
c. Others

2. Forming processes

a. Compression
b. Transfer
c. Cold
d. Injection
e. Extrusion
f. Blow
g. Vacuum
h. Others

3. Fabrication

a. Sheeting
b. Laminating
c. Reinforcing
d. Machining
e. Welding

V. ADDITIONAL MATERIALS

A. OUTLINE OF INSTRUCTION
Class Hours 3

1. Bonding materials

a. Properties
b. Applications

2. Rubber products

a. Properties
b. Applications

3. Glass products

a. Properties
b. Applications

4. Others

VI. REVIEW

A. OUTLINE OF INSTRUCTION
Class Hours __

1. Review key areas.

2. Evaluate student's command of material.

3. Give additional emphasis to weak areas.

SUGGESTED TEXTS:

Either

Bacha, Charles P. and Others. Elements of Engineering Materials. New York: Harper and Row Publishers, 1957.

Or

Committee on Engineering Materials. Engineering Materials. New York: Pitman Publishing Corporation, 1958.

SUGGESTED REFERENCES:

Accident Prevention Manual for Industrial Operations. 5th ed. Chicago, Illinois: National Safety Council, 1964.

Begeman, Myron L. and B. H. Amstead. Manufacturing Processes. 5th ed. New York: John Wiley & Sons, Inc., 1963.

Campbell, James S., Jr. Principles of Manufacturing Materials and Processes. New York: McGraw-Hill Book Company, Inc., 1961.

Clark, D. S. Engineering Materials and Processes. 3rd ed. Scranton, Pennsylvania: International Textbook Company, 1949.

DeGarmo, E. Paul. Materials and Processes in Manufacturing. 2nd ed. New York: The Macmillan Company, 1962.

Industrial Hygiene. Chicago, Illinois: Kemper Insurance, (n.d.).

Keyser, Carl A. Materials of Engineering. 2nd ed. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1956.

Mantell, Charles L. Engineering Materials Handbook. New York: McGraw-Hill Book Company, Inc., 1958.

Moore, Herbert F. and Mark B. Moore. Textbook of Materials of Engineering. 8th ed. New York: McGraw-Hill Book Company, Inc., 1953.

TMe 234

MANUFACTURING PROCESSES II

4 Semester Hours

INTRODUCTION

The study of modern methods of manufacture is continued with major emphasis on machine-shop operations. Sufficient lecture and laboratory time is alloted to develop an understanding of equipment and operation potentials. Continued use of standard references is employed to develop the ability to estimate time and material requirements for various processes.

The instructor and the student should wear clothing appropriate to machine-shop work. Machining operations should be performed only when the operator is wearing appropriate safety equipment, such as safety glasses.

Modern industry places greater emphasis on safety equipment, clothing, procedures, and materials. Every instructor and technician should own and study the Accident Prevention Manual for Industrial Operations. Footnotes and references found in these outlines are to be fourth and fifth editions.

TMe 234. Manufacturing Processes II. Two lectures. Four hours laboratory. (4 semester hours credit). A survey of machine tool operations and finishing processes employed in modern operations using standard references to estimate job time and materials.

MAJOR DIVISIONS

		Class Hours	Laboratory Hours
I.	Machining and Cutting Tools	4	6
II.	Turning Lathes	3	14
III.	Turret and Automatic Lathes	2	8
IV.	Screw Threads	1	4
V.	Drilling	2	4
VI.	Boring	1	2
VII.	Planing, Shaping, and Slotting	1	2
VIII.	Milling	2	10
IX.	Gears and Gearing	2	12
X.	Broaching and Sawing	2	1
XI.	Grinding and Finishing	2	3
XII.	Automation	2	3
XIII.	Numerical Control for Machine Tools	4	0
XIV.	Transfer and Special Machines	4	0
XV.	Metal Finishing	4	3
XVI.	Review		
		Total Class Hours 36	Total Laboratory Hours 72

Total Suggested Clock Hours 108

I. MACHINING AND CUTTING TOOLS

A. OUTLINE OF INSTRUCTION Class Hours 4	B. LABORATORY ACTIVITIES Laboratory Hours 6
1. Principles of metal cutting	
a. Types of machines and tooling	
b. Machinability	
(1) Methods of measuring and reporting machinability	Make laboratory examination of standard handbook and tables. Make simple computations of feed, speed, depth of cut, and coolant for various types of metals and machines in relation to type of tool. Graphically represent the difference between machine time of various metals and tools.
(2) Ratings	These problems will be verified at a later date with actual use of machinery.
(3) Uses of machinability ratings	
(a) Guide in selecting materials from cost standpoint	Compute cost difference using various machine methods.
(b) Standards for machining	
(c) Estimating machining time for new jobs	
2. Cutting tool materials	Select proper cutting tool, determine proper sharpening procedure from handbook, and make cuts as specified by instructor.
3. Tool selection, preparation and maintenance	
a. Cutting angle b. Tool setting	Compute time to be allowed for machining new projects with standard tool with carbide tip.
4. Safety in metal cutting[1]	

[1] Accident Prevention Manual for Industrial Operations (Chicago: National Safety Council, 1964), Chapter 24.
Engineering Consultation Service (Chicago: Kemper Insurance, n.d.), Bulletins 149, 209, 508, 511, 527, 532, 705.

II. TURNING LATHES

A. OUTLINE OF INSTRUCTION Class Hours 3	B. LABORATORY ACTIVITIES Laboratory Hours 14
1. Types a. Engine b. Turret lathes c. Toolroom	Study metal cutting lathes as to type and application in the manufacturing processes. Identify chief difference between types.
2. Construction and design a. Identification and function of parts b. Drive mechanisms c. Attachments	Identify parts of design and methods of construction which point up differences between lathe types. Use proper inspection tools for measuring--micrometers, dial indicators, inside micrometers, etc.
3. Operations a. Turning b. Boring c. Threading d. Facing e. Knurling f. Tapering g. Safety[2]	Plan and make setup and perform indicated operations on selected projects. Use handbook tables for given metals to set feed, speed, depth of cut, and coolant for each operation.

III. TURRET AND AUTOMATIC LATHES

A. OUTLINE OF INSTRUCTION Class Hours 2	B. LABORATORY ACTIVITIES Laboratory Hours 8
1. Types a. Hand operated, manual controls b. Automatic c. Vertical d. Horizontal e. Twin turret f. Automatic screw	
2. Construction and design a. Identification of parts	

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[2] Accident Prevention Manual for Industrial Operations (Chicago: National Safety Council, 1964), Chapter 25, pages 3-5.

b. Drive mechanisms
c. Attachments

3. Operation

a. Safety
b. Turning
c. Cutoff
d. Tapping
e. Knurling
f. Drilling
g. Facing

4. Multiple tooling principles

a. Speeds
b. Feeds

Set up and perform boring, threading, turning, and cutoff operations on a turret lathe. Use blueprint or project sheet to determine proper sequence. Select proper stock for operation. Calculate speed, feed, depth of cut, and coolant on data in handbook. Select and set up proper attachments for turret head.

IV. SCREW THREADS

A. OUTLINE OF INSTRUCTION
Class Hours 1

1. Types

a. Acme
b. American national
c. Square
d. Whitworth
e. International standard
f. Pipe
g. Unified
h. Internal and external

2. Elements

a. Crest
b. Pitch
c. Pitch line
d. Root
e. Lead angle
f. Depth
g. Radius
h. Flats
i. Thread angle
j. Base of thread
k. Major diameter
l. Minor diameter

B. LABORATORY ACTIVITIES
Laboratory Hours 4

m. Pitch diameter
n. Helix angle
o. Fits and specifications

3. Methods of producing

a. Die
b. Lathe
c. Taps
d. Automatic die (turret lathe)
e. Milling machine
f. Threading machine
g. Rolling
h. Die casting
i. Grinding
j. Threaded inserts

Make short lengths of each type of thread as identified by the instructor. Make necessary computations for turning thread forms. Grind tools, set angles and depths. Make internal and external threads.

V. DRILLING

A. OUTLINE OF INSTRUCTION
Class Hours 2

B. LABORATORY ACTIVITIES
Laboratory Hours 4

1. Types

a. Machines

(1) Radial
(2) Pedestal
(3) Bench

b. Drills

(1) Taper shank
(2) Straight shank

Sharpen drill bits on grinder. Use gauge to check for proper angles.

c. Drill classifications

(1) Fractional
(2) Numerical
(3) Alphabetical

Examine each type drill, listing its particular applications.

2. Construction and design

a. Multi-spindle
b. Sensitive

3. Operations

a. Drilling
b. Boring
c. Reaming

Calculate and set up drill speeds and feed for drilling and reaming. Select coolant, tool, and stock for ferrous and non-ferrous metals.

d. Countersinking
e. Counterboring
f. Spot facing
g. Tapping

Select drill bits and sharpen for 3 specified relief angles for special materials assigned by instructor.

4. Safety practices in drilling operations[3]

VI. BORING

A. OUTLINE OF INSTRUCTION
Class Hours 1

B. LABORATORY ACTIVITIES
Laboratory Hours 2

1. Types of machines

a. Most common machines
b. Special machines

2. Types of tools

a. Common boring tools
b. Special boring tools

Perform simple boring operation using measuring device for precision work.

3. Safety[4]

VII. PLANING, SHAPING, AND SLOTTING

A. OUTLINE OF INSTRUCTION
Class Hours 1

B. LABORATORY ACTIVITIES
Laboratory Hours 2

1. Types

a. Planing
b. Shaping
c. Slotting

2. Construction and design

a. Identification of parts
b. Drive mechanism

3. Operations

a. Capacity
b. Procedure

Set up simple project. Perform shaping operation, using standard accessories such as parallels, etc.

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[3] Accident Prevention Manual for Industrial Operations, 4th ed. (Chicago: National Safety Council, 1964), Chapter 25, page 6.
Engineering Consultation Service (Chicago: Kemper Insurance, n.d.), Bulletin 529.

[4] Accident Prevention Manual for Industrial Operations, 4th ed. (Chicago: National Safety Council, 1964), Chapter 25, pages 6-8.

Use handbook for calculating to determine length of stroke, feed of table, and depth of cut for given type of material.

4. Safety practices for shaping, planing, and slotting[5]

VIII. MILLING

A. OUTLINE OF INSTRUCTION
Class Hours 2

B. LABORATORY ACTIVITIES
Laboratory Hours 10

1. Types

a. Machines

(1) Horizontal
(2) Vertical
(3) Chemical milling

Set up simple project for horizontal plane and horizontal universal. The same assignment should be extended to vertical plane. Study of each should be included on field trip.

b. Cutters

(1) Vertical milling cutters

(a) End mill
(b) Shell mill
(c) Dovetail
(d) T-slot
(e) Woodruff key
(f) Ball end

(2) Horizontal milling cutters

Set up 2 or 3 gear-cutting projects, one of which should be helical gear.

(a) Gear cutters
(b) Hobs cutters
(c) Form cutter
(d) Side cutter
(e) Slitting saw
(f) Staggered-tooth cutter

Make setup as specified by instructor for simple climb-cut straddle milling. Repeat for conventional or "upcut" milling.

2. Construction and design

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[5] Engineering Consultation Service (Chicago: Kemper Insurance, n.d.), Bulletins 530 and 531.
Accident Prevention Manual for Industrial Operations, 4th ed. (Chicago: National Safety Council, 1964), Chapter 25, page 11.

a. Vertical
b. Horizontal

3. Operations

a. Slotting
b. Slab
c. Key way
d. Splining
e. Gears
f. Fly

Calculate the number of turns and select proper hole circle in index plate required for milling a given number of divisions. Calculate lead angle and gear ratio for milling a given helix.

4. Attachments and accessories

a. Arbors
b. Dividing head
c. Rotor table
d. Holding devices

Set up machine for slitting, using a 1/16" by 2" or 2½" saw with special emphasis on procedures and precautions in use of such cutters.

5. Safety practices in milling[6]

IX. GEARS AND GEARING

A. OUTLINE OF INSTRUCTION
Class Hours 2

1. Nomenclature

a. Identification of parts and gears
b. Identification of machines to produce gear

2. Types

a. Spur
b. Pinion
c. Helical
d. Bevel
e. Hypoid
f. Spiral
g. Miter bevel
h. Worm
i. Cone

B. LABORATORY ACTIVITIES
Laboratory Hours 12

Examine gear assortment in identification practice. This should include appropriate cutter or selected gear.

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[6] Engineering Consultation Service (Chicago: Kemper Insurance, n.d.), Bulletin 150.
Accident Prevention Manual for Industrial Operations, 4th ed. (Chicago: National Safety Council, 1964), Chapter 25, pages 8-9.

3. Methods of fabrication

a. Templet
b. Shaper cutter
c. Milling
d. Gear-generating machine
e. Hob cutter

Calculate outside diameter and depth of tooth of a 42-tooth, 6-diametral-pitch spur gear. Set up and cut on milling machine.

X. BROACHING AND SAWING

A. OUTLINE OF INSTRUCTION
Class Hours 2

1. Types

a. Machines

(1) Vertical single-side surface
(2) Vertical double-side surface
(3) Vertical push
(4) Vertical pull down
(5) Vertical pull up
(6) Horizontal
(7) Rotary
(8) Continuous
(9) Saws (power hack, continuous band)
(10) Electrical discharge

b. Cutters

(1) Selected for machine
(2) Selected for metal cut

2. Methods

a. Operations

(1) Purpose
(2) Safety

b. Setups

3. Safety procedure[7]

B. LABORATORY ACTIVITIES
Laboratory Hours 1

Calculate from data provided and plan setup for the type of machine to do the following:

1. Cut a key way and a gear.

2. Cut the cap on a connecting rod.

Calculate the feed and speed of a continuous saw blade for various metals. Cut one hole requiring breaking of blade. Insert in drilled hole and reweld blade.

[7] Accident Prevention Manual for Industrial Operations, 4th ed. (Chicago: National Safety Council, 1964), Chapter 25, pages 9 and 12.

XI. GRINDING AND FINISHING

A. OUTLINE OF INSTRUCTION Class Hours 2	B. LABORATORY ACTIVITIES Laboratory Hours 3
1. Types	
a. Machines (1) Surface (2) Internal (3) Centerless (4) Tool and cutter (5) Tool post	Using magnetic chuck, set up surface grinding project, including specified material and appropriate wheel. Make practice passes to establish procedure in this type operation.
b. Grinding wheels (1) Aluminum oxide (2) Silicon carbide (3) Diamond	Determine wheel types, spindle speed, peripheral speed, and grinding time for a selected project. Operational r.p.m. must not exceed design r.p.m. Examine grinding wheels periodically for cracks.
2. Operations	
a. Snagging b. Surfacing c. Radiusing d. Cylindrical grinding e. Forming	Dress grinding wheel for desired operation.
3. Surface finishes	
a. Classifications (1) Micro-inch (2) R.M.S.	
b. Measurement	
4. Safety practices in grinding and finishing[8]	

[8] Engineering Consultation Service (Chicago: Kemper Insurance, n.d.), Bulletins 533 and 711.
Accident Prevention Manual for Industrial Operations, 4th ed. (Chicago: National Safety Council, 1964), Chapter 25, page 13.

XII. AUTOMATION

A. OUTLINE OF INSTRUCTION
Class Hours 2

1. Definition

2. Automatic controls

   a. Types
   b. Purposes

3. Area of use

   a. Machining
   b. Steel making
   c. Materials handling
   d. Metal casting
   e. Press working
   f. Heat treating

B. LABORATORY ACTIVITIES
Laboratory Hours 3

Give orientation on the processes, equipment, and controls to be observed on a field trip to an industry employing processes discussed in OUTLINE OF INSTRUCTION.

XIII. NUMERICAL CONTROL FOR MACHINE TOOLS

A. OUTLINE OF INSTRUCTION
Class Hours 4

1. Definition

2. Conventional vs. numerical control method

3. Computers

4. Application potential

5. Control concepts

6. Preparation for use

7. System details

8. Transfer line

B. LABORATORY ACTIVITIES
Laboratory Hours 0

Plan the programming of a tape (numerical) control machine. Select proper operations in proper sequence from blueprint or information supplied by instructor (such as drilling, boring, tapping, milling). Using coordinate system, determine exact X and Y axis points for each operation.

XIV. TRANSFER AND SPECIAL MACHINES

A. OUTLINE OF INSTRUCTION
Class Hours 4

1. Introductory definition

2. Transfer-type machines

B. LABORATORY ACTIVITIES
Laboratory Hours 0

a. Operation
b. Achievement

3. Process machines

4. Sectionized automation

5. Integrated-interlocked line

6. Case studies

XV. METAL FINISHING

A. OUTLINE OF INSTRUCTION
Class Hours 4

1. Methods

a. Polishing
b. Buffing
c. Grinding
d. Scraping
e. Filing

2. Surface preparation

a. Degreasing
b. Rust preventative

3. Surface protection

a. Anodizing
b. Bluing
c. Plating
d. Painting
e. Plastic coating

4. Safety practices in metal finishing[9]

B. LABORATORY ACTIVITIES
Laboratory Hours 3

Using project assigned by the instructor, grind, file, and polish one surface of a ferrous and a non-ferrous metal and a plastic.

Use the following protection methods which are suitable to materials assigned by instructor:
1) anodizing
2) bluing
3) plating
Adequate ventilation is required. Exhaust loads must be located over finishing tanks.

XVI. REVIEW

A. OUTLINE OF INSTRUCTION
Class Hours __

1. Review key areas.

2. Evaluate student's command of material.

3. Give additional emphasis to weak areas.

B. LABORATORY ACTIVITIES
Laboratory Hours __

Assign additional laboratory applications for reinforcement.

[9] Industrial Hygiene (Chicago: Kemper Insurance, n.d.), Bulletins 12, 13, 28, 36, 52, 93.

SUGGESTED TEXTS:

Either

Rusinoff, S. E. Manufacturing Processes--Materials and Production. 3rd ed. Chicago, Illinois: American Technical Society, 1962.

or

Lindberg, Roy A. Processes and Materials of Manufacture. Boston, Massachusetts: Allyn and Bacon, Inc., 1964.

SUGGESTED REFERENCES:

Accident Prevention Manual for Industrial Operations. 5th ed. Chicago, Illinois: National Safety Council, 1964.

Begeman, Myron L. and B. H. Amstead. Manufacturing Processes. 5th ed. New York: John Wiley & Sons, Inc., 1963.

Burghardt, Henry D., Aaron Axelrod, and James Anderson. Machine Tool Operation. Part I. 5th ed. New York: McGraw-Hill Book Company, Inc., 1959.

_____. Machine Tool Operation. Part II. 4th ed. New York: McGraw-Hill Book Company, Inc., 1960.

Campbell, James S., Jr. Principles of Manufacturing Materials and Processes. New York: McGraw-Hill Book Company, Inc., 1961.

Carson, Gordon B. Production Handbook. 2nd ed. New York: The Ronald Press Company, 1964.

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Industrial Hygiene. Chicago, Illinois: Kemper Insurance, (n.d.).

Jones, Franklin D. and Henry H. Ryffel. Gear Design Simplified. 3rd ed. New York: The Industrial Press, 1961.

LeGrand, Rupert (editor). The New American Machinists' Handbook. New York: McGraw-Hill Book Company, Inc., 1955.

Maynard, H. B. Industrial Engineering Handbook. 2nd ed. New York: McGraw-Hill Book Company, Inc., 1963.

Metals Handbook. 8th ed. Cleveland, Ohio: American Society for Metals, 1961.

Miner, Harvey D. and John G. Miller. Exploring Patternmaking and Foundry. Princeton, New Jersey: D. Van Nostrand Company, Inc., 1959.

Schaller, Gilbert S. Engineering Manufacturing Methods. 2nd ed. New York: McGraw-Hill Book Company, Inc., 1959.

Williams, R. S. and V. O. Homerberg. The Principles of Metallography. 5th ed. New York: McGraw-Hill Book Company, Inc., 1948.

Wilson, Frank W. (editor in chief). Manufacturing Planning and Estimating Handbook. New York: McGraw-Hill Book Company, Inc., 1963.

_____. Tool Engineers Handbook. 2nd ed. New York: McGraw-Hill Book Company, Inc., 1959.

TMe 343

HYDRAULICS & PNEUMATICS

3 Semester Hours

INTRODUCTION

Modern industrial equipment is powered by a variety of methods. Among those occurring most frequently are hydraulics and pneumatics. The content of this course is intended to familiarize the technical student with the location and function of typical components within circuits. Lecture sections describe types and operational principles; laboratory sessions concern themselves with student problem solving and examination of components and circuits, including disassembly, inspection, reassembly, and testing.

TMe 343. Hydraulics and Pneumatics. Two lectures. Two hours laboratory. (3 semester hours credit). Lecture and laboratory examination of hydraulic and pneumatic components and circuits including typical applications and operations.

MAJOR DIVISIONS

		Class Hours	Laboratory Hours
I.	Introduction to Hydraulics	2	1
II.	Principles of Power Hydraulics	4	3
III.	Hydraulic Fluids and Flow Measurement	2	4
IV.	Hydraulic Pumps	4	4
V.	Control Valves	4	4
VI.	Hydraulic Motors	2	2
VII.	Accessories	2	3
VIII.	Hydraulic System Design	3	3
IX.	Pneumatic Power Unit	2	2
X.	Pneumatic Controls	2	2
XI.	Air and Hydraulic Cylinders	2	2
XII.	Pneumatic Circuitry	4	2
XIII.	Combination Systems--Air & Oil	3	4
XIV.	Review		
	Total Class Hours	36	Total Laboratory Hours 36
	Total Suggested Clock Hours		72

I. INTRODUCTION TO HYDRAULICS

A. OUTLINE OF INSTRUCTION
Class Hours 2

1. The scope of hydraulics

   a. Importance of hydraulics in engineering
   b. Importance of hydraulics to the technician.
   c. Importance of hydraulics in industry

      (1) The potential uses for hydraulics in industry
      (2) Reasons for use of hydraulic-operated equipment over other means

2. Assignments, term projects, notebook, problems, and tests

B. LABORATORY ACTIVITIES
Laboratory Hours 1

Tour laboratory facilities; identify hydraulic and pneumatic equipment, emphasizing nomenclature. Compare and contrast circuit operation principles and components.

II. PRINCIPLES OF POWER HYDRAULICS

A. OUTLINE OF INSTRUCTION
Class Hours 4

1. Physical laws and principles

   a. Power--its meaning, formula

      (1) Force, pressure, p.s.i.
      (2) Atmospheric pressure

   b. Work--its meaning, formula

      (1) Torque

      (2) Horsepower

2. Physical properties of liquids

   a. Differences between solids, liquids, and gases
   b. Pascal's law

B. LABORATORY ACTIVITIES
Laboratory Hours 3

Solve selective problems involving the pressure developed in the container when a given force is applied to a piston of a given area.

Calculate pressure resulting from levers of given length having given force supplied.

Solve problem in torque, force, pressure, and horsepower by determining the amount of work required (in horsepower) to develop given pressure.

(1) Meaning
(2) Applications

c. Mechanics of liquids

(1) Forms of energy

(a) Potential
(b) Kinetic
(c) Heat

(2) Liquids in force multipliers
(3) Liquids and transfer of motion

d. Characteristics of flow

(1) Static factors

(a) Static pressure vs. heat energy
(b) Potential energy vs. kinetic energy

(2) Dynamic factors

(a) Bernoulli's principle and applications

(b) Kinetic energy--applications

3. Safety hazards of hydraulic liquids

III. HYDRAULIC FLUIDS AND FLOW MEASUREMENT

A. OUTLINE OF INSTRUCTION
Class Hours 2

1. Reservoirs, strainers, and filters

a. Principles and characteristics of reservoirs
b. Types and principles of strainers and filters

B. LABORATORY ACTIVITIES
Laboratory Hours 4

Calculate pressure variations at given points within a system having different cross sections at these points. Verify experimentally.

Disassemble, inspect and reassemble reservoirs, strainers, and filters having common and contrasting features.

2. Hydraulic piping and fitting

a. Classifications--JIC standards

b. Selections (use of charts and layout)

Practice identification of components in hydraulics systems from industrial blueprints. Identify details such as pump capacity, degree of filtration, direction of flow, capacities.

c. Installation

Inspect pipes, tubing, hose, and fittings; study sizes, shapes, and applications.

d. Packing

(1) Composition
(2) O-rings

Make a laboratory examination of packing and sealing devices.

3. Hydraulic fluids

a. Requirements of a hydraulic fluid

b. Characteristics of hydraulic oils

(1) Initial suitability
(2) Viscosity and viscosity index

Use a Saybolt Universal Viscosimeter to determine viscosity of several fluids. Compare with standard table ratings and typical on-the-job comparitors.

(3) Pour point
(4) Oxidation stability
(5) Rust prevention
(6) Foaming

c. Maintenance and storage of hydraulic oils

Use commercial flow meters to make basic flow measurements in closed pipe circuits. Employ meters incorporating principles of the simple pitot, combined pitot-static, venturi, orifice, etc. Using a monometer, calibrate each flow meter. Make measurements of flow at varying pressures, and compare with standard tables.

IV. HYDRAULIC PUMPS

A. OUTLINE OF INSTRUCTION
Class Hours 4

1. Purpose of hydraulic pumps

2. Performance ratings

B. LABORATORY ACTIVITIES
Laboratory Hours 4

3. Classification of hydraulic pumps

a. Principles of operation of nonpositive displacement pumps

(1) Centrifugal pumps (volute and diffuser)
(2) Propeller pumps
(3) Mixed flow pumps

b. Principles of operation of positive displacement pumps

(1) Rotary pumps--gear, lobe, vane, or piston-type rotary
(2) Reciprocating pumps

For each type of pump, calculate pressure in cylinder of given dimensions having known pressure applied or forces exerted on levers of given lengths. Calculate volume per stroke and output capacity; calculate capacity for various strokes per minute.[1]

Construct hydraulic pump, using simple hydraulic cylinder and check valves. Using data available, calculate power requirements for various discharge pressures and volumes.

V. CONTROL VALVES

A. OUTLINE OF INSTRUCTION
Class Hours 4

B. LABORATORY ACTIVITIES
Laboratory Hours 4

1. Introduction to valves

a. Types
b. Classification--ratings

2. Pressure-control valves

Assemble hydraulic circuits containing control valves as directed.

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[1] Accident Prevention Manual for Industrial Operations, 4th ed. (Chicago, Illinois: National Safety Council, 1964), Chapter 24, pages 31-32.

Make pressure and flow checks at assigned points to:

Describe action within efficiently operating system.

Diagnose problems arising with variety of control valves.

3. Directional-control valves

a. General classification

(1) Spool types and rotary types
(2) Two-, three-, and four-connection types
(3) Flow paths

b. Specific types

(1) Manual
(2) Pilot-operated
(3) Solenoid-controlled
(4) Solenoid-controlled pilot-operated

c. Check valves

(1) Simple or standard type
(2) Prefill type
(3) Foot valve
(4) Pilot-operated

4. Flow-control valves

a. Gate, plug, and needle valves
b. Pressure-compensated flow-control valves

VI. HYDRAULIC MOTORS

A. OUTLINE OF INSTRUCTION
Class Hours 2

1. Rotary

a. Classification
b. Rating-torque-speed

B. LABORATORY ACTIVITIES
Laboratory Hours 2

Calculate requirements of pressure, volume, speed, torque, and horsepower in various applications of hydraulic motors.

Set up circuits with available equipment and experimentally verify.

Plot horsepower and torque graphs for various speeds.

2. Rams

a. Classifications
b. Ratings

VII. ACCESSORIES

A. OUTLINE OF INSTRUCTION
Class Hours 2

B. LABORATORY ACTIVITIES
Laboratory Hours 3

1. Principles of operation

a. Accumulators
b. Heat exchangers
c. Oil coolers

Make temperature tests at inlet and outlets of components such as motors, filters, heat exchangers, rams, etc.

d. Oil filters

Analyze the impurities and foreign matter present in an operating hydraulic system by extracting a sample and allowing to settle, by filtering, by passing over magnetic field, by litmus test, etc.

2. Applications

VIII. HYDRAULIC SYSTEM DESIGN

A. OUTLINE OF INSTRUCTION
Class Hours 3

B. LABORATORY ACTIVITIES
Laboratory Hours 3

1. Hydraulic circuits

Design an elementary system containing major components using specifications indicated by instructor. Calculate pressure losses, flow temperature, and motor speeds. Verify by setting up circuits using available equipment and apply power; make pressure and flow measurements.

IX. PNEUMATIC POWER UNIT

A. OUTLINE OF INSTRUCTION Class Hours 2	B. LABORATORY ACTIVITIES Laboratory Hours 2
1. Construction and principle of operation of the compressor	Disassemble, inspect, and reassemble basic compressor types. Give special attention to nomenclature, purpose, and operation of component parts.
2. Cylinder arrangements	
3. Air tank construction and dimensions	
4. Pressure switch control	
5. Coupling methods of motor to compressor	
6. Power requirements	Solve problems involving power requirements for several types and capacities of compressors.
7. R.F.L. units (regulator, filter, lubricator)	Examine construction, flow path, adjustments, and operational limits for regulator units.
8. Safety codes	

X. PNEUMATIC CONTROLS

A. OUTLINE OF INSTRUCTION Class Hours 2	B. LABORATORY ACTIVITIES Laboratory Hours 2
1. Directional-control valves, construction and operation	Assemble pneumatic circuits containing control valves as directed. Make pressure and flow checks at assigned points to:
a. Four-way valves, manual b. Three-way valves, manual c. Pilot-operated valves d. Solenoid-operated valves	Describe action within efficiently operating system. Diagnose problems arising with variety of control valves.
2. Flow-control valves, construction and operation	
a. Manually-operated b. Cam-operated	
3. Sequence valves	

a. Construction and principle of operation
b. Location in circuit

XI. AIR AND HYDRAULIC CYLINDERS

A. OUTLINE OF INSTRUCTION Class Hours 2	B. LABORATORY ACTIVITIES Laboratory Hours 2
1. Types of air and hydraulic cylinders a. Light, medium, heavy b. Tandern c. Duplex d. Double-end	Examine internal construction and flow path through various types of cylinders.
2. Cylinder parts a. Tube b. Cover c. Packing gland d. Cushion assembly	Measure cylinder air consumption at various thrusts.
e. Piston and piston seals	Measure piston's speed as it is affected by such variables as friction, volume, and restrictions.
f. Rods	
3. Installation, application, and maintenance	

XII. PNEUMATIC CIRCUITRY

A. OUTLINE OF INSTRUCTION Class Hours 4	B. LABORATORY ACTIVITIES Laboratory Hours 2
1. Power-operated holding devices a. Advantages and accuracy b. Power chucking applications c. Power-operated mandrels d. Clamping devices	Set up an elementary pneumatic circuit containing safety devices. Calculate pressures and volumes of gases under proposed conditions. Verify calculations and operation of safety devices.
2. Pneumatic safety circuits a. Protection when pressure drops b. Protection against overloads c. Interlock for machine protection	Set up an elementary pneumatic circuit containing safety devices. Calculate pressures and volumes of gases under proposed conditions. Verify calculations and operation of safety devices.

d. Emergency reversal
e. Holding at two pressure levels
f. Safeguarding the operator's hands

3. Remote control of pneumatic systems

a. Bleed-type, pilot-operated valves
b. Pressure-type, pilot-operated valves
c. Pilot-operated system
d. Solenoid-operated systems
e. Cam-operated limit switches

XIII. COMBINATION SYSTEMS--AIR & OIL

A. OUTLINE OF INSTRUCTION Class Hours 3	B. LABORATORY ACTIVITIES Laboratory Hours 4
1. Application and advantages	Set up and operate circuits involving air and oil:
2. Air-controlled, hydraulic valves	Air-hydraulic rapid traverse circuit
3. Oil-controlled, air valves	Air-loading, hydraulic performance circuit
4. Air control of multiple hydraulic circuits	Dampening circuits
5. Air as a cushion for hydraulic systems	
6. Air-hydraulic booster	

XIV. REVIEW

A. OUTLINE OF INSTRUCTION Class Hours __	B. LABORATORY ACTIVITIES Laboratory Hours __
1. Review key areas.	Assign additional laboratory applications for reinforcement.
2. Evaluate student's command of material.	
3. Give additional emphasis to weak areas.	

SUGGESTED TEXT:

Pippenger, John P. and Tyler G. Hicks. Industrial Hydraulics. New York: McGraw-Hill Book Company, Inc., 1962.

SUGGESTED REFERENCES:

Accident Prevention Manual for Industrial Operations. 5th ed. Chicago, Illinois: National Safety Council, 1964.

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Black, Newton H. and A. P. Little. An Introductory Course in College Physics. 4th ed. New York: The Macmillan Company, (n.d.).

Ernst, Walter. Oil Hydraulic Power and Its Industrial Applications. 2nd ed. New York: McGraw-Hill Book Company, Inc., 1960.

Furry, W. H., E. M. Purcell, and J. C. Street. Physics for Science and Engineering Students. New York: McGraw-Hill Book Company, Inc., 1952.

Graham, Frank D. Pumps, Hydraulics and Air Compressors. Indianapolis, Indiana: T. Audel, & Company, 1943.

Gray, Dwight E. (editor). American Institute of Physics Handbook. 2nd ed. New York: McGraw-Hill Book Company, Inc., 1963.

Khaimovich, E. M. Hydraulic Control of Machine Tools. New York: Pergamon Press, Inc., 1965.

Stewart, Harry L. Hydraulic and Pneumatic Power for Production. Brighton, England: Machinery Publishing House, (n.d.).

TMe 353

METALLURGY

3 Semester Hours

INTRODUCTION

Personnel working at the technical level in forming and fabrication of metal must be familiar with industrial methods of metallurgical testing and analyzing. To comprehend the analytical process, interpret charts and graphs, prepare their own reports, and communicate with both engineering and production personnel, they must be familiar with fundamental procedures, testing equipment, and computation of results.

The instructor is responsible for the orientation of the students in the use of the majority of this equipment. However, some equipment may necessarily be used by the instructor only, and the student becomes familiar with these procedures only to the point of insight into higher skill and knowledgeable operation. The student takes readings from indicating instruments and makes mathematical computations.

TMe 353. Metallurgy. One lecture. Four hours laboratory. (3 semester hours credit). Lecture presentations of techniques of destructive and non-destructive testing and the analysis of ferrous and non-ferrous metals. Laboratory activities involve the testing and analysis of samples, and preparation of reports.

MAJOR DIVISIONS

		Class Hours	Laboratory Hours
I.	Extractive Metallurgy	1	2
II.	Physical Metallurgy	3	12
III.	Casting	2	2
IV.	Hot and Cold Working	2	6
V.	Heat Treatment	3	12
VI.	Surface Hardening	2	12
VII.	Alloying	2	8
VIII.	Testing	3	18
IX.	Review		
	Total Class Hours	18	Total Laboratory Hours 72
	Total Suggested Clock Hours		90

I. EXTRACTIVE METALLURGY

A. OUTLINE OF INSTRUCTION
Class Hours 1

1. The production of iron and steel

   a. Types of iron and steel, terminology

      (1) Cast iron
      (2) Steel
      (3) Wrought iron

   b. Preliminary treatment of iron ores

      (1) Iron ore
      (2) Treatment before refining

   c. Principles of blast furnace smelting

      (1) Furnace description
      (2) Furnace charge
      (3) Furnace operation
      (4) Classification of pig irons
      (5) Smelting under pressure

   d. Production of steel

      (1) Processes
      (2) Tonnage and special steels
      (3) Acid and basic steels
      (4) Removal of impurities
      (5) Ferroalloys

2. Additional widely used processes

   a. The Bessemer process

      (1) General
      (2) The converter
      (3) The process

   b. The open-hearth process

      (1) General

B. LABORATORY ACTIVITIES
Laboratory Hours 2

NOTE: Use laboratory section to orient students in practices in extractive metallurgy to assist their understanding of the following sections. Film strips and moving films would survey extractive processes.

(2) The furnace
(3) The process
(4) Bessemer vs. open-hearth process

c. Other steel-making processes

(1) General
(2) Direct-arc electric furnace
(3) Induction furnace
(4) Duplex and triplex processes
(5) Cementation and crucible processes

II. PHYSICAL METALLURGY

A. OUTLINE OF INSTRUCTION Class Hours 3	B. LABORATORY ACTIVITIES Laboratory Hours 12
1. Properties of metal	
a. Chemical	
b. Electrical	
c. Thermal	Find the critical temperature and identify content of steel sample supplied by instructor. Make thermal analysis by controlled heating, by plotting a temperature-time chart, and by comparing with iron-iron-carbon diagram (ASM).
d. Mechanical	
2. Metallurgical characteristics	
a. Metallic state	
b. Crystalline state	Examine common table salt under a microscope at low to high power. After careful orientation, observe grain, crystal, and lattice structure. Compare observation with laboratory manual.
c. Grain structure	Examine the grain growth of a given type of steel; heat to specified temperatures below, in, and above the critical range; quench, break, and make microscopic (low power) examinations and hardness tests.

d. Stress and strain
e. Plastic deformation by slip
f. Rupture by cleavage
g. Recrystallization
h. Cold crystallization
i. Critical temperature

III. CASTING

A. OUTLINE OF INSTRUCTION
Class Hours 2

1. Molding considerations

2. Freezing

3. Inclusion of gases

4. Normal and inverse segregation

5. Cooling contraction

6. Safety practices

B. LABORATORY ACTIVITIES
Laboratory Hours 2

Make a macroscopic examination of cast and forged pieces by cutting, filing, polishing, and etching. Identify porosity, cracks, segregations, depth of carburization, etc., which are present.

IV. HOT AND COLD WORKING

A. OUTLINE OF INSTRUCTION
Class Hours 2

1. Rolling

a. Critical temperature
b. Recrystallization

2. Forging

a. Critical temperature
b. Recrystallization

3. Extrusion

a. Critical temperature
b. Recrystallization

B. LABORATORY ACTIVITIES
Laboratory Hours 6

Use the impact test to compare the relative hardness of hot rolled stock with that of quenched and drawn stock. Compare the relative resistance to impact in line with and transverse to the direction of rolling.

Determine the cost of a given forging and evaluate the economic advisability of buying as opposed to making.

4. Safety precautions[1]

V. HEAT TREATMENT

A. OUTLINE OF INSTRUCTION
Class Hours 3

B. LABORATORY ACTIVITIES
Laboratory Hours 12

1. Hot working

2. Annealing

3. Quenching

Make hardness tests before and after heating and quenching specimens of several types of steel, using water, brine, oil, and air as quenching media. Wear face shield while quenching.

4. Carburizing

5. Spheroidizing

6. Hardening

7. Tempering

Compare effect of tempering on hardness, brittleness, and toughness of steel by comparing selected specimens of those tempered and not tempered following hardening.

8. Low-temperature working

9. Others

VI. SURFACE HARDENING

A. OUTLINE OF INSTRUCTION
Class Hours 2

B. LABORATORY ACTIVITIES
Laboratory Hours 12

1. Carburizing

   a. Pack
   b. Gas
   c. Liquid

Make microscopic inspections of carburized steels. Compare the structure of specimens taken from the hardened surface and the more ductile core.

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[1] Accident Prevention Manual for Industrial Operations (Chicago, Illinois: National Safety Council, 1964), Chapter 27, page 33, "Hammers"; page 45, "Upsetting"; page 47, "Presses".

2. Nitriding[2]

3. Cyaniding[3]

4. Flame and induction hardening

5. Hardface welding

X-ray a steel plate which has been hardfaced by welding. Note variation in grain structure.[4]

VII. ALLOYING

A. OUTLINE OF INSTRUCTION
Class Hours 2

B. LABORATORY ACTIVITIES
Laboratory Hours 8

1. Ferrous

a. Iron base
b. Carbon

Prepare several samples of iron with known carbon content; identify each with number punch and make hardness test. Heat each to a given temperature to include a range below, above, and at Critical Temperature. Remove, quench, make micro-examination and hardness tests. Compare effects of heat and carbon content on hardness as shown when data are graphed.

c. Vanadium
d. Tungsten
e. Molybdnum
f. Manganese
g. Silicone
h. Titanium
i. Others

(1) hi-nickel
(2) hi-chrome
(3) hi-carbon

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[2]Accident Prevention Manual for Industrial Operations (Chicago, Illinois: National Safety Council, 1964), Chapter 40, page 44, "Nitric Dioxide".
[3]Accident Prevention Manual for Industrial Operations (Chicago, Illinois: National Safety Council, 1964), Chapter 40, page 52, "Cyanides".
[4]Accident Prevention Manual for Industrial Operations (Chicago, Illinois: National Safety Council, 1964), Chapter 42, page 3, "Ionizing Radiation"; page 38, "Regulations and Controls".

(4) hi-yield
(5) hi-tensile

2. Non-ferrous

a. Copper
b. Aluminum
c. Manganese
d. Lead
e. Zinc

VIII. TESTING

A. OUTLINE OF INSTRUCTION Class Hours 3	B. LABORATORY ACTIVITIES Laboratory Hours 18
1. Microscopic sections a. Selecting representative sample b. Grinding and polishing c. Etching d. Examining with microscope	Prepare a specimen by grinding, polishing, and etching. Make a microscopic examination noting characteristics as indicated by instructor. Select 2-4 pieces of metal. Finish and polish one surface. Test each surface with an acid 1-3 minutes. Dip samples into neutralizing solution. Examine for degrees of corrosion--on finished surfaces, on unfinished surfaces. Polish for surface smoothness and study under microscope. Compare types of material and finishes.
2. Photomicrography	Use a photomicrograph to record the structure of metals prior to and following destructive testing.
3. Macroscopic etch	Make a macroscopic examination of cast and forge pieces by cutting, filing, polishing, and etching. Identify porosity, cracks, segregations, depth of carburization, etc., which are present.
4. Magnaflux and Zyglo	
5. Radiograph	Determine the voltage, exposure time, and critical geometrical positioning to make X rays of ferrous metals; use a floroscope for

	light metals such as aluminum, magnesium, etc. Identify shrinkage cavities, gas cavities, cracks, etc. in castings; slag inclusion, cracks, and incomplete fusion in welds.
6. Tensile testing a. Tensile strength b. Elastic limit c. Yield point d. Ultimate strength	Prepare 1-3 ferrous specimens for testing, using Hydraulic Universal Testing Machine. Record data for calculation for stress, strain, elasticity, ultimate strength, and yield point.
7. Compression	Make compression tests on non-ferrous metals, using a Universal Testing Machine. Note typical fractures and compare instrument readings with standard tables.
8. Impact	Perform Izod and Charpy tests with pendulum-type impact testing machine to determine foot-pounds required to fracture brittle specimens.
9. Fatigue	Use tension-compression type, rotation under bending-load type, or flexion type, fatigue-testing machines to examine resistance to fatigue and character of failure of various metals.
10. Hardness	
a. Brinell	Measure two diameters of the impression made, using a Brinell Hardness Tester. Calculate hardness number and compare with tables supplied with equipment. Calculate tensile strength where applicable from Brinell scale, using formula: T.S. (lb./in.^{2}) = 500 X Brinell number.
b. Rockwell	Make (standard and superficial) penetration tests with a Rockwell Tester for tool steel and case hardened steel.

c. Scleroscope

Make several indention tests for a given grade of metals using a scleroscope. Account for variation in reading and compare with standard tables.

d. Others

11. Spark

Practice identification of steels of varying hardness and carbon content by spark characteristics when grinding.

12. Ultrasonic testing

13. Die penetrant

IX. REVIEW

A. OUTLINE OF INSTRUCTION
Class Hours __

1. Review key areas.

2. Evaluate student's command of material.

3. Give additional emphasis to weak areas.

B. LABORATORY ACTIVITIES
Laboratory Hours __

Assign additional laboratory applications for reinforcement.

SUGGESTED TEXTS:

Either

Johnson, Carl G. and William R. Weeks. Metallurgy. 4th ed. Chicago, Illinois: American Technical Society, 1956.

or

Hultgren, Ralph. Fundamentals of Physical Metallurgy. New York: Prentice-Hall, Inc., 1952.

SUGGESTED REFERENCES:

Accident Prevention Manual for Industrial Operations. 5th ed. Chicago, Illinois: National Safety Council, 1964.

Chelyustkin, A. B. The Application of Computing Technique to Automatic Control Systems in Metallurgical Plants. New York: The Macmillan Book Company, 1964.

Frier, W. T. Elementary Metallurgy. 2nd ed. New York: McGraw-Hill Book Company, Inc., 1952.

Kehl, George Louis. The Principles of Metallographic Laboratory Practice. 3rd ed. New York: McGraw-Hill Book Company, Inc., 1949.

Liddicoat, R. T. and Philip O. Potts. Laboratory Manual of Materials Testing. New York: The Macmillan Book Company, 1952.

Reese, Lymon C. Materials Laboratory Manual. State College, Mississippi: Civil Engineering Department, 1955.

Rolfe, Robert Thatcher. A Dictionary of Metallography. New York: Tudor Publishing Company, 1955.

Taylor, Abraham. X-Ray Metallography. New York: John Wiley & Sons, Inc., 1961.

Umowski, Joseph S. Ferrous Metallurgy--Laboratory Manual. Chicago, Illinois: American Technical Society, 1960.

TMe 362

INSPECTION TECHNIQUE

2 Semester Hours

INTRODUCTION

The fact that an increasingly larger part of the production dollar now goes into inspection only emphasizes the need for a more intensive study of the use and care of precision and non-precision instruments, tools, and methods of industrial inspection.

In the classroom the study and understanding of theory and principle will be emphasized. The laboratory sessions will deal with the practical aspect of measuring devices, control limits, and optical and statistical methods of quality control and quality assurance. The care and calibration of all measuring instruments are emphasized inasmuch as this area is recognized as one of the specialties of the technician.

TMe 362. Inspection Technique. One lecture. Two hours laboratory. (2 semester hours credit). Classroom and laboratory examination of basic principles of modern industrial and aerospace inspection methods. Special emphasis is placed on calibration and care of all instruments.

MAJOR DIVISIONS

		Class Hours	Laboratory Hours
I.	Basic Concepts of Inspection	1	2
II.	Dimensional Control and Measurement	8	16
III.	Testing for Physical and Mechanical Properties	6	12
IV.	Statistical Methods of Quality Control	2	4
V.	Inspection Organization	1	2
VI.	Review		
	Total Class Hours	18	Total Laboratory Hours 36
	Total Suggested Clock Hours		54

I. BASIC CONCEPTS OF INSPECTION

A. OUTLINE OF INSTRUCTION Class Hours 1	B. LABORATORY ACTIVITIES Laboratory Hours 2
1. Understanding and appreciating industrial and aerospace inspection	
2. Origin and need	
a. Basic size limits	
b. Clearance and allowance	
c. Tolerance	
d. Interference	
e. Selective assembly	
f. Specifications	
(1) AISC	
(2) ASM	
(3) MILS	
(4) Lloyds of London	
(5) Others	
3. Classes of fits	Compute basic size of parts, allowance, and the maximum permissible clearance with information furnished by the teacher.
a. Selective	
b. Transition	
c. Zoning assembly	

II. DIMENSIONAL CONTROL AND MEASUREMENT

A. OUTLINE OF INSTRUCTION Class Hours 8	B. LABORATORY ACTIVITIES Laboratory Hours 16
1. Units of length	
a. English system	
b. Metric system	
2. Sight and touch	
3. Measurement	
4. Specifications of dimensions	Compute assigned problems dealing with decimals and fractions. Convert inches to millimeters and centimeters.
5. Non-precision measurement	Inspect machine parts, using non-precision measuring devices.

a. Tools of non-precision measurement b. Care and use of tools	
6. Precision measurement a. Micrometers b. Vernier calipers, gages c. Vernier micrometer d. Care and adjustments of micrometers and vernier calipers, gages e. Limits of precision measurement	Check the accuracy of micrometers and check measurements to the one thousandth of an inch. Compare two measurement methods.
7. Ring, plug, and snap gages a. Master gages b. Care of gages c. Gaging policy	Using go-no-go gages, snap, ring, and plug gages, inspect machine parts assigned by the instructor.
(1) Tolerances for gage-makers (2) Wear allowance (3) Human error	To show human error, graphically represent micrometer readings of the class on a large volume of parts.
8. Precision gage blocks a. Industrial function b. Tolerance and classification	Mathematically compute error by gage blocks due to heat and linear expansion problems to be selected by the instructor.
c. Care and use of gage blocks	Verify the accuracy of micrometers and verniers, using gage blocks.
9. Comparison measurement a. Uses of comparison measurement in inspection (1) Advantages (2) Limitations	
b. Care and adjustment of dial indicator and dial gages c. Mechanical and optical comparators d. Electrical and electronic comparators e. Air comparators f. Multicheck comparators g. Automatic gaging	Verify measurement, using comparison and indicating methods. Industrial problems are to be set up by instructor for comparison measurement.

10. Optical instruments in industrial inspection

    a. Microscopes
    b. Optical comparators
    c. Light-wave interference

        (1) Equipment
        (2) Principles of light-wave measurement

Using gage blocks and optical flats, check size of ball bearings, size and parallelism of steel block.

11. Precision angle measurement

    a. Basic tools
    b. Sine bar
    c. Simple indexing
    d. Sine plates

Mathematically compute angular measurements, using the gage blocks, sine bar, and simple indexing.

12. Tool-room specialties

    a. Surface plate
    b. Angle irons
    c. Parallels
    d. Squares and straight edges
    e. Level
    f. Thread wires

13. Ultrasonic measurement

14. Supramicrometer and measuring machine

15. Calibration and care of all measuring devices

III. TESTING FOR PHYSICAL AND MECHANICAL PROPERTIES

A. OUTLINE OF INSTRUCTION
Class Hours 6

1. Destructive testing

    a. Typical destructive test
    b. Impack testing
    c. Equipment used

2. Hardness testing

    a. Simple test for hardness
    b. Brinell hardness test
    c. Rockwell hardness test

B. LABORATORY ACTIVITIES
Laboratory Hours 12

Perform destructive testing of selected ferrous and non-ferrous metals, oak and pine, thermoplastic and thermosetting plastics, and cermets, using Universal Testing Machine.

3. Magnetic particles inspection a. Basic concepts of magnetism b. Problems of magnetism c. Equipment used	Make magnetic particle inspection of ferrous metals, using magnaflux equipment.
4. Non-magnetic methods of non-destructive testing a. Zyglo b. Stratiflux c. Partek d. Struscoat e. Liquid penetrant	Use Zyglo process to make crack tests in non-magnetic materials.
5. Industrial radiography[1] a. Radiographic process b. X-ray generation equipment c. Geometric principles in radiography d. Protection e. Application of industrial radiography	X-ray several welds and other mechanical parts, develop film, and analyze.[1]

IV. STATISTICAL METHODS OF QUALITY CONTROL

A. OUTLINE OF INSTRUCTION Class Hours 2	B. LABORATORY ACTIVITIES Laboratory Hours 4
1. Basic theory of quality control	
2. Quality control by attributes a. Sampling method b. Sample sizes	Using statistical methods and random sampling, charting, tolerance, and analysis charts, set up a quality control problem.
3. Quality control by variables a. Frequency distribution curve b. Range c. Sampling procedures	

[1] Accident Prevention Manual for Industrial Operations (Chicago, Illinois: National Safety Council, 1964), Chapter 42, "Ionizing Radiation".

d. Using the work sheet
e. Control limits and tolerances

V. INSPECTION ORGANIZATION

A. OUTLINE OF INSTRUCTION Class Hours 1	B. LABORATORY ACTIVITIES Laboratory Hours 2
1. The inspection problem of industry	
2. Relationship of inspection to overall industrial organization	
3. Internal organization	
a. Receiving inspection	Set up receiving inspection situation. Determine method of sampling and inspection. Prepare report indicating quality or acceptability of incoming materials with justification.
b. Shipping inspection c. Process inspection d. Other inspection	COMPREHENSIVE PROBLEM Plan a limited manufacturing process, indicating routing from beginning processes through to packaging. Determine the number of checkpoints needed and identify their locations. Indicate the features to be inspected on each part (overall length, hole spacing, etc.), the type of technique employed at each checkpoint (mechanical, electrical, etc.), and the necessary tools or equipment.

VI. REVIEW

A. OUTLINE OF INSTRUCTION Class Hours __	B. LABORATORY ACTIVITIES Laboratory Hours __
1. Review key areas.	Assign additional laboratory applications for reinforcement.
2. Evaluate student's command of material.	
3. Give additional emphasis to weak areas.	

SUGGESTED TEXT:

Michelon, Leno C. Industrial Inspection Methods. Rev. ed. New York: Harper & Row Publishers, 1950.

SUGGESTED REFERENCES:

Accident Prevention Manual for Industrial Operations. 5th ed. Chicago, Illinois: National Safety Council, 1964.

Dodge, Harold F. and Harry G. Romig. Sampling Inspection Tables: Single and Double Sampling. 2nd ed. New York: John Wiley & Sons, Inc., 1959.

Lytel, Allan. Industrial X-Ray Handbook. Indianapolis, Indiana: Howard W. Sams and Company, Inc.

TMe 473

STRENGTH OF MATERIALS

3 Semester Hours

INTRODUCTION

The objective of Strength of Materials is a study of the characteristics of industrial materials under work or load conditions and the nature of predictable change in external dimensions which result. Theory, explanation, and demonstration in class provide the student with sufficient background to make mathematical computations using standard references and to verify experimentally the nature and extent of changes under working conditions.

TMe 473. Strength of Materials. Two lectures. Two hours laboratory. (3 semester hours credit). A lecture and laboratory study of the stressing and deformation of modern industrial materials.

MAJOR DIVISIONS

		Class Hours	Laboratory Hours
I.	Strength of Materials as Related to Product Design	2	0
II.	Properties of Materials	3	0
III.	Introduction to Statics	4	2
IV.	Stress and Strain	4	4
V.	Welded Joints, Rivets, and Threaded Fasteners	4	4
VI.	Beams	3	4
VII.	Center of Gravity and Centroids	4	3
VIII.	Columns	4	8
IX.	Torsion--Shafts, Shaft Couplings, and Keys	4	8
X.	Combined Stresses	4	4
XI.	Review		
	Total Class Hours	36	Total Laboratory Hours 36

Total Suggested Clock Hours 72

I. STRENGTH OF MATERIALS AS RELATED TO PRODUCT DESIGN

A. OUTLINE OF INSTRUCTION
Class Hours 2

B. LABORATORY ACTIVITIES
Laboratory Hours 0

1. Strength
2. Weight
3. Sales appeal
4. Ease of manufacture
5. Availability and cost
6. Life of the product

II. PROPERTIES OF MATERIALS

A. OUTLINE OF INSTRUCTION
Class Hours 3

B. LABORATORY ACTIVITIES
Laboratory Hours 0

1. Strength
   a. Tension
   b. Compression
   c. Shear
   d. Bending
   e. Twisting
2. Elasticity
3. Stiffness
4. Resilience
5. Ductility
6. Hardness
7. Malleability
8. Toughness
9. Machinability
10. Fatigue
11. Creep
12. Durability

III. INTRODUCTION TO STATICS

A. OUTLINE OF INSTRUCTION Class Hours 4	B. LABORATORY ACTIVITIES Laboratory Hours 2
1. Composition and resolution of forces	
2. Conditions of equilibrium	
3. Inertia	
4. Moments	Use data supplied by the instructor to review the principle of moments by solving problems involving various beam lengths, load weights, and points, and support or fulcrum.

IV. STRESS AND STRAIN

A. OUTLINE OF INSTRUCTION Class Hours 4	B. LABORATORY ACTIVITIES Laboratory Hours 4
1. Load and unit stress	
2. Strain	
3. Hooke's Law	
4. Young's Modules	Determine the elastic limit, modulus of elasticity, and ultimate strength of a material supplied by the instructor. Verify experimentally with a strain gage by applying tension to the material and measuring strain for each unit of force; continue to add force to determine the elastic limit and ultimate strength.
5. Thermal stress	Using data supplied by the instructor, calculate the linear expansion and/or contraction of given materials for a 40-degree temperature change.
6. Pressure vessels	Calculate the change in the force on a given surface area of a cylinder with changes in internal pressure.
7. Factor of safety	Calculate the factor of safety for the above materials.

V. WELDED JOINTS, RIVETS, AND THREADED FASTNERS

A. OUTLINE OF INSTRUCTION Class Hours 4	B. LABORATORY ACTIVITIES Laboratory Hours 4
1. Welded joints	
2. Riveted joints	
3. Bolted joints	Prepare three joints using varying quality bolts. Calculate deformation of fastener and plate. Verify experimentally and represent graphically.
4. Typical problems	Using the three major fastening methods, prepare joints. Calculate the shear point of fastener, shear of plate or crushing of the plate. Use a universal tester to verify calculation. Graphically represent the comparative strengths of these methods. Examine cost and typical uses of each.

VI. BEAMS

A. OUTLINE OF INSTRUCTION Class Hours 3	B. LABORATORY ACTIVITIES Laboratory Hours 4
1. Types of beams	
a. Simple	
b. Cantilever	
2. Shapes of beams	
a. I beam	
b. Tubular	
(1) Round	
(2) Square	
3. Types of loads	
a. Uniform	
b. Concentrated	
4. Application of moments	
5. Reactions	

6. Bending	Use a transverse testing machine to verify calculations on bending of beams of various materials as assigned by instructor.
7. Shear	Calculate the load or pressure requirements for shear point of the above-mentioned beams.

VII. CENTER OF GRAVITY AND CENTROIDS

A. OUTLINE OF INSTRUCTION Class Hours 4	B. LABORATORY ACTIVITIES Laboratory Hours 3
1. Definition of center of gravity	Experimentally determine the center of gravity of irregularly shaped objects using the intersecting center-line technique. Suspend the object from line; locate the center line; change the position of the object and locate a second center line. Continue this process until the converging point of all center lines is determined.
2. Distinction between center of gravity and centroid	
3. Moment of inertia	
4. Practical application	Using a suspended platform on which the object is mounted, make appropriate measurements of distance and period of swing. Mathematically compute the moment of inertia from experimentally determined data.

VIII. COLUMNS

A. OUTLINE OF INSTRUCTION Class Hours 4	B. LABORATORY ACTIVITIES Laboratory Hours 8
1. Length / area ratio a. Short b. Medium or intermediate c. Long--Euler's formula	
2. Materials a. Steel b. Wood c. Concrete d. Plastics e. Aluminum and its alloys	

3. Strength

   a. Inversely as length
   b. Directly as area
   c. Directly as moment of inertia

4. Loading

   a. Buckling
   b. Ultimate

Calculate the buckling load and the ultimate load for columns of various lengths/area ratios and materials.

5. Bracing

   a. Rotation
   b. Translation

Use a universal testing machine to verify experimentally the above calculations.

Make comparisons of the relative strengths, costs, weights, and other characteristics of the above materials.

6. Shape

   a. I beam
   b. Tubing

Use a transverse testing machine to load beams of various shapes. Determine the bend moment and the vertical shear. Represent findings graphically.

IX. TORSION--SHAFTS, SHAFT COUPLINGS, AND KEYS

A. OUTLINE OF INSTRUCTION Class Hours 4	B. LABORATORY ACTIVITIES Laboratory Hours 8
1. Definitions	
2. Torsional shearing stress	
3. Angle of twist	
4. Power of transmission	Use a torsion tester to test shafts of known diameter, length, and composition for torsional deformation and ultimate stress resulting from various tangential load conditions.
5. Types of couplings	Repeat the above experiment for shaft couplings.
6. Stress in couplings	
7. Design of keys	Use a torsion tester to determine the shear points of keys of given sizes and metals.

Tabulate and plot findings. Compare with standard tables.

X. COMBINED STRESSES

A. OUTLINE OF INSTRUCTION
Class Hours 4

1. Principle of superposition
2. Combined axial and bending stresses
3. Eccentrically loaded, short-compression members
4. Eccentric loading of machine members
5. Combined shear stresses
6. Combined bending and tension

B. LABORATORY ACTIVITIES
Laboratory Hours 4

Use a universal testing machine to run complete tension and compression tests on ferrous and non-ferrous metals. Make computations and plot strain diagrams. Indicate elastic limit and ultimate strength of each material by calculation and experimental verification. Compare with standard tables.

XI. REVIEW

A. OUTLINE OF INSTRUCTION
Class Hours __

1. Review of key areas.
2. Evaluate student's command of material.
3. Give additional emphasis to weak areas.

B. LABORATORY ACTIVITIES
Laboratory Hours __

Assign additional laboratory applications for reinforcement.

SUGGESTED TEXT:

Pisani, Torquato J. Essentials of Strength of Materials. 3rd ed. Princeton, New Jersey: D. Van Nostrand Company, Inc., 1964.

SUGGESTED REFERENCES:

Breneman, John W. Strength of Materials. 3rd ed. New York: McGraw-Hill Book Company, Inc., 1965.

Goff, Robert H. and Donald E. Hardenbergh. Introduction to Engineering Statics. New York: Holt, Rinehart, & Winston, 1964.

Harris, Charles O. Strength of Materials. 2nd ed. Chicago, Illinois: American Technical Society, 1963.

Jensen, Alfred. Statics and Strength of Materials. New York: McGraw-Hill Book Company, Inc., 1962.

Parker, Harry. Simplified Mechanics and Strength of Materials. 2nd ed. New York: John Wiley and Sons, Inc., 1961.

Timoshenko, Stephen and D. H. Young. Elements of Strength of Materials. 4th ed. Princeton, New Jersey: D. Van Nostrand Company, Inc., 1962.

Trathen, Roland H. Statics and Strength of Materials. New York: John Wiley and Sons, Inc., 1954.

TMe 483

MOTION AND TIME STUDY

3 Semester Hours

INTRODUCTION

Lecture sections of this course impart principles of industrial methods and procedures for analyzing the manipulative activities of the production worker. Application is of equal importance. The technical student engages in analyses using typical industrial materials and equipment.

Laboratory activities include the analysis of the fundamental physical motions, the construction of various charts, the practice of dividing operations into elements, and time-study observations. Additional experience is gained in recognizing and giving value to foreign elements, allowances, and performance rating, and in calculating average cycle time, minimum observations, and standard times.

TMe 483. Motion and Time Study. Two lectures. Two hours laboratory. (3 semester hours credit). The systematic study of methods, materials, tools and equipment involved in motion and time studies. Laboratory practice centers around analysis of operational motions and time requirements as practiced in industry.

MAJOR DIVISIONS

		Class Hours	Laboratory Hours
I.	History of Methods Engineering	2	1
II.	Process Charts	4	4
III.	Operations Analysis	2	2
IV.	Motion Study	2	1
V.	Micromotion and Memomotion Study	2	4
VI.	Predetermined Time Systems	2	2
VII.	Factory Cost	2	2
VIII.	Time-Study Equipment	2	1
IX.	Elements of Time Study	2	2
X.	Performance Rating	4	4
XI.	Allowances	2	2
XII.	Standard or Allowed Time	2	2
XIII.	Standard Data and Formulas	4	4
XIV.	Work Sampling	2	3
XV.	Wage Payment Plans	2	2
XVI.	Review		
	Total Class Hours	36	Total Laboratory Hours 36

Total Suggested Clock Hours 72

I. HISTORY OF METHODS ENGINEERING

A. OUTLINE OF INSTRUCTION
Class Hours 2

1. Introduction

   a. The production function
   b. Scope of methods engineering and time study
   c. Methods engineering
   d. Time-study requirements
   e. Wage payment

2. Development of motion and time study

   a. Taylor and Gilbreth
   b. Motion study
   c. Early contemporaries
   d. Organizations
   e. Present trends

B. LABORATORY ACTIVITIES
Laboratory Hours 1

Laboratory orientation involves equipment and general procedures.

II. PROCESS CHARTS

A. OUTLINE OF INSTRUCTION
Class Hours 4

1. Introduction

2. Operation-process chart

3. Flow-process chart

4. Man-and-machine process chart

5. Gang-process chart

6. Operator-process chart

B. LABORATORY ACTIVITIES
Laboratory Hours 4

Make an operation-process chart.

Make a flow-process chart.

Make a man-and-machine process chart.

Make a gang-process chart.

III. OPERATIONS ANALYSIS

A. OUTLINE OF INSTRUCTION
Class Hours 2

1. Introduction

2. Purpose of operation

3. Design of part

B. LABORATORY ACTIVITIES
Laboratory Hours 2

Practice in motion analysis:

Determine method of doing a specific job. Establish a proposed method.

4. Tolerances and specifications

Determine best method of doing a particular job in terms of quantity and quality. Consider tooling and labor cost.

5. Material

6. Process of manufacture

7. Setup and tools

8. Working conditions

9. Material handling

10. Plant layout

11. Principles of motion economy

IV. MOTION STUDY

A. OUTLINE OF INSTRUCTION
Class Hours 2

1. Fundamental motions (Therbligs)

2. Principles of motion economy

3. Theory of motion economy

4. Motion analysis as applied in planning

B. LABORATORY ACTIVITIES
Laboratory Hours 1

Identify the fundamental motions in specific tasks and describe their function.

Construct an operations-instruction card.

V. MICROMOTION AND MEMOMOTION STUDY

A. OUTLINE OF INSTRUCTION
Class Hours 2

1. Introduction

   a. Preparation for a micromotion study
   b. Equipment

2. Motion pictures

   a. Analyzing the film
   b. Creating and improving method
   c. Teaching and standardizing the new method

B. LABORATORY ACTIVITIES
Laboratory Hours 4

Prepare micromotion study of typical assembly operation, using movie camera with cyclegraphic and chromocyclegraphic study. Analyze operations to eliminate wasted motion.

3. Other motion-study, photographic techniques

a. Monomotion study
b. Cyclegraphic and chromocyclegraphic study

Construct a simo-chart (simultaneous motion) for a specific assembling operation.

VI. PREDETERMINED TIME SYSTEMS

A. OUTLINE OF INSTRUCTION
Class Hours 2

1. Introduction

2. Definition

3. Predetermined time systems

a. Work factor
b. Methods--time measurement
c. Basic motion-time study
d. Motion-time analysis
e. Dimensional-motion times

B. LABORATORY ACTIVITIES
Laboratory Hours 2

Analyze specific operations in terms of the basic division of accomplishment and calculate the total cycle time by applying synthetic basic motion-time values.

VII. FACTORY COST

A. OUTLINE OF INSTRUCTION
Class Hours 2

1. Introduction

2. Job analysis

3. Job evaluation

a. Randing method
b. Classification method
c. Factor comparison method
d. Point system

4. Labor standards

5. Cost distribution

B. LABORATORY ACTIVITIES
Laboratory Hours 2

Make a tour of two or more production plants. Observe and compare the job evaluation methods employed in each. Evaluate the managerial policy for employing each.

6. Cost of accidents[1]

VIII. TIME-STUDY EQUIPMENT

A. OUTLINE OF INSTRUCTION
Class Hours 2

1. Necessary equipment

2. Auxiliary equipment

3. Special equipment

4. Forms

B. LABORATORY ACTIVITIES
Laboratory Hours 1

Convert decimal minutes to decimal hours as used in timing equipment.

IX. ELEMENTS OF TIME STUDY

A. OUTLINE OF INSTRUCTION
Class Hours 2

1. Analysis of materials and methods

2. Elemental breakdown

3. Types of studies

4. Taking the study

5. Rating

6. Allowances

7. Calculations--average cycle time, minimum cycles

B. LABORATORY ACTIVITIES
Laboratory Hours 2

Practice dividing operations into elements based on time-study observations of operation cycles. Record the time consumed by each element and the difficulties encountered.

Calculate average cycle time and minimum number of cycle-study requirements for the above.

X. PERFORMANCE RATING

A. OUTLINE OF INSTRUCTION
Class Hours 4

1. Necessity of rating

2. Concept of normal

3. Principles of rating

B. LABORATORY ACTIVITIES
Laboratory Hours 4

Analyze time-study data resulting from observations of different individuals performing the same task; compute the systematic error mean deviation and the absolute error for each person and for the group.

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[1] Engineering Consultation Service (Chicago, Illinois: Kemper Insurance, n.d.), Bulletin 278, "Accident Costs".
Accident Prevention Manual for Industrial Operations (Chicago, Illinois: National Safety Council, 1964), Chapters 10 and 12, "Cost Estimating for Accidents".

4. Rating method

5. Analysis of rating

6. Training for rating

Analyze time-study data and apply the more common techniques of performance rating such as skill and effort rating, objective rating, and synthetic rating.

XI. ALLOWANCES

A. OUTLINE OF INSTRUCTION
Class Hours 2

1. Types

a. Personal
b. Fatigue
c. Delay
d. Machining

2. Application of allowances

B. LABORATORY ACTIVITIES
Laboratory Hours 2

Using time-study data on an operation, calculate the standard time after determining and applying personal, fatigue, delay, and machining allowances as they apply to each element.

XII. STANDARD OR ALLOWED TIME

A. OUTLINE OF INSTRUCTION
Class Hours 2

1. Concept

2. Standard time

3. Types of standards

4. Maintenance of standards

B. LABORATORY ACTIVITIES
Laboratory Hours 2

Using time study of an operation, evaluate the time study and then compare it with standard-time data. Convert to decimal hour per hundred pieces and calculate operator efficiency.

XIII. STANDARD DATA AND FORMULAS

A. OUTLINE OF INSTRUCTION
Class Hours 4

1. Direct work standards

a. Observation sheet
b. Spread or comparison sheet
c. Manual and machine elements
d. Constants
e. Variables
f. Development of standard data
g. Application of data

2. Indirect work standards

a. Need

B. LABORATORY ACTIVITIES
Laboratory Hours 4

Develop standard times of constant and variable elements of various types of work and machines.

Make graphs, tables, and monograms showing standard times for press working, foundry operations, and machining operations.

b. Methods analysis
c. Types

XIV. WORK SAMPLING

A. OUTLINE OF INSTRUCTION
Class Hours 2

1. Details

2. Application

3. Control chart

4. Technique

B. LABORATORY ACTIVITIES
Laboratory Hours 3

Use the alignment chart to determine the number of observations required for a given degree of accuracy. Use the formula to check the accuracy of the alignment chart.

Conduct a simple work-sampling project.

XV. WAGE PAYMENT PLANS

A. OUTLINE OF INSTRUCTION
Class Hours 2

1. Direct financial plans

2. Indirect financial plans

3. Nonfinancial plans

B. LABORATORY ACTIVITIES
Laboratory Hours 2

Industrial field trip.

XVI. REVIEW

A. OUTLINE OF INSTRUCTION
Class Hours __

1. Review key areas.

2. Evaluate student's command of material.

3. Give additional emphasis to weak areas.

B. LABORATORY ACTIVITIES
Laboratory Hours __

Assign additional laboratory applications for reinforcement.

The techniques for making methods and operations analyses, as outlined in this course, are intended for use in methods engineering, operations analysis, production scheduling and process-flow chart preparation and not for the settling of jurisdictional matters or for the setting of wages or hours.

SUGGESTED TEXTS:

Either

Barnes, Ralph M. Motion and Time Study: Design and Measurement of Work. 5th ed. New York: John Wiley & Sons, Inc., 1963.

or

Nadler, Gerald. Motion and Time Study. New York: McGraw-Hill Book Company, Inc., 1955.

_____. Motion and Time Study, (Workbook). New York: McGraw-Hill Book Company, Inc., 1955.

SUGGESTED REFERENCES:

Accident Prevention Manual for Industrial Operations. 5th ed. Chicago, Illinois: National Safety Council, 1964.

Carson, Gordon B. Production Handbook. 2nd ed. New York: The Ronald Press Company, 1964.

Close, Guy C., Jr. Work Improvement. New York: John Wiley & Sons, Inc., 1960.

Engineering Consultation Service. Chicago, Illinois: Kemper Insurance, (n.d.).

Krick, Edward V. Methods Engineering. New York: John Wiley & Sons, Inc., 1962.

Lowry, Stewart M., Harold B. Maynard, and G. J. Stegemarten. Time and Motion Study and Formulas for Wage Incentives. 3rd ed. New York: McGraw-Hill Book Company, Inc., 1940.

Maynard, H. B. Industrial Engineering Handbook. 2nd ed. New York: McGraw-Hill Book Company, Inc., 1963.

Maynard, H. B., G. J. Stegemarten, and J. L. Schwab. Methods-Time-Measurement. New York: McGraw-Hill Book Company, Inc., 1948.

Mundel, M. E. Motion and Time Study. 3rd ed. New York: Prentice-Hall, Inc., 1960.

Niebel, Benjamin W. Laboratory Manual for Motion and Time Study. 3rd ed. Homewood, Illinois: Richard D. Irwin, Inc., 1962.

TMe 494

PRODUCTION PLANNING AND PROBLEMS

4 Semester Hours

INTRODUCTION

The objectives of this course are twofold: (1) to round out the production background of the student by presenting the factors involved in cost estimating, and (2) to point out the role of each segment of manufacturing production while emphasizing the planning and coordination required for effective operation.

Previous courses have concerned themselves with laboratory activities which were somewhat individual in nature. The comprehensive problem approach as set forth in the last major division of this course requires that the student combine these many separate knowledges and skills and apply them as a whole in analyzing and planning the manufacture of a given item.

A sample problem employing the comprehensive approach is found on page 197 of the appendix along with suggested steps of procedure in its solution. The technical instructor is encouraged to exercise his prerogative in assigning this problem or a similar one of greater or lesser difficulty and length in accord with the interests and abilities of his class. Regardless of the particular problem assigned, the procedure of production planning remains applicable.

Half of the contact time of this course has been allocated to the comprehensive problem. However, there is every indication that the number of hours necessary for completion is in excess of hours allotted. Outside work is encouraged. During scheduled laboratory periods, the instructor should guide and direct individual students in problem solving while encouraging use of laboratory and library facilities.

TMe 494. Production Planning and Problems. One lecture. Six hours laboratory. (4 semester hours credit). Examination of the factors involved in cost estimating. Identification of production problems and techniques of solution in lecture. Use of resource material in laboratory in application and problem solving.

MAJOR DIVISIONS

		Class Hours	Laboratory Hours
I.	Cost Estimating Methods	3	3
II.	Cost Estimating Elements	4	12
III.	Production Activities	3	10
IV.	Scientific Production Control	7	20
V.	Comprehensive Problem	1	63
	Total Class Hours	18	Total Laboratory Hours 108
	Total Suggested Clock Hours		126

I. COST ESTIMATING METHODS

A. OUTLINE OF INSTRUCTION Class Hours 3	B. LABORATORY ACTIVITIES Laboratory Hours 3
1. Introduction	
2. Estimating requirements	
3. General methods a. Weights, sizes, and commercial shapes b. Equipment costs and equipment life	Determine shape weights of forgings and castings. Determine cut weights, bar weights, and consumed weights of fabricated materials.
4. The detail method	
5. The basic time study method	
6. The ratio method	
7. Estimating forms	

II. COST ESTIMATING ELEMENTS

A. OUTLINE OF INSTRUCTION Class Hours 4	B. LABORATORY ACTIVITIES Laboratory Hours 12
1. Use of graphs and tables	
2. Preparation time (setup)	
3. Tool maintenance	
4. Performance time	Construct feed, speed, and rpm charts and graphs.
5. Personal allowances	
6. Process loss allowances	
7. Number of operations and passes	
8. Sequence of operations	Determine machining times, setup times, and handling times for various specified jobs.
9. Quality of requirements	
10. Materials	

11. Labor and burden rates

12. Departmental costs

Calculate the total cost of manufacturing specified items in given quantities in terms of applicable factors.

13. Difficulty factors

III. PRODUCTION ACTIVITIES

A. OUTLINE OF INSTRUCTION
Class Hours 3

1. Scheduling

2. Machine loading

3. Design changes

4. Methods improvement

5. Inventory

6. Work areas

7. Work hazards

8. Scrap and salvage

9. Processing

10. Maintenance

11. Balancing production lines

B. LABORATORY ACTIVITIES
Laboratory Hours 10

Schedule for production specified jobs in quantity, having several component parts and given target dates. Consider material in stock, lead time, scrap ratio, processing techniques, machine loads, and possible change in design to reduce and simplify operations.

Solve problems in production-line balancing by equating time standards, number of personnel, combining and eliminating operations, reducing elemental times, changing feeds and speeds, and introducing special-purpose machines.

IV. SCIENTIFIC PRODUCTION CONTROL

A. OUTLINE OF INSTRUCTION
Class Hours 7

1. Linear programming

B. LABORATORY ACTIVITIES
Laboratory Hours 20

a. Index method	Solve order problems, using the index method in which several orders are programmed on a given number of machines, and have specified standard times for each piece and machine hours available.
b. The modified distribution method	Solve problems in linear programming, using the modified distribution method, with specific order loads, available machine times, standard pieces per hour, and cost per piece.
c. Simplex method (introduction)	
2. Economic order quantity	
a. Computing standard-order quantity	
b. Economic-order quantity formula	
c. To make vs. to buy	Estimate engineering, founding, forging, stamping, machining, assembling, packaging, and shipping costs and set up production scheduling for a typical industrial product.

V. COMPREHENSIVE PROBLEM

A. OUTLINE OF INSTRUCTION
Class Hours 1

1. Problem assignment

2. Orientation

3. Procedure

B. LABORATORY ACTIVITIES
Laboratory Hours 63

Plan the production of an assigned item, following the steps of procedure as outlined in the sample problem found on page 197 in the appendix. Beginning with the acceptance of a design, prepare detailed assembly drawings; make cost estimates; determine required parts and raw materials; process and fabricate. Problem is completed with assembly employing a final inspection prior to packaging.

SUGGESTED TEXTS:

Either

Carson, Gordon B. Production Handbook. 2nd ed. New York: The Ronald Press Company, 1964. $15.60.*

or

Wilson, Frank W. (editor in chief). Manufacturing Planning and Estimating Handbook. New York: McGraw-Hill Book Company, Inc., 1963. $22.50.*

SUGGESTED REFERENCES:

Accounting Manual for the Tool and Die Industry. Cleveland: National Tool & Die Manufacturers Association, 1959.

Carson, Gordon B. Production Handbook. 2nd ed. New York: The Ronald Press Company, 1964.

Koepke, Charles A. Plant Production Control. 3rd ed. New York: John Wiley & Sons, Inc., 1961.

Mallick, Rudolph W. and Armand T. Gaudreau. Plant Layout: Planning and Practice. New York: John Wiley & Sons, Inc., 1951.

Voris, William. Production Control. Homewood, Illinois: Richard D. Irwin, Inc., 1961.

Wilson, Frank W. (editor in chief). Manufacturing Planning and Estimating Handbook. New York: McGraw-Hill Book Company, Inc., 1963.

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*While the cost of these books makes questionable the advisability of requiring purchase by students, examination reveals that each is a rich source of information on production planning and estimating, and both are excellent single-volume compilations.

SUPPORTING TECHNICAL COURSES

FOR THE

MECHANICAL TECHNOLOGY CURRICULUM

SGr 113 Mechanical Drafting I

SGr 223 Mechanical Drafting II

SMa 113 Technical Math I (Algebra)

SMa 223 Technical Math II (Trigonometry)

SMa 333 Technical Math III (Analytical Geometry & Calculus)

SSc 213 Physics I (Properties of Matter and Mechanics)*

SSc 323 Physics II (Heat, Light, and Sound)*

SSc 433 Physics III (Electricity and Magnetism)*

*Adapted, with permission, from outlines prepared by Curriculum Laboratory, Department of Community Colleges, State Board of Education, Raleigh, North Carolina.

INTRODUCTION

This beginning course is for those with little or no drafting experience. It assumes a background of plane geometry and arithmetic fundamentals.

The principal objective is to give the student a new communication tool--the language of industry. Additional objectives are to develop sketching-instrument drawing ability, to add greater depth in understanding of mechanical processes, and to introduce the area of tool design.

The course is developed as three two-hour laboratories to gain maximum contact time. Lecture-laboratory ratio is about 1-5. Lecture sessions are scheduled as needed for progress.

SGr 113. Mechanical Drafting I. Six hours laboratory. (3 semester hours credit). Theory and practice in sketching and instrument drafting. Orthographic projection and pictorial representation of mechanical objects.

MAJOR DIVISIONS

		Laboratory Hours
I.	Fundamentals	2
II.	Lettering	2
III.	Sketching of Elementary Orthographics	12
IV.	Isometric and Oblique Pictorial Sketching	12
V.	Geometric Construction	10
VI.	Multiview Projection and Dimensioning	16
VII.	Scales	3
VIII.	Sections and Conventions	15
IX.	Fasteners	18
X.	Auxiliary Views	18
XI.	Review	
	Total Laboratory Hours	108

I. FUNDAMENTALS

A. OUTLINE OF INSTRUCTION	B. LABORATORY ACTIVITIES Laboratory Hours 2
1. Function of drafting in design and production	
2. Equipment and supplies a. Standard drafting b. Drafting media c. Reproduction equipment d. Reproduction media	Examine drafting equipment, including: drafting machines, instruments, triangles, irregular curves, scales, templates, pencils, pens, ink, paper types, and cleaning equipment.
3. Alphabet of lines a. Widths of lines b. Meaning of lines c. Proper method of drawing	Practice line technique, including coding and width.
4. Sheet layout a. Typical sheet sizes b. Borders and title blocks c. Arrangement of lettering	Lay out various borders and title blocks. Calculate placement of these for various paper sizes.

II. LETTERING

A. OUTLINE OF INSTRUCTION	B. LABORATORY ACTIVITIES Laboratory Hours 2
1. Lettering styles a. Gothic b. Roman c. Italic d. Text	Develop border system, title strip, and guide lines to be used in the exercises to be assigned in lettering practice.
2. Composition a. Uniformity b. Stability c. Condensed d. Extended	
3. Guide lines a. Horizontal b. Vertical c. Inclined	Prepare lettering guide sheet for vertical upper case Gothic; space horizontal lines one-half inch apart down entire length of sheet.

4. Types

a. Lightface
b. Boldface
c. Vertical

(1) Upper case
(2) Lower case

d. Inclined

(1) Upper case
(2) Lower case

Exercise lettering techniques for:
a. upper case vertical
b. upper case inclined
c. lower case vertical
d. lower case inclined.

As skill develops, reduce spacing to ¼". Continue lettering practice with outside assignments.

5. Lettering instruments

a. Ames lettering instrument
b. Braddock and Rowe
c. Leroy lettering device
d. Wrico lettering device
e. Grid back-up sheets

Use drafting equipment to draw lettering guide lines as previously indicated. Practice lettering technique with assigned instruments.

III. SKETCHING OF ELEMENTARY ORTHOGRAPHICS

A. OUTLINE OF INSTRUCTION

B. LABORATORY ACTIVITIES
Laboratory Hours 12

1. Sketching

a. Materials
b. Line and arc technique
c. Estimating size and proportion
d. Choosing scale
e. Two-dimension figures

Sketch straight line and arcs.

2. Orthographic projection

a. Definition
b. Principal planes
c. Principal views
d. Projecting points
e. Quality of finished sketches

Sketch simple geometric solids to develop sense of proportion, ability to select and align views, and to recognize precedent of lines.

Sketch four plates involving objects having arcs, angles, holes, slots, grooves, etc.

IV. ISOMETRIC AND OBLIQUE PICTORIAL SKETCHING

A. OUTLINE OF INSTRUCTION

B. LABORATORY ACTIVITIES
Laboratory Hours 12

1. Isometric sketching

   a. Materials
   b. Principles

      (1) Isometric projection
      (2) Isometric drawing

   c. Techniques

      (1) Blacking in
      (2) Isometric and non-isometric lines
      (3) Angles in isometric drawing
      (4) Isometric ellipses
      (5) Arcs and curves
      (6) Sections
      (7) Intersections

Sketch simple isometrics and obliques composed of straight lines only; sketch additional pictorials having curved surfaces. Emphasize technique of "blocking".

Assign additional pictorials, using instruments and dimensioning completely, as these areas are developed in lecture sessions.

2. Oblique sketching

   a. Cavalier drawing principles
   b. Cabinet drawing principles
   c. Positioning of object
   d. Steps in oblique drawing
   e. Offset measurements
   f. Ellipses
   g. Arcs and curves
   h. Angles
   i. Sections

V. GEOMETRIC CONSTRUCTION

A. OUTLINE OF INSTRUCTION

1. Bisecting arcs, lines, and angles

   a. Compass and triangle
   b. Triangle and T square

2. Parallel and perpendicular lines

   a. Compass and straight edge
   b. T square and triangle
   c. Drafting machine

B. LABORATORY ACTIVITIES
Laboratory Hours 10

Use instruments and equipment in geometric-construction techniques as described in lecture outline. Assign one or more problems involving the proper procedure in the execution of methods listed in topics 1 through 5.

3. Dividing a line into equal parts

   a. Conventional method
   b. Method preferred by draftsmen

4. Constructing regular polygons

   a. Conventional methods
   b. Methods preferred by draftsmen

5. Tangents

   a. Circle tangent to a line at a given point
   b. Tangent to a circle through a point
   c. Tangents to two circles
   d. Line through a given point and tangent to an arc
   e. Tangent arc to two lines at right angles
   f. Tangent arc to two lines at acute or obtuse angles
   g. Tangent arc to an arc and a straight line
   h. An arc tangent to two arcs
   i. An arc tangent to two and enclosing one or both
   j. A series of tangent arcs conforming to a curve
   k. Tangent arcs forming an ogee curve
   l. A curve tangent to three intersecting lines

6. Constructing ellipses

   a. Axes and foci method
   b. Trammel method
   c. Concentric-circle method
   d. Ellipse on conjugate diameters
   e. Parallelogram ellipse
   f. Approximate ellipse

Construct six ellipses: one by each method listed at the left. Each student must make his own Trammel for use in constructing the ellipse by the Trammel method.

7. Parabola

   a. Given focus and directrix

Construct parabolas using at least two of the four methods listed by which a parabola may be constructed.

b. Given rise and span
c. Given rectangle or parallelogram
d. Given two points to join by a parabolic curve

8. Hyperbola

9. Involute

10. Spiral of Archimedes

11. Cycloid

12. Epicycloid

13. Hypocycloid

14. Helix

Construct one drawing of each geometric construction listed under topic 8 through 14.

Outside assignments may be made on the drawings listed above.

VI. MULTIVIEW PROJECTIONS AND DIMENSIONING

A. OUTLINE OF INSTRUCTION

1. Relationship of views to folding line

   a. Conventional placement of views
   b. Alternate positions of views
   c. Partial-view location
   d. Removed-views location

2. Angles of projection

   a. First-angle projection
   b. Third-angle projection

3. Lines

   a. Visible lines
   b. Invisible lines
   c. Center lines
   d. Lines produced by the intersection of two surfaces
   e. Omission of line at the intersection of two surfaces

B. LABORATORY ACTIVITIES

Laboratory Hours 16

Use instruments and equipment to draw simple geometric solids. Emphasize relationship of views to each other and the placement of reference and miter lines.

Assign more complex geometric solids having covered surfaces, symmetrical holes, and hidden lines. Emphasize proper line techniques.

4. Surfaces

   a. Normal surfaces
   b. Inclined surfaces
   c. Oblique surfaces
   d. Curved surfaces

5. Curves

   a. Fillets
   b. Rounds
   c. Runouts

6. Theory and technique of dimensioning

   a. True-position dimensions
   b. Maximum material condition
   c. Lines
   d. Arrowheads
   e. Fractional and decimal dimensions
   f. Leaders
   g. Fillets and rounds
   h. Finish marks
   i. Notes

7. Dimensioning rules

8. Special dimensions

   a. Mating dimensions
   b. Machine pattern and forging dimensions
   c. Notes in dimensioning

9. Preference in dimensioning

   a. Function dimensions
   b. Shop processes

10. Rules for dimensioning isometric and oblique drawings

11. Terms and definitions

    a. Dimension line
    b. Extension line
    c. Arrowheads
    d. Leaders
    e. Notes
    f. Finish marks

Assign various problems of some difficulty, requesting the projection of points among adjacent views to complete a third view. Emphasize use of projection lines and techniques. Dimension the preceding simple instrument drawings.

g. Dimension figures

12. Classes of fit

a. Running and sliding fits

b. Location fits
c. Force fits
d. Tolerances

Assign one or more plates that involve the proper execution of the designation of the various fits listed under "Classes of fit".

Assign one plate to show the proper method of dimensioning tolerances.

13. Surface-quality control

a. Roughness
b. Waviness
c. Lay

Indicate properly the surface qualities listed in the lecture column on at least one drawing.

14. Machine finishes

a. Ream
b. Grind
c. Hone
d. Lap, polish, super-finish

Use correct method to indicate machine finishes: ream, grind, hone, lap, and polish on one or more drawings.

VII. SCALES

A. OUTLINE OF INSTRUCTION

1. Engineer's

2. Architect's

3. Metric

B. LABORATORY ACTIVITIES
Laboratory Hours 3

Use all scales in the measurement of and the drawing of line segments. Drawings hereafter will include those other than FULL SIZE.

VIII. SECTIONS AND CONVENTIONS

A. OUTLINE OF INSTRUCTION

1. Function of sectional views

2. Cutting plane

a. Representation on working drawing
b. Location of cutting plane line
c. Direction of sight

3. Classification of sections

B. LABORATORY ACTIVITIES
Laboratory Hours 15

Section selected problems to illustrate various types of sectioning and conventional practice.

At least one problem involving each type of section is recommended.

a. Full sections
b. Half sections
c. Broken-out sections
d. Revolved sections
e. Aligned sections

4. Section lining

a. Codes
b. Spacing
c. Angle and direction

5. Conventions

Execute properly the conventional practices listed under Conventions in lecture.

a. Cutting plane lines
b. Section lines (A.S.A.)
c. Spokes, arms, ribs, and lugs in section
d. Breaks

6. Dimensioning

Dimension the previously prepared sections and conventions.

IX. FASTENERS

A. OUTLINE OF INSTRUCTION	B. LABORATORY ACTIVITIES Laboratory Hours 18
1. Types	
a. Removable	
b. Permanent	
2. Screw threads	
a. Types and uses	
b. Terms and definitions	
c. Thread forms, series, and classes	
d. Tapped holes	
e. Detailed representations	Assign problem involving representation of the various forms of screw threads, classes of fit, and notes.
f. Semi-conventional representation	
g. Conventional representations (A.S.A. thread symbols)	
h. Thread notes and specifications	

3. Threaded fasteners a. Types b. Proportions c. Detailed and conventional representations d. Notes and specifications	Represent fasteners listed in instructional column, using appropriate tables and formulas.
4. Keys and pins a. Types b. Detailed and conventional representations c. Notes and specifications	Represent the types and shapes covered in instruction column, following standard tables as to size, fit, and dimensions.
5. Rivets a. Types and uses b. Proportions c. Detailed and conventional representations d. Notes and specifications	
6. Springs a. Types and uses b. Detailed and conventional representation c. Notes and specifications	Using tables and dimensions, assign problem involving extension, compression and torsion springs.
7. Welds	

X. AUXILIARY VIEWS

A. OUTLINE OF INSTRUCTION	B. LABORATORY ACTIVITIES Laboratory Hours 18
1. Function of auxiliary views	
2. Classification of surfaces	
3. Primary auxiliary views--width, depth, height, auxiliaries a. Direction of sight b. Reference plane c. Projection technique d. Transfer of measurements e. Auxiliary view from a principal view f. Principal view from an auxiliary view	Develop a true shape and size primary auxiliary surface by projecting and transferring from principal views; assign a more complex problem and require development of complete object.

g. Dihedral angles
h. Plotted curves

4. Partial auxiliary views

5. Half auxiliary views

6. Auxiliary sections

7. Secondary auxiliary views

8. Descriptive geometry applied to true measurements of lines, angles, and surfaces

Develop a true shape and size secondary auxiliary surface from principal views; assign a more complex problem requiring development of the complete object.

XI. REVIEW

A. OUTLINE OF INSTRUCTION

1. Review key areas.

2. Evaluate student's command of material.

3. Give additional emphasis to weak areas.

B. LABORATORY ACTIVITIES
Laboratory Hours __

Assign additional laboratory applications for reinforcement.

SUGGESTED TEXTS:

Either

Giesecke, Frederick E., Alva Mitchell, and Henry Cecil Spencer. Technical Drawing. 4th ed. New York: The Macmillan Company, 1958.

or

Zozzora, Frank. Engineering Drawing. 2nd ed. New York: McGraw-Hill Book Company, Inc., 1958.

SUGGESTED REFERENCES:

French, Thomas E. and Charles J. Vierck. A Manual of Engineering Drawing for Students and Draftsmen. 9th ed. New York: McGraw-Hill Book Company, Inc., 1960.

Giachino, J. W. and Henry J. Beukema. Drafting and Graphics. Chicago, Illinois: American Technical Society, 1961.

Grant, Hiram E. Practical Descriptive Geometry. 2nd ed. New York: McGraw-Hill Book Company, Inc., 1965.

Luzadder, Warren J. Fundamentals of Engineering Drawing. 5th ed. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1965.

Pare, Eugene G. and Others. Introduction to Engineering Design. New York: Holt, Rinehart, & Winston, 1963.

INTRODUCTION

This course complements SGr 113 and was constructed with the same objectives in mind. The fundamental areas of mechanical drafting are completed, and several special allied fields are introduced. This branching into special areas is justified because of the frequency of contact with other areas which the mechanical technician will experience.

SGr 223. Mechanical Drafting II. Six hours laboratory. (3 semester hours credit). A continuation of drafting fundamentals with an introduction to specialized areas such as architectural drafting, structural drafting, electrical drafting, and basic tool design.

MAJOR DIVISIONS

		Laboratory Hours
I.	Working Drawings	12
II.	Intersections & Developments	8
III.	Gears	8
IV.	Cams	8
V.	Architectural Drawings	6
VI.	Structural Drawings	6
VII.	Electricity - Electronics Drawings	6
VIII.	Pipe Drawings	6
IX.	Welding Drawings	10
X.	Charts, Graphs, Nomographs	4
XI.	Basic Tool Design	34
XII.	Review	
	Total Laboratory Hours	108

I. WORKING DRAWINGS

A. OUTLINE OF INSTRUCTION

B. LABORATORY ACTIVITIES
Laboratory Hours 12

NOTE: The emphasis in applying dimensions to working drawings requires that the draftsman be aware of the shop processes. Remember that dimensions are for the craftsman who forms or fabricates the objects, not for the draftsman in preparing the layout.

1. Detail drawing

   a. Layout and arrangement
   b. Types

      (1) Pattern-shop detail
      (2) Forging details
      (3) Machine details
      (4) Welding details
      (5) Stamping drawing

Make detail drawings for the processes and uses listed at the left. Emphasize accuracy and retain plate for use in developing an assembly drawing.

2. Assembly drawings

   a. General-assembly drawing

      (1) Views
      (2) Dimensions
      (3) Hidden lines
      (4) Identification of part

   b. Detail assembly
   c. Diagram assembly
   d. Working-drawing assembly
   e. Installation assembly
   f. Check assembly

Use previously made detail drawings in making assembly drawings of major types.

Design a simple machine, including in this machine permanent and removable fasteners and various machine processes; follow standard drafting-room practices.

Assign various drafting room practices (working orders, change orders, revisions, etc.)

3. Sectioning assembly drawings

II. INTERSECTIONS AND DEVELOPMENTS

A. OUTLINE OF INSTRUCTION

B. LABORATORY ACTIVITIES
Laboratory Hours 8

1. Intersections

   a. Classification of surfaces

      (1) Ruled surfaces
      (2) Single-curved surfaces
      (3) Warped surfaces

b. Common geometric solids
c. Intersection of solids by planes

(1) Plane surfaces
(2) Curved surfaces

d. Applications to design problems

Draw two views of simple geometric solids intersected by planes; by other geometric solids.

2. Developments

a. Types of surfaces

(1) Developable
(2) Nondevelopable or approximate

b. Types of developments

(1) Intersection of plane and prism
(2) Intersection of plane and cylinder
(3) Intersection of plane and oblique prism
(4) Intersection of plane and oblique cylinder
(5) Intersection of plane and pyramid
(6) Intersection of plane and cone
(7) Truncated oblique-rectangular prisms
(8) Oblique cones (triangulation method)
(9) Transition pieces
(10) Intersecting prisms
(11) Intersecting cylinders
(12) Intersecting prisms and cones
(13) Intersecting cylinders and cones
(14) Intersecting cylinder and sphere

Given necessary views, make developments of assigned surfaces of appropriate types as listed at the left.

c. Methods of development

(1) Auxiliary views
(2) Rotation
(3) Triangulation
(4) Gore method
(5) Zone method

III. GEARS

A. OUTLINE OF INSTRUCTION

1. Types of gears
   a. Spur
   b. Rack
   c. Internal
   d. Pinion
   e. Bevel
   f. Miter
   g. Helical
   h. Worm
   i. Roller chain and sprockets
2. Standard spur-gear terms
3. Spur-gear tooth profile
4. Detail drawings of gears
5. Rack and pinion
6. Bevel and miter gears
7. Formulas
8. Splines
9. Serrations
10. Bearing
    a. Types
    b. Selection
    c. Representing bearing on drawing
11. Notes for gears

B. LABORATORY ACTIVITIES

Laboratory Hours 8

Draw various elementary-gear types and parts, using standard formulas and tables.

Make a full-size drawing of pinion engaging a ring gear; show how teeth mesh; construct teeth exactly and note any interference.

IV. CAMS

A. OUTLINE OF INSTRUCTION

1. Followers--types
2. Cam motion--kinds

B. LABORATORY ACTIVITIES

Laboratory Hours 8

Assign problems involving selected cam representations and motion diagrams, using standard formulas and tables.

3. Motion diagrams--kinds

4. Profiles--types

V. ARCHITECTURAL DRAWING (INTRODUCTION)

A. OUTLINE OF INSTRUCTION

1. Architectural-drawing techniques

2. Architectural-drawing standards

   a. Symbols
   b. Units
   c. Handbooks

3. Classification

   a. Floor plans
   b. Elevations
   c. Special layouts
   d. Sections
   e. Details

B. LABORATORY ACTIVITIES
Laboratory Hours 6

Draw a simple floor plan and elevation with representative details for a two-bedroom house.

VI. STRUCTURAL DRAWING (INTRODUCTION)

A. OUTLINE OF INSTRUCTION

1. Classification of structural drawings

2. Structural materials

   a. Shapes
   b. Connectors
   c. Floor and erection plans
   d. Riveting
   e. Welding
   f. Calculations
   g. Handbooks
   h. Working drawings and conventions
   i. Materials and corrosion factors

      (1) Ferrous
      (2) Non-ferrous

B. LABORATORY ACTIVITIES
Laboratory Hours 6

Assign detail drawings from wood, steel, and concrete structural assemblies. Use standard texts, references, and tables.

j. Material expansion

(1) Ferrous
(2) Non-ferrous

3. Timber structures

a. Materials
b. Trusses
c. Connectors
d. Working drawings and conventions
e. Material protection and preservation

4. Masonry structures

a. Materials

(1) Brick
(2) Tile and terra cotta
(3) Stone

b. Basic construction details
c. Drafting conventions

5. Reinforced concrete

a. Types of drawings

(1) Engineering
(2) Placing

b. Manual of standard practice
c. Drawings, sections, and conventions

6. Notes on structural drawing

VII. ELECTRICAL-ELECTRONICS DRAWINGS

A. OUTLINE OF INSTRUCTION

1. Diagrams

a. Single wire
b. Schematic

2. Electrical drafting techniques

3. Electrical symbols

B. LABORATORY ACTIVITIES
Laboratory Hours 6

Use electrical symbols to make a wiring diagram of a shop or small office building.

4. Typical electrical circuits

Use electronic symbols to draw a simple schematic of an electronic instrument.

5. Electrical charts

6. Notes on electrical drawings

VIII. PIPE DRAWINGS

A. OUTLINE OF INSTRUCTION

B. LABORATORY ACTIVITIES
Laboratory Hours 6

1. Types of pipes and tubes

   a. Steel and wrought iron
   b. Cast iron
   c. Copper
   d. Aluminum
   e. Stainless steel
   f. Plastics

2. Pipe joints and fittings

   a. Fittings
   b. Joints

Make one isometric or orthographic drawing, using selected pipe joints and/or fittings.

3. Valves

   a. Globe
   b. Check
   c. Gate

4. Pipe threads

5. Hangers and supports

   a. Rod
   b. Pipe

6. Pipe specifications and dimensions

7. American Standard code

8. Piping symbols

Make one schematic involving symbols in piping drafting.

9. Piping drawings

   a. Orthographic
   b. Isometric

10. Insulation materials and clearances

11. Notes for pipe drawings

IX. WELDING DRAWINGS

A. OUTLINE OF INSTRUCTION

1. Welding processes

   a. Oxyacetylene
   b. Metallic arc
   c. Carbon arc
   d. Stud Welding
   e. Atomic hydrogen
   f. Inert gas welding
   g. Automatic and semi-automatic
   h. Thermit welding
   i. Spot welding
   j. Pulsation welding
   k. Projection welding
   l. Seam welding
   m. Flash welding
   n. Forge welding

2. Bonding processes

   a. Brazing
   b. Soft soldering
   c. Plastics

3. Types of joints

   a. Butt joint
   b. Corner joint
   c. Tee joint
   d. Lap joint
   e. Edge joint

4. Types of welds

   a. Fillet
   b. Plug or slot
   c. Groove

5. Welding symbols

   a. General explanation of welding symbols
   b. Fillet-weld symbols

B. LABORATORY ACTIVITIES

Laboratory Hours 10

Make a prearranged visit to a welding shop to observe welding and bonding processes, types of joints, and types of welds.

Represent joint types, weld types, and welding methods, using standard symbols.

c. Plug-weld symbols
d. Slot-weld symbols
e. Arc-spot weld symbols
f. Arc-seam weld symbols
g. Groove-weld symbols
h. Flange-weld symbols
i. Resistance-spot weld symbols
j. Resistance-seam weld symbols
k. Projection-weld symbols
l. Flash-or upset-weld symbols

X. CHARTS, GRAPHS, AND NOMOGRAPHS

A. OUTLINE OF INSTRUCTION

B. LABORATORY ACTIVITIES
Laboratory Hours 4

1. Purpose

2. Terminology

a. Chart
b. Graph
c. Axis
d. Absissa
e. Ordinate
f. Origin
g. Coordinate
h. Plot
i. Fair
j. Scale
k. Independent variable
l. Dependent variable

3. Types

Draw the following charts and graphs:

a. Bar

A simple bar chart to show a comparison of two items.

b. Pie

A simple pie chart to show components adding to a total.

c. Pictorials
d. Trilinear

A simple trilinear chart to show the relationship among three items.

e. Rectilinear

A simple rectilinear chart to demonstrate the continuity of relationship between two items.

f. Nomographs

A simple nomograph which simplifies the calculation of the value of a dependent variable when the value of an independent variable is known.

g. Others

XI. BASIC TOOL DESIGN

A. OUTLINE OF INSTRUCTION

B. LABORATORY ACTIVITIES
Laboratory Hours 34

1. Jigs and fixtures

a. Classification of jigs
b. Classification of fixtures
c. Jig and fixture details
d. Design procedure

Design a diameter drill jig for drilling a hole in a pin.

Design a milling fixture for either face milling or end milling. Provide set-up gages. State the kind and size of mill for which the fixture is designed.

Design a lathe fixture for turning, facing, boring, and tapping operations.

2. Punches and Dies

a. Classification
b. Presswork operations
c. Punch and die details
d. Special dies
e. Punch and die design

Design a simple blanking and piercing die to punch out a specific workpiece.

XII. REVIEW

A. OUTLINE OF INSTRUCTION

B. LABORATORY ACTIVITIES
Laboratory Hours __

1. Review key areas.

2. Evaluate student's command of material.

3. Give additional emphasis to weak areas.

Assign additional laboratory applications for reinforcement.

SUGGESTED TEXTS:

Either

Giesecke, Frederick E., Alva Mitchell, and Henry Cecil Spencer. Technical Drawing. 4th ed. New York: The Macmillan Company, 1958.

or

Zozzora, Frank. Engineering Drawing. 2nd ed. New York: McGraw-Hill Book Company, Inc., 1958.

SUGGESTED REFERENCES:

American Society of Tool and Manufacturing Engineers. Die Design Handbook. New York: McGraw-Hill Book Company, Inc., 1955.

Bishop, Calvin C. Electrical Drafting & Design. 3rd ed. New York: McGraw-Hill Book Company, Inc., 1952.

Cole, Charles Bradford. Tool Design. Chicago, Illinois: American Technical Society, 1941.

Hornung, William J. Architectural Drafting. 3rd ed. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1960.

Ostergaard, D. Eugene. Basic Diemaking. New York: McGraw-Hill Book Company, Inc., 1963.

Sloane, Roscoe C. and John M. Montz. Elements of Topographic Drawing. 2nd ed. New York: McGraw-Hill Book Company, Inc., 1943.

SMa 113. Technical Math I (Algebra). Three lectures. (3 semester hours credit). Broad coverage of the most widely accepted areas of college-level algebra with special applications for technicians.

MAJOR DIVISIONS

		Class Hours
I.	Number Sets	4
II.	Operations with Algebraic Expressions	8
III.	Functions and Graphical Representation	5
IV.	Linear and Quadratic Functions	8
V.	Fractions	6
VI.	Factoring	8
VII.	Graphing	7
VIII.	Exponents and Radicals	4
IX.	Imaginary and Complex Numbers	4
	Total Class Hours	54

I. NUMBER SETS

OUTLINE OF INSTRUCTION
Class Hours 4

A. Basic operations on natural numbers

B. Some properties of natural numbers

C. Representation of natural numbers on a number line

D. Basic operations of integers

E. Some properties of integers

F. Representation of integers on a number line

II. OPERATIONS WITH ALGEBRAIC EXPRESSIONS

OUTLINE OF INSTRUCTION
Class Hours 8

A. Definitions

B. Addition and subtraction with monomials

C. Addition and subtraction with polynomials

D. Use of exponents

E. Multiplication and division of monomials

F. Multiplication and division of polynomials

III. FUNCTIONS AND GRAPHICAL REPRESENTATION

OUTLINE OF INSTRUCTION
Class Hours 5

A. The coordinate system

B. The distance formula

C. Functions and relations

D. Graphical representation of functions and relations

E. Graphical representation of empirical data

IV. LINEAR AND QUADRATIC FUNCTIONS

OUTLINE OF INSTRUCTION
Class Hours 8

A. Equalities

B. Inequalities

C. Fractional equations

D. Linear equations and formula

E. Definition of quadratics

F. Methods of solution

G. Evaluating the discriminate

H. Radical equations

V. FRACTIONS

OUTLINE OF INSTRUCTION
Class Hours 6

A. Definition

B. Fundamental principles

C. Reduction to lowest terms

D. Multiplication

E. Division

F. Signs

G. Addition and subtraction

H. Complex fractions

VI. FACTORING

OUTLINE OF INSTRUCTION
Class Hours 8

A. Factoring monomials

B. Prime factors

C. Multiplication of a polynomial by a monomial

D. Removing a common factor

E. The difference between two squares

F. The square of a binomial

G. Perfect square trinomials

H. Addition of a third term

I. Factoring by grouping

VII. GRAPHING

OUTLINE OF INSTRUCTION
Class Hours 7

A. Introduction

B. The rectangular coordinate system

C. Graphing an equation

D. Solving simultaneous equations by graphs

E. Graphing equations of higher degree

VIII. EXPONENTS AND RADICALS

OUTLINE OF INSTRUCTION
Class Hours 4

A. Laws of exponents

B. Radical and fractional exponents

C. Multiplication and division of radical quantities

D. Addition and subtraction of radical quantities

E. Rationalizing

F. The number j

IX. IMAGINARY AND COMPLEX NUMBERS

OUTLINE OF INSTRUCTION
Class Hours 4

A. Imaginary numbers

B. Simplifying imaginary numbers

C. The imaginary unit

D. Addition and subtraction

E. Multiplication

F. Complex numbers

G. Conjugate-complex numbers

H. Addition and subtraction of complex numbers

I. Multiplication and division of complex numbers

J. Equal complex numbers

K. Graphing of complex numbers; addition and subtraction by graphing

NOTE: Modern mathematics is making significant inroads within modern industry. The increased frequency of its use will require that all engineers and technicians become knowledgeable in its use. It is recommended that the inclusion of its concepts and terminology be promoted in future mathematics courses.

SUGGESTED REFERENCES:

Bardell, Ross H. and Abraham Spitzbart. College Algebra. Reading, Massachusetts: Addison-Wesley Publishing Company, 1953.

Mancill, Julian D. and Mario O. Gonzalez. Modern College Algebra. Boston, Massachusetts: Allyn and Bacon, Inc., 1960.

Rees, Paul K. and Fred W. Sparks. Algebra and Trigonometry. New York: McGraw-Hill Book Company, Inc., 1962.

Rosenbach, J. B. and Others. Essentials of College Algebra. 2nd ed. Massachusetts: Ginn and Company, 1958.

Vance, Elbridge P. Modern College Algebra. Massachusetts: Addison-Wesley Publishing Company, 1962.

Weast, Robert C. (editor in chief). Standard Mathematics Tables. 14th ed. Cleveland, Ohio: Chemical Rubber Company, 1965.

SMa 223. Technical Math II (Trigonometry). Three lectures. (3 semester hours credit). Broad coverage of the most widely accepted areas of college-level trigonometry with special applications for the technician.

MAJOR DIVISIONS

		Class Hours
I.	Radian Measure	4
II.	Trigonometric Functions	4
III.	Solution of Right Triangle	7
IV.	Identities	8
V.	Logarithms	8
VI.	Vectors	7
VII.	Oblique Triangles	6
VIII.	Inverse Functions	5
IX.	Complex Numbers	5
	Total Class Hours	54

I. RADIAN MEASURE

OUTLINE OF INSTRUCTION
Class Hours 4

A. Circumference of a circle

B. The radian

C. Arc length

D. Changing from degrees to radians and from radians to degrees

E. Linear and angular velocity

II. TRIGONOMETRIC FUNCTIONS

OUTLINE OF INSTRUCTION
Class Hours 4

A. Introduction and definitions

B. Positive and negative angles

C. The rectangular Cartesian-coordinate system

D. Functions and variables

E. Algebraic signs of trigonometric functions

III. SOLUTION OF RIGHT TRIANGLES

OUTLINE OF INSTRUCTION
Class Hours 7

A. Definitions and nomenclature

B. Acute angles in a right triangle

C. Solving right triangles

IV. IDENTITIES

OUTLINE OF INSTRUCTION
Class Hours 8

A. Algebraic identities

B. Fundamental relations

C. Proofs

D. Variations of basic equations

V. LOGARITHMS

OUTLINE OF INSTRUCTION
Class Hours 8

A. Definitions

B. Logarithm bases

C. Theorems on logarithms

D. Multiplying, dividing, roots, and powers

VI. VECTORS

OUTLINE OF INSTRUCTION
Class Hours 7

A. Arithmetic additions

B. Algebraic addition

C. Representation by line segments

D. Geometric addition

E. Resultants and components

F. Use of the coordinate system

G. Finding the resultant of two components

H. Finding the components of a given vector

VII. OBLIQUE TRIANGLES

OUTLINE OF INSTRUCTION
Class Hours 6

A. The distance formula

B. Law of cosines

C. Law of sines

D. The ambiguous case

E. Law of tangents

F. Half-angle formulas

VIII. INVERSE FUNCTIONS

OUTLINE OF INSTRUCTION
Class Hours 5

A. Definitions

B. Inverse trigonometric functions

C. Graphical representation

D. Principle values

E. Transformations

IX. COMPLEX NUMBERS

OUTLINE OF INSTRUCTION
Class Hours 5

A. Definitions

B. Cartesian form

C. Graphical representation

D. DeMoivre's theorem

E. Roots of complex numbers

SUGGESTED REFERENCES:

Bardell, Ross H. and Abraham Spitzbart. College Algebra and Plane Trigonometry. 2nd ed. Reading, Massachusetts: Addison-Wesley Publishing Company, 1964.

Hillman, Abraham P. and G. L. Alexanderson. Functional Trigonometry. Boston, Massachusetts: Allyn and Bacon, Inc., 1961.

Rutledge, William A. and John A. Pond. Modern Trigonometry. 2nd ed. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1961.

Sparks, Fred W. and Paul K. Rees. Plane Trigonometry. 5th ed. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1965.

SMa 333. Technical Math III (Analytical Geometry & Calculus). Three lectures. (3 semester hours credit). Basic analytical geometry and calculus, including limits, derivations, and integrations; mechanics of La Place operational calculus as related to the study of control circuits; problem assignments illustrating applications; oscilloscope demonstrations showing mathematical interpretations of electric waveforms; differentiation and integration to provide an understanding of expressions frequently encountered in technical literature.

MAJOR DIVISIONS

		Class Hours
I.	Graphical Methods of Calculus	3
II.	The Functions	2
III.	Differentiation	17
IV.	Differentiation of Higher Order	2
V.	Integration	17
VI.	Additional Trigonometric Functions in Calculus	10
VII.	Logarithmic and Exponential Functions	3
	Total Class Hours	54

I. GRAPHICAL METHODS OF CALCULUS

OUTLINE OF INSTRUCTION
Class Hours 3

A. Slopes and rate of change

B. Increments--work-force diagrams

C. Nonlinear equations--slopes

D. The derivative, graphically

E. Maxima and minima

F. Inflection points

G. Areas, graphically

II. THE FUNCTIONS

OUTLINE OF INSTRUCTION
Class Hours 2

A. Variables and constants

B. Dependent and independent variables

C. Continuous functions

D. Single value

E. Explicit and implicit

III. DIFFERENTIATION

OUTLINE OF INSTRUCTION
Class Hours 17

A. Algebraic methods

B. Limits

C. General rules

D. Where $X = f(y)$

E. Where $X = f(y)^n$

F. Sum or difference

G. Maximum and minimum values

H. Basic trigonometric functions

I. $Y = e^u$ where $u = f(x)$

J. Repeated differentiation

IV. DIFFERENTIATION OF HIGHER ORDER

OUTLINE OF INSTRUCTION
Class Hours 2

A. Second derivative

B. Application to falling bodies

V. INTEGRATION

OUTLINE OF INSTRUCTION
Class Hours 17

A. Introduction of integration

B. The integration constant

C. The mechanics of the indefinite integral

D. Evaluation of the constant of integration

E. Integrals

F. The integral applied to acceleration

G. Area determination with integrations

H. Average values by integration

I. Integration of basic trigonometric functions

J. Volumes by integration

VI. ADDITIONAL TRIGONOMETRIC FUNCTIONS IN CALCULUS

OUTLINE OF INSTRUCTION
Class Hours 10

A. Inverse functions

B. Electrical application of waves to differentiation and integration circuits

VII. LOGARITHMIC AND EXPONENTIAL FUNCTIONS

OUTLINE OF INSTRUCTION
Class Hours 3

A. Exponential function

B. Exponential functions in calculus

C. Electrical transients

SUGGESTED REFERENCES:

Fischer, Bernhard and Herbert V. Jacobs. Elements of Mathematics for Radio, Television, and Electronics. New York: The Macmillan Company, 1954.

Freilich, Julius and Others. Algebra for Problem Solving, Book I and II. New York: Houghton Mifflin Company, 1957.

Harris, Charles O. Slide Rule Simplified. 2nd ed. Chicago, Illinois: American Technical Society, 1961.

Nodelman, Henry M. and Frederick W. Smith. Mathematics for Electronics with Applications. New York: McGraw-Hill Book Company, Inc., 1956.

Rice, Harold S. and Raymond M. Knight. Technical Mathematics. 2nd ed. New York: McGraw-Hill Book Company, Inc., 1964.

Richardson, Moses. Fundamentals of Mathematics. 3rd ed. New York: The Macmillan Company, 1965.

Richmond, Allan E. Calculus for Electronics. New York: McGraw-Hill Book Company, Inc., 1958.

Singer, B. B. Basic Mathematics for Technical Courses. 2nd ed. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1952.

SSc 213. Physics I (Properties of Matter and Mechanics). Two lectures. Two hours laboratory. (3 semester hours credit). A fundamental course covering several basic principles of physics such as the nature of scientific measurement and the most widely used systems, properties of matter including elementary atomic structure and the states of matter, mechanics and basic machines, and the solution of problems related to these areas. Laboratory periods will be used for demonstration and student experiments.

MAJOR DIVISIONS

		Class Hours	Laboratory Hours
I.	Introduction	2	1
II.	Measurement	4	2
III.	Atoms and Molecules	2	2
IV.	Properties and Phenomena of Solids	3	4
V.	Properties and Phenomena of Liquids	3	4
VI.	Properties and Phenomena of Gases	4	6
VII.	Vectors and Graphic Solutions	2	3
VIII.	Force and Motion	3	2
IX.	Work, Energy, and Power	4	2
X.	Analysis of Basic Machines and Friction	6	8
XI.	Rotation, Torque, and Power Transmission	3	2
		Total Class Hours 36	Total Laboratory Hours 36

Total Suggested Clock Hours 72

I. INTRODUCTION

OUTLINE OF INSTRUCTION
Class Hours 2

A. Physics: a study of matter and energy

1. Matter

a. Solid
b. Liquid
c. Gas

2. Energy

a. Forms

(1) Potential

(a) Chemical
(b) Position
(c) Nuclear

(2) Kinetic

(a) Motion (Momentum)
(b) Heat
(c) Light
(d) Sound
(e) Electrical

b. Conversion

B. Mathematics for physics

1. Decimals

2. Exponents

3. Trigonometric functions

a. Sin alpha
b. Cos alpha
c. Tan alpha

4. Design and interpretation of graphs

5. The slide rule--a, b, c, d, k, and l scale

a. Multiplication
b. Division
c. Squares and cubes
d. Square root and cube roots
e. Logarithms

C. Symbols and terms

D. Problem solving

1. Drawing of simple diagram

2. Listing of known and sought-after quantities

3. Type of problem and equation(s) needed

4. Substitution of letters for numbers

5. Cancelling and solving algebraically

6. Determining and giving unit for each number solved

7. Consideration of reasonableness of values obtained

II. MEASUREMENT

OUTLINE OF INSTRUCTION
Class Hours 4

A. Fundamental units of measurement

1. Length

a. English

(1) Inch
(2) Foot
(3) Yard, 3600/3937 meter
(4) Rod
(5) Mile

b. Metric

(1) Angstrom
(2) Micron
(3) Millimeter
(4) Centimeter
(5) Decimeter
(6) Meter, standard unit of length for world

(a) Old standard
(b) New standard

(7) Kilometer

c. Conversion factors

(1) 1 inch = 2.54×10^{-2} meter
(2) 1 meter = 39.37 inches

2. Mass

a. English

(1) Pound
(2) Slug
(3) Conversion

b. Metric

(1) Milligram
(2) Gram
(3) Kilogram
(4) Metric ton

c. Conversion factors

(1) 1 Kilogram = 2.205 pounds (mass)
(2) 1 slug = 14.6 Kilograms

3. Time - second

B. Secondary units of measure

1. Area

a. English

(1) Square inch
(2) Square foot
(3) Acre

b. Metric

(1) Square centimeter
(2) Square meter

2. Volume

a. English

(1) Fluid ounce
(2) Quart
(3) Gallon
(4) Cubic foot

b. Metric

(1) Milliliter
(2) Liter

C. Systems of units

1. English

a. Foot-pound-second (F.P.S.)
b. Foot-slug-second (F.S.S. or British Engineering)

2. Metric

a. Centimeter-gram-second (C.G.S.)
b. Meter-kilogram-second (M.K.S.)

3. Table of corresponding units

D. The art of measurement

1. Closeness of measurement

2. The doubtful figure: tolerance

3. Significant figure

4. One part in so many

5. Accuracy of measurement

6. Percentage of error

7. Percentage deviation from the mean

E. Measuring devices

1. Length

a. Scaled-straight edge
b. Calipers and dividers
c. Micrometer caliper

(1) Least count
(2) Reading

d. Vernier caliper

(1) Least count (vernier)
(2) Reading

e. Gage blocks
f. Optical flats

2. Area: compensating polar planimeter

3. Volume: specific-gravity bottles--pyknometers

4. Mass

a. Trip balance
b. Beam balance
c. Analytical balance
d. Inertia balance

5. Force--spring balance

6. Time

a. Stop clock
b. Stop watch
c. Atomic-decay measurement

7. Direction

a. Units

(1) Degree
(2) Radian

b. Measurement

(1) Protractor
(2) Theodolite

c. Scales

(1) Navigator's
(2) Mathematician's and scientist's

III. ATOMS AND MOLECULES, SOME OF THEIR INTERACTIONS

OUTLINE OF INSTRUCTION
Class Hours 2

A. Structure of matter

1. Atoms

a. Electron--orbits
b. Nucleus

(1) Protons
(2) Neutrons

2. Molecules

3. Compounds

4. Mixtures

B. Phases of matter

1. Solid

2. Liquid

3. Gas

C. Forces among molecules

1. Cohesion

2. Adhesion

3. Capillary action

D. Molecules in motion

1. Brownian movement

2. Diffusion

3. Osmosis

4. Kinetic theory

IV. PROPERTIES AND PHENOMENA OF SOLIDS

OUTLINE OF INSTRUCTION
Class Hours 3

A. Density

1. Mass

2. Weight

B. Elasticity

1. Tensional

2. Compressional

3. Torsional

4. Shearing

5. Bending

C. Stress

D. Strain

E. Hooke's law

F. Young's modulus

1. Ratio of stress to strain

2. Elastic limit

G. Hardness, malleability, ductility, and tensile strength

H. The effect of heat

1. Linear expansion

2. Area expansion

3. Volumetric expansion

V. PROPERTIES AND PHENOMENA OF LIQUIDS

OUTLINE OF INSTRUCTION
Class Hours 3

A. Pressure

1. Measurement

2. Calculation

3. Pascal's vases

4. Head

B. Forces in fluids

1. Archimedes' principle

2. Bernoulli's principle

C. Physical

1. Viscosity

2. Volatility

3. Specific gravity: hydrometer

4. Density

D. Hydraulics

1. Hydraulic press

2. Pumps

a. Centrifugal
b. Lift
c. Force
d. Gear

3. Motors (hydraulic driven)

VI. PROPERTIES AND PHENOMENA OF GASES

OUTLINE OF INSTRUCTION
Class Hours 4

A. Elasticity and compressibility

1. Boyle's law

2. Charles' law

3. Ideal gas law

B. Pressure

1. Vacuum

2. Atmospheric

3. Absolute

C. Pressure gage

1. Barometer

a. Mercury
b. Aneroid: altimeter

2. Bourdon gage

VII. VECTORS AND GRAPHIC SOLUTIONS

OUTLINE OF INSTRUCTION
Class Hours 2

A. Vectors

1. Quantity representation

2. Parallelogram of forces

3. Equilibrium of forces

4. The vector triangle

5. Vector polygon

6. Vectors applied to structural problems

a. Condition I (translational)
b. Condition II (rotational)

7. Equilibrium due to concurrent forces

a. Tension
b. Compression

VIII. FORCE AND MOTION

OUTLINE OF INSTRUCTION
Class Hours 3

A. Force

1. Definition

2. The force of gravitation

a. Sir Issac Newton--universal law of gravitation
b. Gravit's relation to weight
c. Means of measuring

B. Concept of motion

1. Velocity--the time rate of displacement

2. Acceleration

a. Positive
b. Negative

3. Velocity and acceleration

4. Distance and acceleration

5. Acceleration due to the force of gravity

a. Free-fall motion
b. Ballistic problems

C. Newton's laws of motion

1. First law--inertia

2. Second law--acceleration

3. Third law--action and reaction

IX. WORK, ENERGY, AND POWER

OUTLINE OF INSTRUCTION
Class Hours 4

A. Work

1. Definition

2. Units of work

a. Metric
b. English

B. Energy

1. Classification

a. Kinetic energy

(1) Electrical
(2) Heat
(3) Sound
(4) Light
(5) Mechanical

b. Potential energy

(1) Chemical
(2) Positional
(3) Nuclear

2. Measurement of energy

a. Metric
b. English

3. Energy and its transformations

a. Original sources

(1) Sun
(2) Atom

b. Conversion to other forms

4. Law of conservation of energy

C. Momentum

1. Impulse

2. Impact of moving fluids

3. Momentum and Newton's third law

a. The law of conservation of momentum
b. Rockets and jets

D. Power

1. Definition

2. Units of power

3. Efficiency

4. Measuring horsepower

a. Brake horsepower: the Prony brake

b. The dynamometer

X. ANALYSIS OF BASIC MACHINES AND FRICTION

OUTLINE OF INSTRUCTION
Class Hours 6

A. Basic machines

1. The lever

a. Mechanical advantage

(1) Actual
(2) Theoretical

b. Examples and types

2. The inclined plane

a. Vectorial analysis
b. Applications

B. Friction

1. Nature of friction

2. Analyzing frictional forces

3. Coefficient of friction

a. Starting
b. Sliding
c. Rolling

4. Effect of friction of machines

5. Mechanical advantage and efficiency of machines

C. Modification of the basic machines

1. The wedge

a. Types
b. Theorectical mechanical advantage

2. Screws

a. Terminology
b. Applications
c. Mechanical advantage
d. Efficiency

3. Wheel and axle

a. Theoretical mechanical advantage
b. Actual mechanical advantage
c. Applications

4. Pulleys

a. Simple
b. Compound
c. Chain fall
d. Power transmitting--variable pitch

5. Gears

a. Types
b. Ratios

D. Compound machines

XI. ROTATION, TORQUE, AND POWER TRANSMISSION

OUTLINE OF INSTRUCTION
Class Hours 3

A. Rotary motion

1. Rotation as opposed to translation

2. Angular measurements

a. Displacement
b. Velocity
c. Acceleration

B. Torque

1. Units of torque

2. Contrast to work

3. Applications

C. Power transmission

1. Work and power in rotary motion

2. Drive shafts

D. Centripetal force

1. Uniform circular velocity

2. Circular acceleration

3. Relationship of Newton's first law of motion

4. Relationship of Newton's second law of motion

5. Applications

E. Centrifugal force

1. Relationship of Newton's third law of motion

2. Industrial applications

SUGGESTED TEXTS:

Either

Harris, Norman C. and Edwin M. Hemmerling. Introductory Applied Physics. 2nd ed. New York: McGraw-Hill Book Company, Inc., 1963.

or

White, Marsh W., Kenneth V. Manning, and Robert L. Weber. Practical Physics. 2nd ed. New York: McGraw-Hill Book Company, Inc., 1955.

SUGGESTED REFERENCES:

Black, Newton H. and A. P. Little. An Introductory Course in College Physics. 4th ed. New York: The Macmillan Book Company, (n.d.).

Dull, Charles E., H. Clark Metcalfe, and William O. Brooks. Modern Physics. New York: Holt, Rinehart, and Winston, 1964.

*Githens, Sherwood, Jr. Introduction to Physics. Part I: Techniques and Tools of the Physicist and Engineer. Durham: Sherwood Githens, Jr., 1961.

*_____. Introduction to Physics. Part II: Mechanics and Properties of Matter. Durham: Sherwood Githens, Jr., 1961.

*_____. Introduction to Physics. Part III: Magnetism, Electricity, Periodic Functions, Wave Motion and Electronics. Durham: Sherwood Githens, Jr., 1961.

White, Harvey E. Physics, An Exact Science. Princeton, New Jersey: D. Van Nostrand Company, Inc., 1959.

*This volume has not been verified by the publisher as being correctly listed and available.

SSc 323. Physics II (Heat, Light, and Sound). Two lectures. Two hours laboratory. (3 semester hours credit). An examination of the theory and applications of temperature and heat, the most widely accepted scales of measurement, sound and wave motion, light and illumination, optical measurement, and the nature of atomic theory.

MAJOR DIVISIONS

		Class Hours	Laboratory Hours
I.	Temperature and Heat	7	8
II.	Sound and Wave Motion	8	10
III.	Light and Illumination	9	6
IV.	Principles of Optical Measurement	7	8
V.	Atomic Energy	5	4
	Total Class Hours	36	Total Laboratory Hours 36
	Total Suggested Clock Hours		72

I. TEMPERATURE AND HEAT

OUTLINE OF INSTRUCTION
Class Hours 7

A. Temperature

1. Definition

2. Measurement

a. English

(1) Fahrenheit
(2) Rankine

b. Metric

(1) Centigrade
(2) Kelvin or absolute

c. Conversion
d. Thermometers

(1) Liquid
(2) Gas
(3) Resistance

(4) Thermoelectric
(5) Pyrometer

(a) Optical
(b) Radiation

B. Heat

1. Definition

2. Contrasted with temperature

3. Measurement

a. English: British Thermal Unit
b. Metric

(1) calorie
(2) Calorie

c. Calorimeter

4. Specific heat and thermal capacity

5. Law of heat exchange

6. Change of phase

a. Latent heat of fusion
b. Melting and freezing
c. Latent heat of vaporization
d. Evaporation, boiling, and condensation
e. The effect of pressure

7. Heat transfer

a. Definition
b. Direction
c. Methods

(1) Convection

(a) Forced
(b) Natural

(2) Radiation

(a) Light and dark surfaces
(b) Polished and dull surfaces

(3) Conduction

II. SOUND AND WAVE MOTION

OUTLINE OF INSTRUCTION
Class Hours 8

A. Wave characteristics

1. Source

2. Frequency

3. Amplitude

4. Length

5. Velocity

a. Effect of medium
b. Effect of temperature

B. Transverse waves

1. Motion

2. Applications

C. Longitudinal waves

1. Rarefaction

2. Condensation

D. Musical tones

1. Pitch

2. Wave characteristics of harmony

E. Calculations

F. Technical applications of sound waves

1. Reflection

a. Measurements
b. Supersonics

2. Refraction

3. Seismograph applications

4. Absorption of sound

a. Coefficients
b. Materials

5. Reproduction of sound

a. Recordings

(1) Wax
(2) Wire
(3) Tape

b. On film

6. Resonance

III. LIGHT AND ILLUMINATION

OUTLINE OF INSTRUCTION
Class Hours 9

A. Early theories

B. Present theories accounting for light properties

1. Wave (polarization)

2. Quantum

C. Velocity of light

D. Illumination calculations

1. Intensity (units of)

2. Effect of distance

a. Photometer
b. Foot-candle meter

E. Color--wave length

F. Diffusion

G. Ultraviolet radiation

H. Fluorescent illumination

IV. PRINCIPLES OF OPTICAL MEASUREMENT

OUTLINE OF INSTRUCTION
Class Hours 7

A. Light rays and beams

B. Reflection of light

1. Diffused

2. Regular

a. Images
b. Calculations of angles
c. Optical levers

(1) Calculations
(2) The sextant

3. Curved or spherical mirrors

a. Real and virtual images

(1) Concave
(2) Convex

b. Calculations

(1) Image location
(2) Image magnitude

C. Refraction of light

1. Index

2. Calculations

3. Critical angles

4. Lenses

a. Types
b. Terminology
c. Formation of images
d. Calculations

(1) Image location
(2) Power of lenses
(3) Image magnitude

D. Dispersion of light

1. The prism

a. Spectro-colors
b. Angles of deviation and dispersion

2. The spectroscope

3. The spectrograph

E. Polarized light

1. Theory

2. Detection

3. Applications

V. ATOMIC ENERGY

OUTLINE OF INSTRUCTION
Class Hours 5

A. Nature of atomic energy

1. Early concepts of atomic structure--historical

2. Nineteenth-century discoveries

a. Dalton's atomic theory
b. Sir William Crookes--cathode rays
c. J. J. Thompson--divisibility of atoms

3. Early twentieth-century discoveries

a. Robert A. Millikan--measurement of electrons
b. E. Goldstein and W. Wien--discovery of protons
c. Lord Rutherford and Niels Bohr--planetary concept
d. James Chadwick--discovery of neutrons

4. Atomic weight and number

5. Energy in the atom

a. Einstein's mass-energy equation
b. Law of conservation of mass-energy
c. Experiment with lithium

6. Atomic disintegration

7. Atomic bombardment

a. Cyclotron
b. Van de Graaf generator
c. Betatron

8. Uranium fission--slow neutron bombardment

9. Fusion

B. Atomic energy for military purposes

1. Separation of U^{235} from U^{238}

2. Fissionable plutonium

C. Industrial uses of atomic energy

1. Plutonium reactor and power developed

2. Radioactive isotopes

SUGGESTED TEXT:

Harris, Norman C. and Edwin H. Hemmerling. Introductory Applied Physics. 2nd ed. New York: McGraw-Hill Book Company, Inc., 1963.

SUGGESTED REFERENCES:

Dull, Charles E., H. Clark Metcalfe, and William O. Brooks. Modern Physics. New York: Holt, Rinehart, & Winston, 1964.

Marcus, Abraham. Physics for Modern Times. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1952.

Sears, Francis W. Mechanics, Wave Motion and Heat. Reading, Massachusetts: Addison-Wesley Publishing Company, 1958.

Weber, Robert L., Marsh W. White, and Kenneth V. Manning. College Physics. 3rd ed. New York: McGraw-Hill Book Company, Inc., 1959.

White, Harvey E. Physics, An Exact Science. Princeton, New Jersey: D. Van Nostrand Company, Inc., 1959.

White, Marsh W., Kenneth V. Manning, and Robert L. Weber. Practical Physics. 2nd ed. New York: McGraw-Hill Book Company, Inc., 1955.

SSc 433. Physics III (Electricity and Magnetism). Two lectures. Two hours laboratory. (3 semester hours credit). Concepts in basic electricity and magnetism with technical applications.

MAJOR DIVISIONS

		Class Hours	Laboratory Hours
I.	Magnetism and Electricity	4	2
II.	Basic Electrical Units and Circuits	5	6
III.	Sources and Effects of Electric Current	3	4
IV.	Electromagnetism	5	4
V.	Electromagnetic Induction	5	2
VI.	Alternating Current	5	6
VII.	Generators and Motors	3	4
VIII.	Production and Distribution of Electric Power	3	4
IX.	Industrial Electronics	3	4
	Total Class Hours	36	Total Laboratory Hours 36
	Total Suggested Clock Hours		72

I. MAGNETISM AND ELECTRICITY

OUTLINE OF INSTRUCTION
Class Hours 4

A. Magnets

1. Natural

2. Artificial

B. Magnetic poles

1. N - north seeking

2. S - south seeking

3. Laws of attraction or repulsion

C. Magnetic fields

1. Lines of force

B. Voltage

1. Potential differences

2. Unit of measure

C. Resistance

1. Types of resistors

2. Unit of measure

D. Ohm's law

1. Stated

2. Analyzed

E. Measuring electrical quantities

1. Potential difference--the voltmeter

2. Current--the ammeter

3. Resistance

a. Ohmmeter
b. Wheatstone bridge
c. Ammeter-voltmeter method

4. Power measurement--the wattmeter

5. Oscilloscope measurements

F. Series circuits

1. Current

2. Voltage

3. Resistance

G. Parallel circuits

1. Current

2. Voltage

3. Resistance

H. Series-parallel circuits

1. Current

2. Voltage

3. Resistance

III. SOURCES AND EFFECTS OF ELECTRIC CURRENT

OUTLINE OF INSTRUCTION
Class Hours 3

A. Properties of electric current

1. Causes of electron flow

2. Direction of electron flow

3. Method of electron flow

a. Through solids
b. Through liquids
c. Through gases

B. Producing electrical currents

1. Chemical means--voltaic cells

a. The dry cell

(1) Polarization
(2) Local action

b. The storage cell

(1) Lead-acid cells
(2) Alkaline cells
(3) Nickel-cadmium cell

2. Electromagnetic generators

3. Photoelectricity

4. Thermoelectricity

C. The effects of electric currents

1. Chemical

2. Magnetic

3. Heating

D. Electrical power and energy

1. Definitions

2. Units

a. Watt and Kilowatt
b. Watt-hour and Kilowatt-hour

3. Electrical energy equivalent to heat energy

IV. ELECTROMAGNETISM

OUTLINE OF INSTRUCTION
Class Hours 5

A. Magnetic fields

1. Around a straight conductor

2. Around a loop

3. Left-hand rule

B. Electromagnets

1. Iron core

2. Residual magnetism

3. Commercial uses

C. Electrical measuring instruments

1. Measuring effects

a. Chemical
b. Heating
c. Magnetic

2. Motor rule

3. Galvanometers

4. Ammeters

5. Voltmeters

6. Alternating-current instruments

V. ELECTROMAGNETIC INDUCTION

OUTLINE OF INSTRUCTION
Class Hours 5

A. Michael Faraday's contribution

1. Mechanical energy to electrical energy

2. Importance of his discovery

B. Magnetic induction terminology

1. Magnetic flux

2. Flux density

3. Permeability

4. Field strength

C. Induced-electromotive forces

1. Lenz's law

2. Mutual inductance

3. Self-induction

VI. ALTERNATING CURRENT

OUTLINE OF INSTRUCTION
Class Hours 5

A. Introduction to alternating current

1. Nature of alternating current

2. Alternating current compared with direct current

3. Cycles--frequency

4. Effective current and voltage

B. Properties of alternating-current circuits

1. Pure-resistive circuits

2. Inductive circuits

3. Resistance and inductance--impedance

4. Capacitive reactance circuits

5. Resistive, capacitive, and inductive circuits

6. Power factor

C. Transformers

1. Structure

   a. Primary coil
   b. Secondary coils
   c. Cores

2. Theory

   a. Formation of magnetic field
   b. Induced electromotive force

3. Types of transformers

   a. Step-up voltages
   b. Step-down voltages

4. Uses of transformers

   a. Power transmission over long distances
   b. Low-voltage, heavy-current supply
   c. Low-voltage control circuits

5. Losses

   a. Eddy currents
   b. Hysterisis

VII. GENERATORS AND MOTORS

OUTLINE OF INSTRUCTION
Class Hours 3

A. Direct-current generators

   1. Components

      a. Field
      b. Brushes
      c. Commutator

   2. Principle of operation

B. Direct-current motors

   1. Construction

   2. Theory of operation

   3. Counter-electromotive force

C. Alternating-current generators

   1. Construction

a. Rotor
b. Stator

2. Phase

a. Single
b. Three

(1) Delta
(2) Y (wye)

D. Types of alternating-current motors

1. Series

2. Shunt

3. Compound

4. Induction

5. Synchronous

E. Measurement of a-c energy consumption

VIII. PRODUCTION AND DISTRIBUTION OF ELECTRIC POWER

OUTLINE OF INSTRUCTION
Class Hours 3

A. Terminology

1. Coulomb

2. Electron power

3. Kilovolt-ampere

B. Production of electric power

1. Steam plants

2. Internal-combustion-engine plants

3. Hydro-electric plants

4. Atomic energy plants

C. Design and operation of alternators

1. Advantages and disadvantages of three-phase alternators

2. General construction

a. Armature
b. Stator

3. Field excitation

4. Connecting alternators to the line

D. Transmission of electric power

1. Types of transmission

2. Principal losses

a. Line
b. Leakage
c. Transformer

3. Transformers for power transmission

4. Substations

IX. INDUSTRIAL ELECTRONICS

OUTLINE OF INSTRUCTION
Class Hours 3

A. Vacuum tube

1. History of discovery

2. Thermionic emission

3. Diodes

4. Triodes

a. Voltage amplifiers
b. Power amplifiers

5. Rectification

6. Audio-frequency amplifiers

B. Semi-conductors

C. Applied electronics

1. Frequency controls

2. Radio and television

3. X rays

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APPENDIX A

SAMPLE PROBLEM

PRODUCTION PLANNING

of a

BELT SANDER

The purpose of the following sample problem is to simulate a typical production assignment. The planning and procedure for production is equally valid for a simple forging with little required machining and for a highly complex piece of equipment composed of many sub-assemblies. In this instance the analysis of a machine of a medium degree of complexity is employed as a teaching device. A simpler or more complex problem could be undertaken without greatly modifying the format or procedure. It remains for the instructor to develop an assignment in accord with the time, material, and equipment limitations that will meet the needs of the class at a given time.

OBJECTIVE

To cause the application of all knowledges and skills acquired by the student during his technical training.

To point out the role of each segment of manufacturing production while emphasizing the planning and coordination required for effective operation.

INTRODUCTION

Company market research predicts strong sales potential for a small belt sander, competitively priced, similar to the one pictured. Surveys indicate that the market will support an initial output of 3,000 units and 2,000 units each month thereafter.

After reviewing the matter carefully, management has given the "go-ahead" for the first 25,000 units, which are to be similar in quality and design as well as in size and capacity.

The responsibility for planning and producing this machine lies with the production manager. Factors to be considered, in a review of company capabilities, are plant, materials, equipment, and labor.

Although the plant is small, it contains adequate floor and working space to house the equipment listed during a recent inventory.

A further review of the inventory, which follows, indicates that although there is no special tooling in stock, there is a sufficient supply of standard-size drills, cutters, reamers, etc.

EQUIPMENT INVENTORY

1 - 35-ton press brake
1 - 3/16" capacity x 6' shear
2 - turret lathe
1 - 100-ton punch press

2 - 17" drill press

1 - horizontal milling machine

1 - vertical milling machine

1 - Blanchard surface grinder 24" wheel size

1 - engine lathe 14" swing

1 - air compressor

1 - welder, arc

1 - welder, acetylene

1 - welder, electric spot

Assorted hand tools

The Personnel Department states that the local labor market contains a source of skilled and semi-skilled machinists and assemblers.

After this estimate of company position has been made, production planning gets underway according to the following procedure.

PROCEDURE

Analyze available information to develop an over-all idea of the makeup of the item to be produced. Read through the following steps of procedure to determine what is to be done and what is wanted.

1. Develop a set of working drawings.

   a. Use available information (a pilot model, sketches, pictures, pictorials, etc.)

   b. Prepare details, assemblies, etc., as necessary.

2. Develop a production bill of materials.

   a. List each part as identified by number.

   b. Specify quantity of each part required.

   c. Determine the most likely method of forming (stamping, forging, casting, etc.)

3. FOR EACH PART, make recommendations on whether to BUY or BUILD.

   a. Determine the manufacturing cost by making a cost analysis.

(1) Materials--determine material requirements, economical stock sizes and lot quantities; calculate salvageable scrap and waste.

(2) Labor--determine basic operations required to manufacture to specifications; combine into a likely sequence; estimate time.

(3) Add the material costs and labor costs; apply burden or overhead costs.

b. Determine likely sources for purchased parts; advertise for bids; specify delivery time.

c. Compare cost of manufacture with cost of purchase; make recommendation.

4. Plan the overall manufacturing process.

a. Develop a master routing sheet.

b. Specify tooling required.

c. Lay out floor plan, showing placement of tooling and flow of work.

d. Develop a routing sheet of each part and each sub-assembly, outlining the processing of each.

(1) Use previously made operation analyses to plan sequential operations and handling.

(2) Take from delivery or storage, route through applicable process, place in temporary storage where necessary, and/or deliver to assembly point in proper quantity at appropriate time.

5. Plan an assembly line.

a. Indicate points where each part and each sub-assembly are to be delivered.

b. Specify transportation requirements from storage through processing to assembly.

c. Determine number of assembly workers required to meet production schedule.

6. Plan a quality-control program for incoming raw materials and purchased parts; for inspection stations during processing stages and on the assembly line; and for final inspection.

a. Specify techniques and tooling.

b. Outline in detail the application of techniques and tooling.

c. Develop tolerancing charts.

7. Develop production schedule, working backwards.

   a. Set target date for finished packaged machine.

   b. Set target dates for finished parts to be delivered to assembly department.

   c. Determine the time required for manufactured parts.

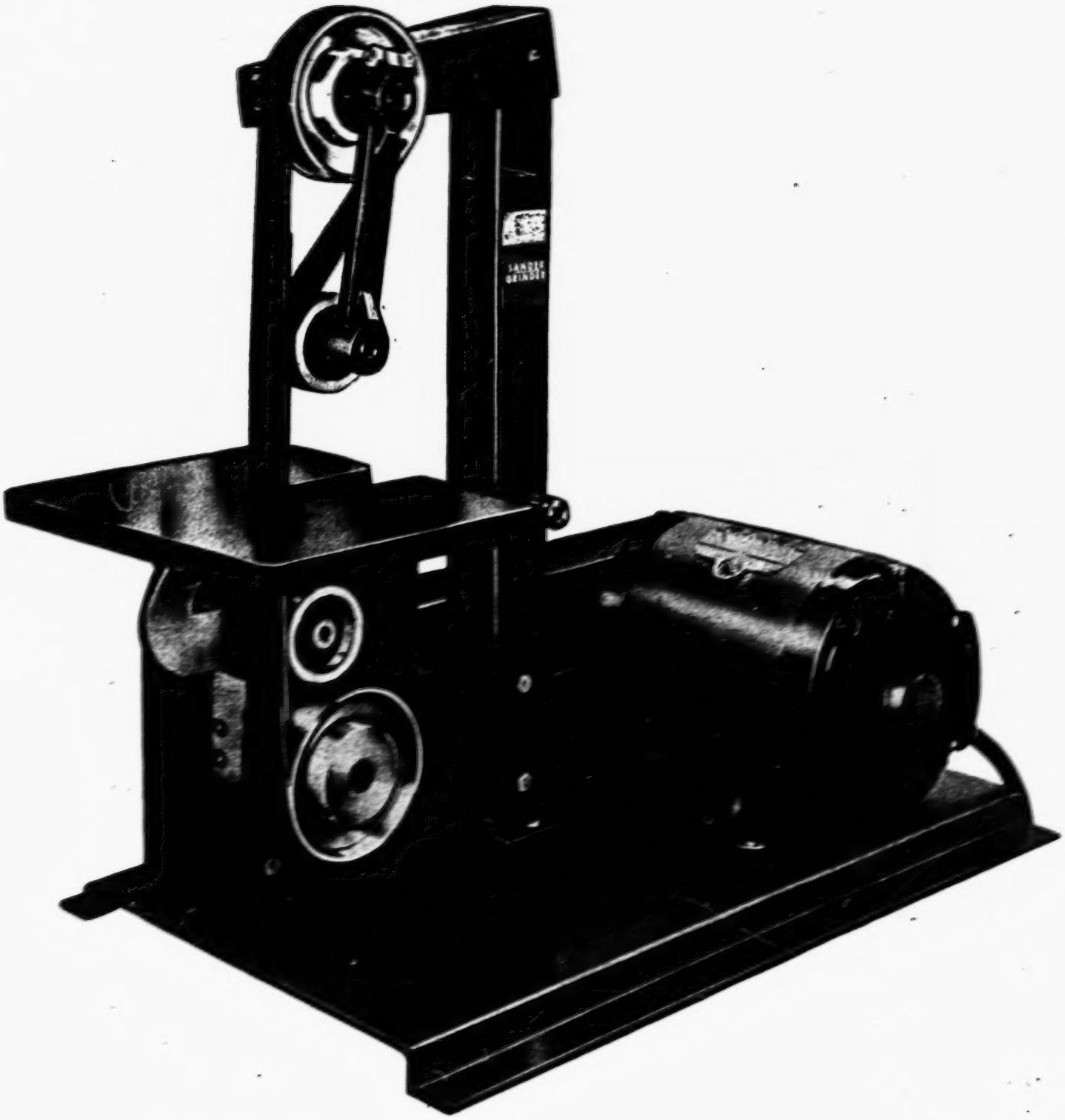
   d. Set target date for beginning manufacture.

   e. Set target dates for delivery of raw materials.

   f. Set target dates for delivery of purchased parts.

   g. Set target dates for cartons ordered (delivered).

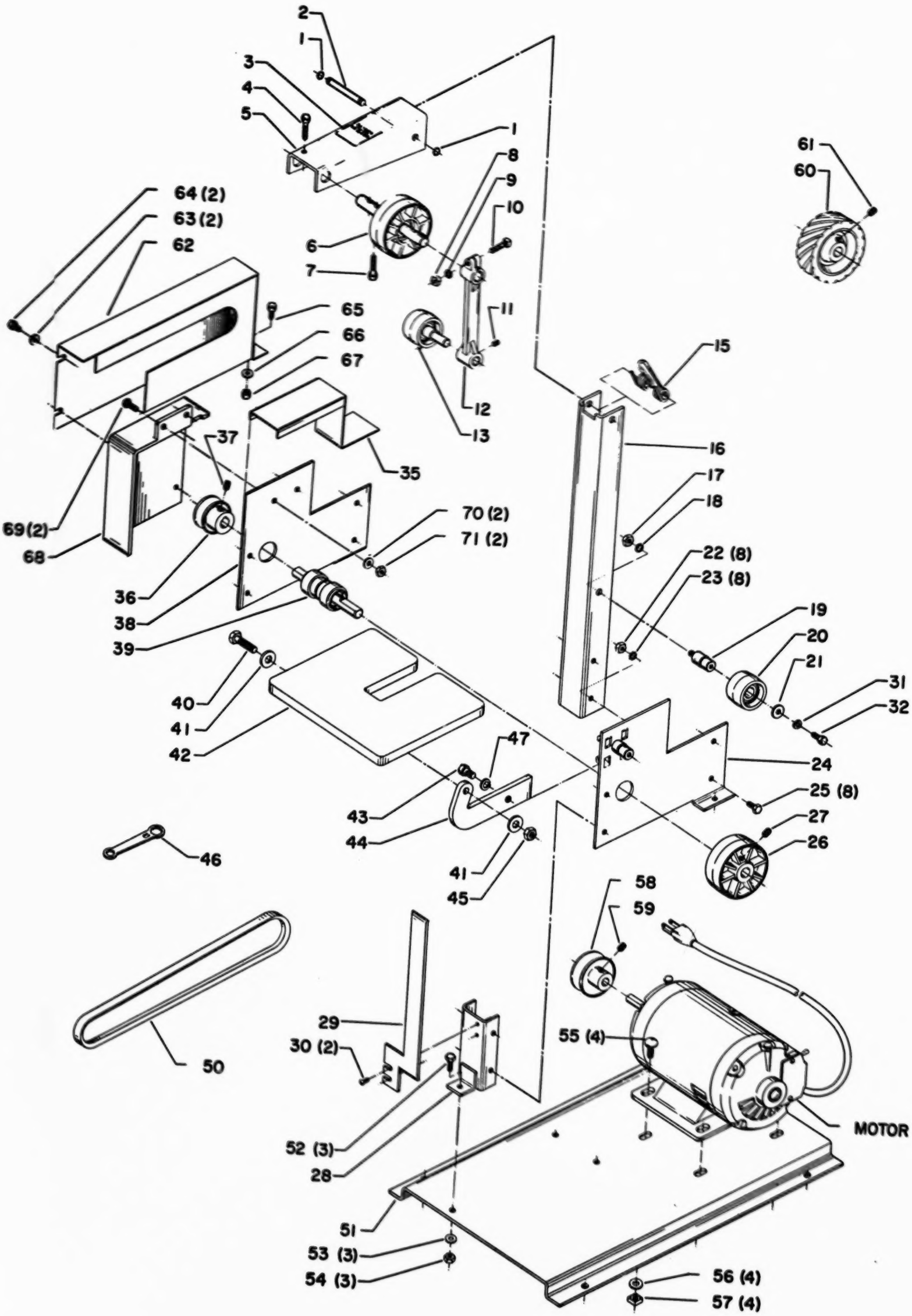
   h. Set target dates for printed material ordered (delivered).



The above pictorial and the drawing on the second page following are reproduced with the permission of the Rockwell Manufacturing Company.

PARTS LISTING

Ref. No.	Description
1	Retaining Ring
2	Shaft
3	Name Plate
4	1/4-28 x 1" Hex. Hd. Screw
5	Overarm
6	Pulley with Bearing & Shaft
7	1/4-28 x 1" Hex. Hd. Screw
8	1/4-20 Hex. Nut
9	1/4" Ext. Tooth Lockwasher
10	1/4-20 x 1" Sq. Hd. Bolt
11	1/4-20 x 1/4" Soc. Set Screw
12	Idler Arm
13	Idler Pulley W/Bearing & Shaft
15	Double Torsion Spring
16	Column
17	5/16"-18 Hex. Jam Nut
18	5/16" Int. Tooth Lockwasher
19	Idler Pulley Shaft
20	Idler Pulley
21	17/64 x 13/16 x 1/16" Steel Washer
22	1/4"-20 Hex. Nut
23	1/4" Ext. Tooth Lockwasher
24	Right Plate Assembly
25	1/4-20 x 1/2" Hex. Hd. Screw
26	Drive Pulley, Including:
27	5/16-18 x 5/16" Soc. Set Screw
28	Front Cover Plate
29	Flat Platen for 1" Belts
30	#10-32 x 3/8" Rd. Hd. Screw
31	1/4" Ext. Tooth Lockwasher
32	1/4-20 x 1/2" Hex. Hd. Screw
35	Cover
36	2" Dia. Arbor Pulley (5/8" Bore)
37	5/16-18 x 5/16" Soc. Set Screw
38	Left Plate
39	Arbor with Bearing
40	3/8-16 x 1½" Hex. Hd. Screw
41	7/16 x 1 x 5/64" Steel Washer
42	Table
43	3/8-24 x ½" Hex. Hd. Screw
44	Table Bracket
45	3/8"-16 Hex. Nut
46	7/16" Hex. & 9/16" Hex. Box Wrench
47	3/8" Int. Tool Lockwasher
50	V-Belt
51	Base Plate, Including
52	1/4-20 x 5/8 Hex. Hd. Cap Scr.
53	9/32 x 5/8 x 1/16 Steel Washer
54	1/4-20 Hex. Nut
55	5/16-18 x 3/4 Carriage Bolt
56	5/16 x 3/4 x 1/16 Steel Washer
57	5/16-18 Square Nut
58	2½" Dia. Motor Pulley (Specify 1/2, 5/8, 3/4 Bore), Including:
59	5/16-18 x 5/16 Soc. Hd. Set Scr.
60	4" Dia. Rubber Contact Wheel, Including:
61	5/16-18 x 5/16 Soc. Hd. Set Scr.
62	Belt Guard, Including:
63	9/32 x 5/8 x 1/16" Steel Washer
64	1/4-20 x 3/8" Hex. Hd. Screw
65	1/4-20 x 1/2" Hex. Hd. Screw
66	9/32 x 5/8 x 1/16" Steel Washer
67	1/4"-20 Hex. Nut
68	Guard for Arbor Pulley, Including:
69	1/4-20 x 5/8" Hex. Hd. Screw
70	9/32 x 5/8 x 1/16" Steel Washer
71	1/4"-20 Hex. Nut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APPENDIX B

TOOLS AND EQUIPMENT LIST FOR MECHANICAL TECHNOLOGY LABORATORY

The following tools and equipment have been recommended as being the minimum number and capacity to effectively carry out the necessary instruction, demonstration, and experimentation required in the area of Mechanical Technology.

Quantity	Description
1	Hacksaw, power cutoff, with coolant system. Min. 4" stroke.
1	Drill press; min. size 20"; variable speed; with pedestal.
1	Radial drill, ram-type; min. 6" column, 31" arm; 115 to 5400 RPM; 1/2 HP motor and controls.
1	Grinder, pedestal; floor mounted; wheel dia. min. 8".
1	Grinder, pedestal; min. 3 HP; 1725 RPM, with 12" dia., 2 1/4" wide wheels, for 1" arbor.
1	Surface grinder, min. 6" x 18"; with magnetic chuck, hydraulic operated.
1	Band saw, metal cutting; 20"; with blade welding attachment.
2	Engine lathes; min. swing 13"; to include accessories and extras.
2	Engine lathes; min. swing 16"; to include tooling and accessories.
1	Turret lathe; min. swing 13"; 2 speed; to include tooling and accessories.
1	Automatic screw machine for turning, boring, tapering, reaming, polishing, cutoff.
1	Milling machine, horizontal; table; with vertical shaping attachment; to include accessories; min. 32".
1	Milling machine, horizontal, universal; min. table dimensions 8" x 30"; to include cutters and power driven indexing unit.
1	Numerical control machine for drilling, boring, tapping, and milling.
1	Key-seating machine (broaching).

Quantity	Description
1 set	Sockets, 1/4" square-drive.
1 set	Sockets, 3/8" square-drive.
1 set	Sockets, 1/2" square-drive.
1 set	Sockets, 3/4" square-drive.
1	Grease gun, hand-type; high-pressure utility lever.
3	#2 Morse taper lathe center.
3	#3 Morse taper lathe center.
2 sets	Trammel points; complete with caliper legs and ball points.
6	Punches, prick; 5/16" x 4".
6	Punches, center; 1/2" x 5".
3	Combination sets, 2 with 12" scale, 1 with 18" scale.
6	Scribes, high-speed steel.
3	Rules, hook, spring-steel, tempered 6".
6	Rules, spring-steel, tempered 12".
1	Rule, nickel-plated, tape; 10'.
1	Ripping bar; weight approximately 40 lbs.; 30" long.
2	Hammers, ball-pein; 1/4 lb.
2	Hammers, ball-pien; 3/8 lb.
2	Hammers, ball-pein; 1/2 lb.
2	Hammers, ball-pein; 3/4 lb.
2	Hammers, ball-pein; 1 lb.
2	Hammers, blacksmith, hand; 3 lbs.
1	Square, hardened steel; 6".
3 pair	Dividers, with quick-spring nut; 3".
3 pair	Dividers, with quick-spring nut; 4".
3 pair	Dividers, with quick-spring nut; 6".

Quantity	Description
2 pair	Dividers, with quick-spring nut; 8".
2 pair	Dividers, with quick-spring nut; 10".
2 pair	Dividers, with quick-spring nut; 12".
	Lathe dogs: assorted types
3	1/2"
3	3/4"
3	1"
3	1 1/4"
3	1 1/2"
3	1 3/4"
3	2"
	Knurling tools
2	No. 1, single knurl
2	No. 2, single knurl
	Parting tools, engine lathe:
3	1/2" x 1 1/8" straight.
3	1/2" x 1 1/8" left-hand.
3	1/2" x 1 1/8" right-hand.
1	5/8" x 1 3/8" straight.
1	5/8" x 1 3/8" left-hand.
1	5/8" x 1 3/8" right-hand.
3	Lathe centers, live: #2 Morse taper.
	Boring bars, lathe:
1	Size 5/8" x 1 3/8" x 7 7/16".
1	Size 1/2" x 1 1/8" x 6 1/8".
1	Size 3/8" x 7/8" x 5 3/8".
1	Size 5/16" x 3/4" x 4 1/8".
2	Calipers, inside; with quick nut; 3".
2	Calipers, outside; with quick nut; 3".
2	Calipers, inside; with quick nut; 4".
2	Calipers, outside; with quick nut; 4".
2	Calipers, inside; with quick nut; 6".
2	Calipers, outside; with quick nut; 6".

Quantity	Description
2	Calipers, outside with screw adjusting (firm joint); 8".
2	Calipers, firm-joint hermaphrodite; 4".
2	Calipers, firm-joint hermaphrodite; 6".
2	Calipers, firm-joint hermaphrodite; 8".
3 sets	Chisels; 1/4" - 1".
3 sets	Punches; 1/4" - 1".
4	Sleeves, steel drill; size 1-2.
4	Drill sleeves; steel, size 2-3.
2 each	Chucking reamers; high-speed steel; straight flute, straight shank; 3/16", 1/4", 5/16", 3/8", 7/16", 1/2".
2 each	Reamers hand; high-speed steel; straight flute, 1/4", 5/16", 3/8", 7/16", 1/2", 9/16", 5/8", 11/16", 3/4", 7/8", 1".
2	Micrometers, outside; heavy-duty; 0"-1".
2	Micrometers, outside; heavy-duty; 1"-2".
2	Micrometers, outside; heavy-duty; 2"-3".
2	Micrometers, outside; heavy-duty; 3"-4".
1	Micrometer, inside; to measure 2" to 12".
1	Gage, micrometer depth; 0 to 6" range, with 3" base.
1	Caliper, vernier; 6".
1	Gage, vernier height; 12".
2	Gages, combination depth and angle; 6".
1 set	Gages, small hole; range of sizes .125 to .500 inch.
1 set (6)	Gages, telescoping; sizes 5/16" to 6".
1 set	Gage blocks, class BB; consists of 81 pieces, in box, with accessories.
1 set (5)	Rules, tempered steel; with holder and case; rule lengths-1/4", 3/8", 1/2", 3/4", 1"; graduated in 32nds and 64ths.
1 set	Clamps, key seat.

Quantity	Description
1 set	Parallels; to consist of 4 pair in container, size 6" long. 1/8" thick, 1" wide.
1	Protractor, universal bevel; 7" blade.
2	Gages, drill point.
2	Gages, tap and drill.
2	Gages, drill and wire.
2	Gages, 29-degree screw-thread (hardened).
6	Gages, center.
3	Gages, screw pitch; range of threads, 4 to 42 threads per inch.
1 set (16)	Gages, radius; size 1/64" to 1/2" with holder.
2 sets	Gages, thickness with 26 leaves, size range .0015 to .025.
2	Gages, toolmaker's surface; 7" spindle, 2 1/8" x 1 9/16" base.
2	Clamps, toolmaker's parallel; 4".
3 pair	V-blocks and clamps, to hold 1 1/4" round stock.
1	Level, precision ground; graduated vial.; 12".
1	Dial indicator, complete with attachments.
1	Straight edge; steel; 24".
3 pair	Goggles, safety.
2 pair	Gloves, welding.
1	Drill, portable electric; heavy-duty, size 1/4".
1	Drill, portable electric; heavy-duty; size 1/2".
1	Grinder, portable electric; capacity 6" x 1" wheel.
2	Pliers, combination; 6".
2	Pliers, combination; 10".
2	Pliers, chain nose; 4 1/2".

Quantity	Description
1	Anvil, 150-200 lbs.
1	Shaper, min. 12"
1	Air compressor with tank and hoses. 1½ hp, 7 cu. ft. min. displacement.
1	Press, hydraulic; 50-ton.
1	Press, arbor; min. 3-ton.
1	Punch press, deep-throat; min. 10-ton; floor model.
1	Grinder, standard, electric, (lathe) tool-posts; with internal grinding attachment; tool rest for indexing when grinding attachment; tool rest for indexing when grinding cutters, reamers, end mills.
6	Vises, machinist swivel base; 4" jaw.
1	Vise, machinist swivel base; 6" jaw.
1	Welder, electric; motor-generator type; min. size 250 amp., 220 v, 3 hp.; with necessary accessories.
1	Welder, electric; transformer-rectifier type, min. 250 ampere cap. with accessories.
2 sets	Torch, welding; with cutting attachment to include a hand truck and accessories.
1	Jack, hydraulic; ram-type; min. 5-ton
1	Hoist, lifting; min. 1-ton ratchet-type.
6	Hammers, chipping.
12	C-clamps (assorted size).
2	Tongs, blacksmith; straight lip; min. size 3/4" x 22".
2	Shields, hand-held welding; to include lens.
2	Helmets, welder's; to include lens.
2	Goggles, chipping.

Quantity	Description
2	Pliers, heavy-duty diagonal-cutting; 7".
2	Pliers, wrench; 10".
2	Shears, metal cutting; right hand.
2	Shears, metal cutting; left hand.
2	Tap wrench, T-handle; capacity 1/16" - 1/2".
2	Tap wrench, T-handle; capacity 1/16" - 1/4".
2	Tap wrench, T-handle; capacity 1/4" - 5/8".
6	Counter sink, No. 5; high-speed steel.
6	Counter sink, No. 3; high-speed steel.
2 sets	Taps; NC and NF series; No. 4 screws to 1" bolt by 64ths. with container; high-speed steel.
1 set	Dies; NC and NF series; No. 4 screws to 1" bolt by 64ths. with container; high-speed steel.
1 set	Taps, set consisting of 3 taps; tape, plug, bottoming; high speed steel.

1/4" NC	1/2" NC	3/4" NC
1/4" NF	1/2" NF	3/4" NF
5/16" NC	9/16" NC	7/8" NC
5/16" NF	9/16" NF	7/8" NF
3/8" NC	5/8" NC	1" NC
3/8" NF	5/8" NF	1" NF
7/16" NC	11/16" NC	
7/16" NF	11/16" NF	

1 set	Drills, high-speed steel; fractional sizing, 1/64" to 1/2" by 64ths.
1 set	Drills, high-speed steel; straight shank; #1 through #60; with container.
1 set	Drills, high-speed steel; straight shank; letter A through Z; with container.
1 each	Drills, high-speed steel; (two flute); taper shank.

33/64	11/16	15/16
37/64	3/4	1"
19/32	49/64	59/64
5/8	13/16	15/32
21/32	7/8	2"

Quantity	Description
2	Grinding wheel dresser.
2	Hack-saw frame; pistol grip; adjustable.
2	Machine countersinks; high-speed steel; 1/2"; 60 degrees.
2	Machine countersinks; high-speed steel; 1/2"; 82 degrees.
2	Machine countersinks; high-speed steel; 3/4"; 60 degrees.
2	Machine countersinks; high-speed steel; 3/4"; 82 degrees.
2 sets	Wrenches, hex-key, size .050 to 3/8".
1 set	Combination wrenches (box end--open end); sizes 3/8" through 1 1/4" by 16ths; with carrying case.
2	Wrenches, adjustable, open-end; 6".
2	Wrenches, adjustable, open-end; 12".
2	Wrenches, pipe; maximum pipe size 2" capacity; 14" long.
1	Demagnetizer.
1 set	Punches, transfer; 1/8" - 1/2" dia.
1 set	Screws, transfer; 1/4" - 5/16" - 3/8" dia.
1	Furnace, gas-fired; with blower; torch lighter, and pyrometer; Range 0-2400 degrees Fahrenheit.
1	Salt pots, with pyrometer; range 0-2000 degrees Fahrenheit.
1	Furnace, blast; gas-fired; with pyrometer; range 0-3000 degrees Fahrenheit.
1	Furnace, heavy-duty electric; with recording potentiometer; range 0-3000 degrees Fahrenheit.
1	Furnace, electric tempering; with electric controls; range 0-1000 degrees Fahrenheit.
1	Furnace, electric with pyrometer; range 0-2600 degrees Fahrenheit.
1	Furnace, heat-treating, electric, with pyrometer.

Quantity	Description
1	Hydraulic training unit for student and instructor use; to include typical hydraulic components, such as cylinders, pumps, filters, coolers, control valves, motors, seals, connections, complete with all lines, gages, controls (including master-control valve), table.
1	Pneumatic training unit for student and instructor use; to include typical pneumatic components, such as cylinders, pumps, compressors, filters, lubricators, coolers, control valves, seals, connection; complete with all lines, gages, controls (including master-relief valve), table.
1	9" Abrasive cutoff machine with bonded wheel.
1	Comparitor, optical.
1	Hot plate, electric; 12" x 18".
1	Grinder, pedestal; 1" x 8" x 1".
1	Grinder, bench; with diamond wheels; 6" dia.
2	Tanks, quenching; portable.
1	Hardness Testing Machine; Rockwell.
1	Hardness Testing Machine; Brinell.
1	Scleroscope, shore.
1	Impact machine.
1	Magnaflux unit.
1	Torsion Tester.
1	Testing machine; bench-type.
1	X-ray machine; industrial-type.
1	Universal tester with selected attachments.
1	Grinder, belt; horizontal.
1	Press, simplemet; 1 1/4" capacity.
1	Polisher, electro.

Quantity	Description
1	Table, two-stage specimen-polishing.
1	Microscope, metallurgical.
1 set	Optical flats; with granite stage and monolight.
1	Sinebar, horizontal; 5".
1	Melting furnace, aluminum and brass; with pilot light, one crucible, and pyrometer.
2	Crucibles, carbon; #10.
1 set	Tongs, crucible; for operation by one person.
1	Poring ring; to fit above crucibles and operated by one person.
1	Sand box (for casting aluminum and brass); metal lined; with tight fitting lids and provision for building of molds inside box.
1 lot	Sand, molders.
1 each	Riddles: #4, #6, and #8 mesh.
1	Bench rammer; with one flat end and one wedge end.
1 each	Sprue cutter, brass construction: 1" diameter, 1 1/2" diameter.
1	Cutter, vent spike, stainless steel construction.
2 sets	Bellows.
1	Strike-off bar.
1	Spoon and gate cutter.
1	Slick and square.
1	Lifter, casting.
1	Blub sponge, with brush.
8 pair	Flasks (assorted sizes).
	Bottom boards; assortment; plywood construction.

Quantity	Description
2	Dust bags (for parting compounds).
2 pair	Gloves, asbestos.
2	Aprons, asbestos.
2 pair	Sleeves, asbestos.
2 pair	Leggins, asbestos.
	Ingot mold, to match crucibles used.
8	Watches, stop.
1	Camera, motion-picture; 8 mm; silent, with tripod.
1	Projector; with remote control; stopping, and reversing action, 8 mm motion-picture.
1	Screen, projection; 5' x 8'.
1	Cyclograph, with tripod.
1	Chronocyclograph with tripod.

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Agdex 273

ESTABLISHMENT AND MAINTENANCE OF LAWNS

Vocational Agriculture Service
State Department of Education
and
Department of Agricultural Education
The Ohio State University
1965

VT002011

MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) Harlan E. Ridenour (Agency) Agricultural Education Curriculum Material Service

(Address) Room 201, 2120 Fyffe Road, Columbus, Ohio 43210

DATE: 24 July 1967

RE: (Author, Title, Publisher, Date) Dr. Ralph J. Woodin and others, Establishment and Maintenance of Lawns, 1965, Agricultural Education, Curriculum Material Service

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FOREWORD

This unit was developed by Robert Eby, Larry Hazen and Howard Nowels in Agricultural Education 701 during the Winter Quarter of 1965. The unit was edited by Dr. Ralph J. Woodin, Professor of Agricultural Education, The Ohio State University.

The following factors have been instrumental in bringing about the need for a unit of this type:

1. Agricultural instructors have been teaching the management of lawns as an improvement project for some time, but no organized resource material has been available.

2. Some employment opportunities in turf management are available for students with adequate background training in agriculture.

This unit has been prepared specifically as a guide to teachers and should be used as such. It is not a lesson plan, but it is designed in such a way that it can be used to prepare lesson plans. Teachers need not use all of the material contained herein but may select those problem areas which apply to their specific situations.

Ohio Vocational Agriculture
Curriculum Materials Service

ESTABLISHMENT OF NEW LAWNS

PROBLEM I:

TIME OF SEEDING

Items to Consider:

1. Competition of grass by weeds.
2. Survival of grass seeded.
3. Resisting winter-kill.

Related Information:

1. Competition of grass by weeds.

Seventy-five per cent of the lawns in this country are planted at the wrong time. Most gardeners in northern regions assume that spring is the ideal time to sow grass seed, but nothing is farther from the truth. Summer annual weeds (crabgrass, foxtail, ragweed, pigweed, and many others) are always a problem with spring and winter seedings. Summer weeds are usually avoided with early fall seedings made properly, since a good sod develops before the weed seeds germinate.

2. Survival of grass seeded.

The best time to seed a lawn in Northern Ohio is between August 15 and September 15. In Central and Southern Ohio the entire month of September is good. Lawns seeded later in the fall may fail because the young grass does not get enough growth to survive the winter.

The early fall seeded lawn will thow out small stools almost at once and by the time freezing weather arrives, should be able to withstand sub-zero weather.

There is only one short period during the year when northern turf grasses cannot successfully be sown. This is the deceptive spell of warm weather that comes almost every fall just before the first killing frost strikes down tender vegetation. Not enough time is left for seeds to germinate and grass to grow sufficiently to be mowed once or twice to produce a crown for winter survival.

3. Resisting winter-kill.

If seeding cannot be done by October 1 in Northern Ohio or before October 15 in Southern Ohio postpone the job until winter or spring. The earlier in the spring a seeding can be made (preferably March) the better the chances for success.

Time of Seeding

Winter seedings made after November 15 in Northern Ohio and after December 1 in Southern Ohio will not germinate until spring. Lawns seeded during the winter usually start earlier than spring seedings can be made.

Suggested Student Activities:

1. Sow grass seeds in plots and determine germination time at various dates of seeding. Check germination time of weeds.

2. Consult home builders to determine time they seed and the problems with other than fall seedings.

Teaching Materials:

1. Samples of seeds of various grasses and seeds of common weeds.

2. Photographs and slides of good and poor lawns.

References:

"Your Lawn," The Ohio State University Bulletin 271, Cooperative Extension Service, Revised 1964, p. 8.

R. Milton Carleton, Your Lawn: How to Make It and Keep It. (Princeton: D. VanNostrant Co., Inc., 1959.) pp. 75, 83.

PROBLEM II:

SELECTION OF SEED

Items to Consider:

1. Characteristics of recommended species:
   - Rate of establishment
   - Texture
   - Disease tolerance
   - Wear resistance
   - Shade tolerance
   - Tolerance to close clipping
   - Drought tolerance
   - Nitrogen fertility requirement
2. Varietal characteristics.
3. Lawn grass mixtures.
4. Amount to seed.

Related Information:

1. Characteristics of recommended species.
   (see chart on next page.)

SOME CHARACTERISTICS OF VARIOUS TURF GRASSES

Rate of Establishment

Fast	Perennial ryegrass
↑	Creeping bentgrass
	Meadow fescue
	Tall fescue
↓	Kentucky bluegrass
Slow	Red fescue

Texture - Leaf Blade Width

Coarse	Tall fescue
↑	Meadow fescue
	Kentucky bluegrass
	Perennial ryegrass
	Colonial bentgrass
↓	Creeping bentgrass
Fine	Red fescue

Disease Tolerance

High	Tall fescue
↑	Perennial ryegrass
	Meadow fescue
	Kentucky bluegrass
↓	Red fescue
Low	Bentgrasses

Wear Resistance

High	Tall fescue
↑	Perennial ryegrass
	Meadow fescue
	Kentucky bluegrass
↓	Red fescue
Low	Bentgrasses

Shade Tolerance

Shade	Red fescue
↑	Bentgrasses
	Tall fescue
	Meadow fescue
↓	Kentucky bluegrass
Sun	Perennial ryegrass

Tolerance of Close Clipping

Low	Bentgrasses
↑	Tall fescue
	Red fescue
↓	Meadow fescue
High	Perennial ryegrass
cut	Kentucky bluegrass

Drought Tolerance

High	Tall fescue
↑	Red fescue
	Kentucky bluegrass
	Perennial ryegrass
	Meadow fescue
↓	Colonial bentgrass
Low	Creeping bentgrass

Nitrogen Requirement

Low	Red fescue
↑	Tall fescue
	Meadow fescue
	Perennial ryegrass
	Kentucky bluegrass
↓	Colonial bentgrass
High	Creeping bentgrass

2. Varietal characteristics.

The broad leafed grasses grow more rapidly than the fine leafed grasses and "stand out" in the lawn. Also, these coarse grasses often fail because they are not adapted to standard lawn maintenance practices such as close cutting.

Kentucky bluegrass is a hardy, long-lived, sod-forming grass that spreads by underground rootstocks. It is one of the most widely used lawn grasses in the United States. It is the basic lawn grass in cool, humid regions and in cool, dry regions where adequate irrigation water is available.

At present, Merion is the only variety which has shown important advantages over common Kentucky bluegrass or other varieties. Merion, however... is more susceptible to rust and stripe smut diseases than most of the other bluegrasses. It is also much more likely to develop a thatch problem.

Colonial bentgrass is a fine-textured turfed -type grass with few creeping stems and rhizomes. It forms a dense turf when heavily seeded and closely mowed. It is used chiefly in high-quality lawns and putting greens.

Creeping bentgrass is not often used in home lawns, but it is used extensively in golf course putting greens throughout the United States.

Clover in a lawn is a matter of personal taste.

Tall fescue is a tall-growing perennial bunch grass. Because of their wear-resistant qualities, two improved strains of tall fescue, Kentucky 31 fescue and Alta fescue, are used often on play areas, athletic fields, air fields, service yards and other areas where a heavy, tough turf is needed rather than a fine-textured turf.

Next to ryegrass, redtop is probably the most overrated species in commerce, creating more problems than it solves. It is highly touted as a "nurse" grass in lawn seed mixtures. For a year or two, far from nursing the new sod, it competes aggressively with it for light, air, food and water.

Red fescue and Chewings fescue rate next to Kentucky bluegrass as the most popular lawn grasses in the cool humid regions of the United States. They grow well in shaded areas, and they tolerate high acidity. They require good drainage but will grow in poor, droughty soils.

3. Lawn grass mixtures.

A straight seeding of Kentucky bluegrass often gives the best results. Red fescue should be used with bluegrass for shaded areas. No grass can be expected to persist under dense shade.

Never use a mixture containing bentgrass unless you want a bentgrass lawn. A small amount of bentgrass will crowd out the other grasses. Bentgrass can make an excellent lawn if it gets the extreme amount of care it needs.

Many commercial lawn seed mixtures contain too much ryegrass; the ryegrass competes with the permanent grass seedlings for moisture and nutrients. On sloping areas, it is sometimes advisable to include a small amount of ryegrass in the lawn seed mixture to help prevent soil erosion. The use of perennial ryegrass in lawn seed mixtures often results in ragged appearing lawns that are difficult to mow.

4. Amount to seed.
(see next page)

SELECTED LAWN GRASSES

Grass or Mixture		Potential Quality of Lawn	Sun or Shade	Amount of Care and Cost of Upkeep	Seed per 1000 Sq. Ft.
Common Kentucky bluegrass or blends of adapted varieties	100%	good to excellent	sun	average	1 - 3 lb.
Merion* Kentucky bluegrass	100%	excellent	sun	above average	1 - 3 lb.
Common Kentucky bluegrass Red Fescue	40-50% 50-60%	good	light shade	average	1 1/2-4 lb.
Merion* Kentucky bluegrass Creeping Red Fescue	40-50% 50-60%	excellent	sun or light shade	above average	1 1/2-4 lb.
Red Fescue	100%	fair	shade	below average	3 - 5 lb.
Tall Fescue** Common Kentucky bluegrass	90% 10%	poor	sun or light shade	below average	5 - 7 lb.
Bentgrass	100%	excellent	sun or light shade	much above average	1 1/2-2 lb.

*Merion bluegrass had not been adequately tested by the Experiment Station in Southern Ohio.
**Use only where coarse grass is not objectionable.

Suggested Student Activities:

1. Identify varieties of grasses and weeds in local lawns.

2. Secure prices of various grasses and mixtures from local seed houses, nurseries, elevators,etc.

3. Study labels on seed tags for purity, mixtures contained, germination, variety, etc.

Teaching Materials:

1. Magnifying lens for examining seeds.

2. Samples of various grass and weed seeds.

3. Slides showing ideal and poor lawns.

4. Photos of local lawns.

References:

"Your Lawn," O.S.U. Bulletin 271, pp. 6-7.

"Better Lawns," United States Department of Agriculture, Home and Garden Bulletin No. 51, 1962, pp. 25, 27-30.

R. Milton Carleton, Your Lawn: How to Make It and Keep It, p. 63.

Robert W. Miller, "Some Characteristics of Various Turf Grasses," Mimeo, Department of Agronomy, Ohio Agricultural Experiment Station, Wooster, Ohio.

PROBLEM III:

FERTILIZING A NEW LAWN

Items to Consider:

1. The plant food elements.
2. Fertilizer grades.
3. Amount of fertilizer to apply.
4. Method of application.
5. Fertilizer forms.

Related Information:

1. The plant food elements.

All new lawns should have fertilizer applied before seeding. A good weed free lawn needs plenty of plant food in the soil.

Nitrogen is the plant food that grass needs most because it stimulates rapid growth and dark green leaves. Although it is generally present in small amounts, it leaches out of the soil fairly easy and needs to be replaced.

Phosphorus promotes root growth. Grass needs a well developed root system to support a luxuriant top growth. A deep root system increases the ability of desirable grasses to survive midsummer conditions better without frequent watering than will poorly rooted grasses that have to be watered frequently.

Potassium helps to increase vigor, hardiness and disease resistance of lawns. Of the three major plant food elements, potassium is least likely to be lacking.

2. Fertilizer grades.

On every bag of fertilizer sold there appears a grade, which is the minimum guaranteed analysis of the major plant nutrients contained in that material. Such a grade might be 5-20-20, which means that the fertilizer contains by weight 5% nitrogen, 20% phosphorus, as P_2O_5, and 20% potassium, expressed as K_2O.

3. Amount of fertilizer to apply.

When a soil test is made, use the amount and analysis suggested for the specific location. In the absence of a soil test, the following amounts should be adequate:

For common Kentucky bluegrass or a bluegrass mixture apply 40 to 50 pounds per 1000 square feet of a high phosphate analysis fertilizer, such as 6-24-12, 8-16-16; 6-10-4, 4-12-4, 5-10-5 or similar analysis.

For Merion Kentucky bluegrass use the same amount of 15-15-15, 12-12-12, 10-10-10 or similar analysis.

4. Method of application.

The needed fertilizer may be raked into the soil surface for most new lawns. Where soil test shows extreme lack of phosphorus, work the soil deeper.

5. Fertilizer forms.

Some farm granulated or pelleted fertilizers are hard to get through some lawn spreaders; they may work better in the spinner types of spreaders.

Many brands are formulas of liquid fertilizers and soluble powders are available. These produce no better results than the same quantities of plant nutrients supplied from dry fertilizers. Liquids may be more convenient for you to apply; however, they may be more expensive than dry fertilizer.

Suggested Student Activities:

1. Test soil.
2. Measure lawns and compute fertilizer requirements.
3. Apply fertilizers to lawns with different types of applicators.

Teaching Materials:

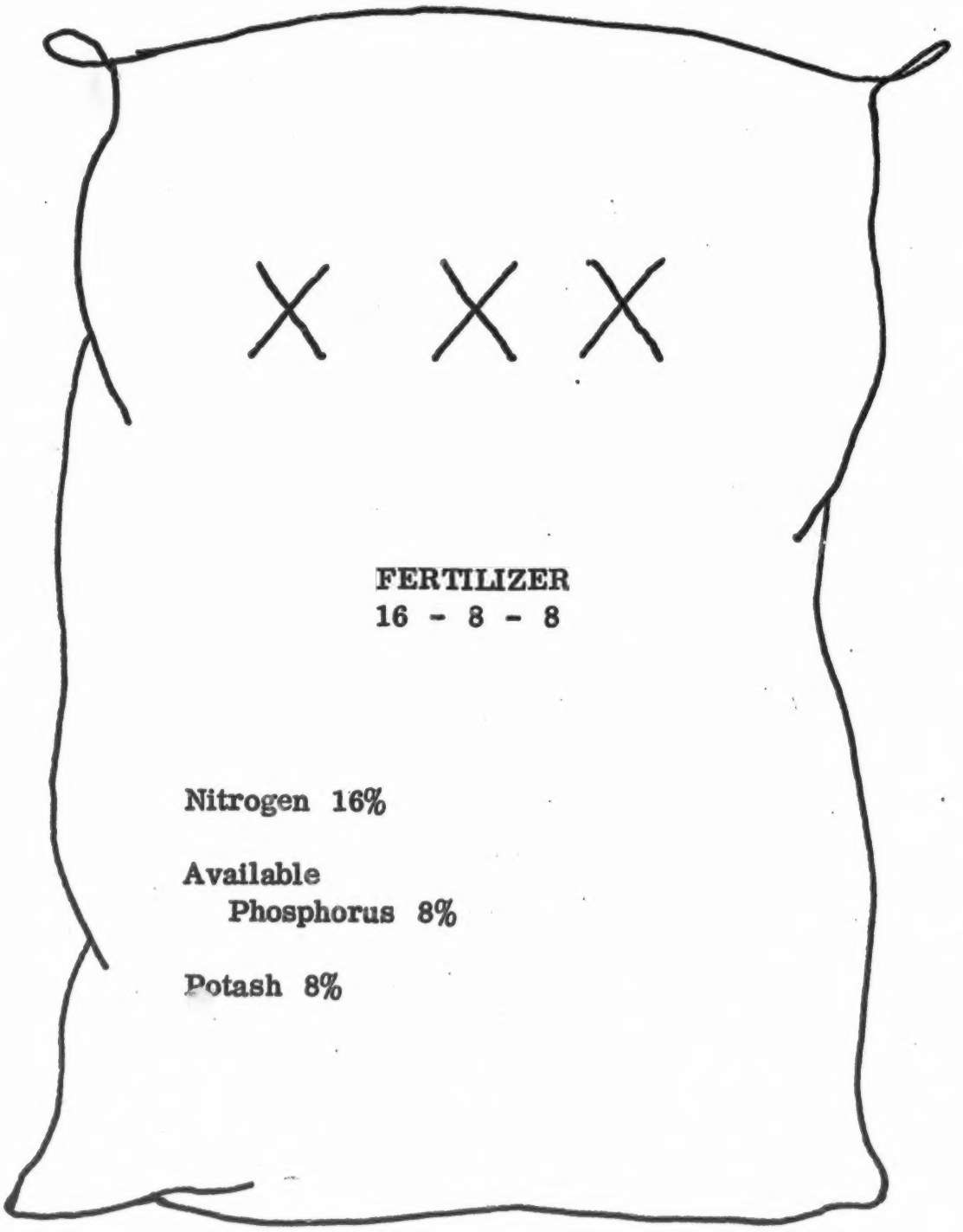
1. Soil sampling tube.
2. Lawn fertilizer spreader.
3. Samples of fertilizer and fertilizer forms.
4. Sample of soil test sheet.
5. Charts.

References:

"Your Lawn," O.S.U. Bulletin 271, pp. 4, 9, 11.

Norman K. Hoover, Approved Practices in Beautifying the Home Grounds. (Danville: Interstate Publishers & Printers, 1959), pp. 93-95.

Nitrogen (N) | Available Phosphorus (P_2O_5) | Potash (K_2O)



PROBLEM IV:

LIMING

Items to Consider:

1. Soil testing.
2. pH level of soil.
3. Need for lime.
4. Type of lime suitable.
5. Time and placement of lime.

Related Information:

1. Soil testing.

Where needed, applications of lime greatly improve the growth and appearance of lawn grasses. The only way to be sure whether or not your lawn needs lime is to have the soil tested. Soil tests every 3 to 5 years determine the lime needs and serve as a check on liming programs.

2. pH level of soil.

Apply enough lime to bring the soil reaction to a pH of 6.0 to 6.5, where a soil pH test indicates that lime is needed.

3. Need for lime.

For every 1# of nitrogen applied as ammonia sulfate, 5# of lime are required to maintain the soil reaction at a given level.

Example: If your fertilizer program includes 3# of nitrogen from ammonia sulfate per 1000 square feet every year, you should apply 30# of lime per 1000 square feet every two years.

4. Type of lime suitable.

Finely ground or pulverized limestone is easily applied, is effective, and does not irritate the skin as does hydrated lime.

5. Time and placement of lime.

Lime may be applied at anytime; however, the best times are late fall or early spring. Work the lime into your soil to a depth of 3 to 6 inches.

Suggested Student Activities:

1. Take soil samples for testing.
2. Calculate the lime requirement according to soil test and to fertilizer applied.
3. Apply lime to a lawn.

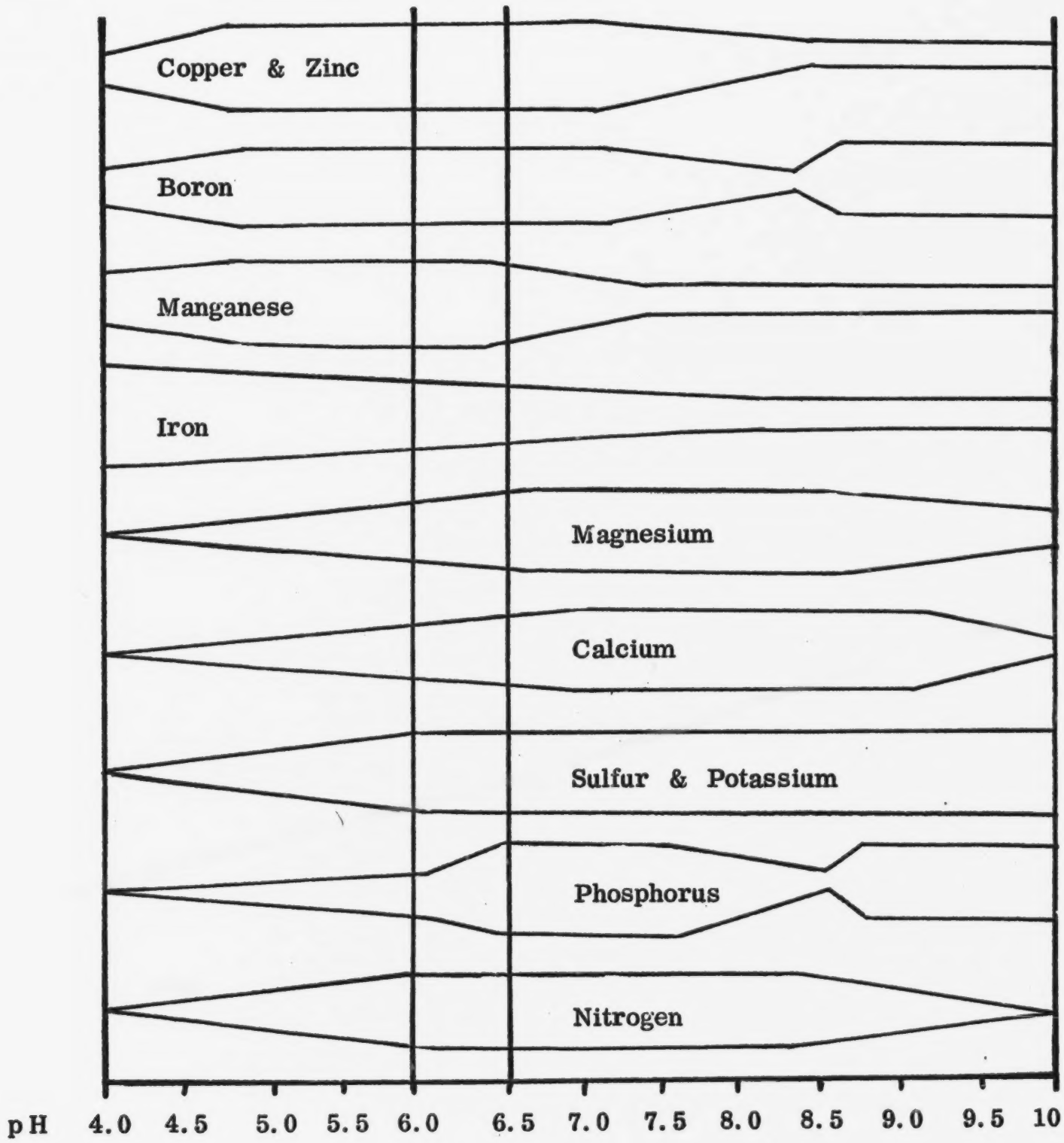
Teaching Materials:

1. Soil sampling tube.
2. Soil test report sheet.
3. Samples of different forms of lime.
4. Chart on nutrient availability at different pH levels.

References:

"Your Lawn," O.S.U. Bulletin 271, pp. 4, 11, 12.

Effect of Soil Reaction (pH) on the Relative Availability of Plant Nutrients



PROBLEM V:

PREPARATION OF SEED BED

Items to Consider:

1. Top soil.
2. Adding sand.
3. Adding organic matter.
4. Grading and draining the lawn.
5. Fitting the soil.

Related Information:

1. Top soil.

Every house-building contract should provide for all topsoil to be piled separately for the final grading and for debris to be removed (not buried on the site.)

How much topsoil is needed? The more the better - from 3 to 4 up to 6 to 8 inches.

Buy topsoil? This is expensive, and much so-called topsoil is little better than the soil you have. Insist on good loamy texture or don't buy it.

2. Adding sand.

Add sand? A small amount of sand may do more harm than good. Enough coarse sand to make up 50 to 80% of the resulting mixture will improve the physical condition of clay soil if uniformly mixed.

3. Adding organic matter.

Add organic matter? In starting a new lawn, add peat to fine textured basement soil. This will greatly improve its physical makeup if you use enough peat. Get fibrous peat (baled sphagnum is best) rather than muck which contains a large amount of clay. Mix the peat with the upper 3 or 4 inches of soil or with less soil if you use only a small amount of peat. Apply at least a one inch layer of peat or compost and work it into the soil.

4. Grading and draining the lawn.

Good surface drainage, so that water does not stand on the lawn is essential. It is doubtful that tiling adds enough to the average lawn to justify the expense as long as good surface drainage is provided.

When grading, slope the subsoil away from the house. A slope of one foot drop in fifty linear feet is adequate. Steep slopes should be avoided if possible. They are not attractive, are difficult to maintain and watering is a problem.

Grading operations should be so planned that the graded subsoil area and fill will have ample time to settle before topsoil is added and final grading is complete. Allow for several heavy rains to penetrate the soil,or heavy watering will aid the settling process.

5. Fitting the soil.

Plow, rototill, disc or spade the soil 3 to 6 inches deep. Work the soil only when moisture conditions are normal. Do not work soil when it is saturated with moisture.

Plowing or spading followed by disking and hand raking are the best methods of preparing the soil for planting.

Suggested Student Acitvities:

1. Lay off a grade line.

2. Observe soils on a lawn before preparation for seeding.

3. Prepare a seed bed for a new lawn.

Teaching Materials:

1. Transit.

2. Samples of light, medium and heavy soils.

3. Samples of different organic matter forms.

4. Slides showing a grading operation.

References:

"Your Lawn," O.S.U. Bulletin 271, pp. 3-5.

Norman K. Hoover, Approved Practices in Beautifying the Home Grounds, pp. 74, 76, 77.

"Better Lawns," U.S.D.A., Home and Garden Bulletin No. 51, pp. 3, 6.

PROBLEM VI:

SEEDING AND MULCHING

Items to Consider:

1. Securing even distribution of seed.
2. Getting seeds covered the proper depth.
3. Mulching and mulches to use.
4. Securing quick growth.
5. How to protect seedlings on slopes.

Related Information:

1. Securing even distribution of seed.

Sow the seed evenly with a spreader. Plan to go over the area to be seeded twice, preferably in a different direction each time. With a low seeding rate it is easier to get good distribution if something is added to the seed to make more bulk.

2. Getting seeds covered the proper depth.

Rake the seed lightly into the soil. If you can still see some seed after raking you have not covered the seed too deeply.

Cover the seed lightly by hand raking or by dragging with a brush or mat. Cover large seeds 1/4 to 3/8 inch deep and small seeds 1/8 to 1/4 inch deep. Firm the seeded area by rolling with a light roller or cultipacker.

3. Mulching and mulches to use.

Apply a mulch at once after seeding. Perhaps the best mulch is an eighth of an inch of ground sphagnum peat. Straw applied in a thin layer is also satisfactory. When the job is finished you should see half soil and half straw when looking directly down on it.

It is not necessary or desirable to remove a mulch when you have spread the proper amount evenly. Piles of mulch caused by wind should be respread or removed to prevent smothering the young grass.

4. Securing a quick growth.

Pre-soaking the seed of bluegrass in water speeds up germination. The purpose of pre-soaking of all species of Poa is to remove an inhibiting chemical which prevents rapid germination. Soaked seed of Merion will germinate in

six days in late August, 7 to 10 days in early September and in less than two weeks in late September. Without this treatment it may not sprout for 20 to 40 days.

5. How to protect seedlings on slopes.

On terraced areas or on sloping banks cheesecloth open-mesh sacking or commercial mulching cloth will help hold the moisture and seeds in place. Grass will grow through the mulching material which may be left to rot.

Suggested Student Activities:

1. Set up sloping and level seed plots. Seed and water.

2. Use mechanical seeder with various lawn seeds in farm shop to check evenness of seeding.

3. Price mulches a local nurseries.

4. Use fan to show separation of light seeds.

5. Seed small area in school lawn.

Teaching Materials:

1. Seeders.

2. Various lawn seed mixtures.

3. Fan

4. Seeding tools, such as rakes, shovels, etc.

References:

"Your Lawn," O.S.U. Bulletin 271, p. 8.

"Better Lawns," U.S.D.A., Home and Garden Bulletin No. 51, p. 9.

R. Milton Carleton, Your Lawn: How to Make It and Keep It, pp. 77-78.

PROBLEM VII:

IRRIGATING A NEW LAWN

Items to Consider:

1. Time to irrigate.
2. Type of soil.
3. Amount of water to apply.
4. Sprinkling systems.

Related Information:

1. Time to irrigate.

Water the surface and keep it moist until the seedlings are established. This usually means that you will need to sprinkle the new seedlings lightly at least twice a day, sometimes more often, depending on how hot the weather is and how often it rains.

As the plant develops and roots become deeper intervals between waterings should be lengthened and the quantity of water used in each application increased.

In general, a program of proper watering to assure a successful lawn seeding means that each morning, if rain does not fall the night before, you should turn on the sprinklers for thirty minutes. If the sun is shining and the temperature is 80 degrees or above turn them on again thirty minutes at noon. Repeat for twenty minutes in late afternoon or evening.

2. Types of soil.

Sands require irrigation more often than silt and silts more often than clay provided other factors are equal.

3. Amount of water to apply.

In new seedlings it is necessary only to keep the top one inch of the soil wet. Water must be applied slowly so that the surface will not puddle or crust. Frequent waterings, often two or more times a day, may be necessary.

Avoid watering the lawn lightly at frequent intervals; this causes shallow growth of grass roots and stimulates growth of weeds. The deeper rooted the grass the less often it is necessary to water.

4. Sprinkling systems.

To prevent damage to a newly seeded lawn make provisions beforehand for a lawn watering setup.

For the great majority of cases, a simple arrangement of hose lines and sprinklers will be excellent. Whether you buy or borrow them, the big thing is to be sure you have enough so that every inch of the surface can be covered - with overlapping sprinkler patterns - without shifting the individual units.

Suggested Student Activity:

1. Visit a newly planted lawn.

2. Observe different types of sprinklers.

3. Lay out a sprinkling system to get an even distribution.

4. Experiment with different amounts and frequencies of water on grass seed to determine difference in depth of root growth.

Teaching Materials:

1. Sprinklers.

2. Soil samples.

3. Grass seed.

4. Small boxes to test plant growth.

References:

"Your Lawn," O.S.U. Bulletin 271, p. 8.

Robert W. Miller, "Irrigation of Turf Grass," Mimeo, Department of Agronomy, Ohio Agricultural Experiment Station, Wooster, Ohio.

"Better Lawns," U.S.D.A., Home and Garden Bulletin No. 51, p. 13.

R. Milton Carleton, Your Lawn: How to Make It and Keep It, pp. 75-76.

PROBLEM I:

CULTURAL PRACTICES FOR LAWN MAINTENANCE

Items to Consider:

1. Raking.
2. Rolling.
3. Aeration.
4. Mowing.

Related Information:

1. Raking the lawn.

Rake the lawn about a week before the time for the first mowing in the spring to remove twigs, leaves and dead grass. Rake easy to avoid pulling out the grass by the roots, especially that which may have heaved during the winter. Avoid excessive raking during the growing season except when leaves are falling from the trees. Do not allow leaves to remain on the lawn for any extended period of time. The leaves will reduce the amount of air and light to the grass blades which will slow the growth of the plants.

2. Rolling the lawn.

Rolling will not make an uneven lawn smooth, but it will bring the surface of a thin lawn to its original level by pushing down bunches of grass which were heaved during the freezing and thawing. If rolling is needed it should be done just after the frost has left the soil but not while it is muddy. A water-weighted roller without the water has sufficient weight. Too much weight may cause excessive compaction which can retard growth and water infiltration.

3. Aeration of the lawn soil.

Aerating may improve water infiltration on some lawns, especially areas with itght soils. Mechanical aerators are of particular benefit on steep slopes or on paths that receive a great deal of traffic. If an aerator is used it should be the type that removes a plug of soil, and it should be operated when the soil is moist.

If an aerator is properly operated it will not harm the turf surfact or injure the grass. It will permit better penetration of water and fertilizer.

4. Mowing the lawn.

Lawns of Kentucky bluegrass should be cut about 2 inches high and as often as necessary so that no more than an inch of leaf is removed at each mowing. The food for the plant is produced in the leaf through the action of sunlight, so the more of the leaf that is left the more food that is produced and thus the stronger the plant. The depth and strength of the grass roots are proportional to the top growth. Close mowing, especially in hot weather, will weaken or may kill most of the cool season grasses.

The Merion variety of bluegrass can be cut from 1 to 1/2 inches without danger of killing the plants. This variety can withstand the closer mowing in regards to weed infiltration as can be seen in the data below. Mowing height can play an important role in weed control. The following results are from work that was conducted at The Ohio State University:

Bluegrass Variety	Number of weeds per sq./ft.	
	3/4" mowing	2" mowing
Merion	3	0
Delta	23	3
Park	25	3
Common Kentucky	21	6

Frequent mowing will reduce to a minimum any problems created from clippings since the short pieces of leaf that are cut off can disappear among the grass blades. Allowing the clippings to remain on the lawn will benefit thin stands by conserving moisture, keeping the soil cooler and permitting the reuse of the fertilizing materials in the grass blades that are cut off. With heavy fertilization it may be necessary to remove the clippings early in the spring to prevent a rapid build up of "thatch" which can mar the apperance and increase disease problems.

Suggested Student Activities:

1. Adjust mowers to the proper height.
2. Adjust reel mower for clean cutting.
3. Observe a commercial aerator in operation.

Teaching Materials:

1. Reel type mower.
2. Rotary mower.
3. Commercial aerator.
4. Assorted colored slides showing height of cut and weed control.
5. Chart on height of cut and weed control.

References:

"Your Lawn," O.S.U. Bulletin 271, pp. 13, 19.

"Better Lawns," U.S.D.A., Home and Garde Bulletin No. 51, pp. 13, 21.

Norman K. Hoover, Approved Practices in Beautifying the Home Grounds, p. 97.

Robert W. Miller, "Irrigation of Turf Grass," Mimeo.

PROBLEM II:

FERTILIZING AN ESTABLISHED LAWN

Items to Consider:

1. Time of application.
2. Analysis and rate of application.
3. Methods of applying.
4. Fertilizer burning.

Related Information:

1. Time of application.

Unless a soil test indicates otherwise, a complete fertilizer should be applied in September for best results. If spring applications are to be made they should be applied before the green growth has started. Additional nitrogen can be supplied about July 15.

Time of application of nitrogen on Merion bluegrass should be between March 15 to April 15, June 1 to the 15th, and July 15 to August 15.

2. Analysis and rate of application.

Any complete fertilizer, such as 10-10-10, 12-12-12 or an equivalent, can be used for the fall or early spring application. The rate should not exceed two pounds of actual nitrogen per 1000 square feet. (To determine the rate needed divide the per cent nitrogen, which is the first number in the fertilizer analysis, into pounds of nitrogen to be applied per application.)

Example: 20-10-5 analysis, 2# N wanted per 1000 square feet
2 lbs. ÷ .20 = 10# of 20-10-5 to give 2# of actual nitrogen

The additional nitrogen applied during the growing season should be at the rate of one pound nitrogen per 1000 square feet and in the form of soluble inorganic or soluble organic fertilizer. (Care must be used to prevent burning with these materials.)

Common Kentucky bluegrass should receive a total of three to four pounds of nitrogen per 1000 square feet per year. Merion bluegrass lawns should receive a total of five to seven pounds of nitrogen per 1000 square feet per year.

3. Method of application.

It is safe to broadcast all types of fertilizer on lawns at recommended rates early in the spring if you apply them before green growth has started.

4. Fertilizer burning.

All soluble nitrogen fertilizer materials if not properly applied can cause a light burning of the grass leaves which can be unsightly for a week or more. The following precautions should be taken to avoid these fertilizer burns:

a. Do not apply more than two pounds nitrogen per 1000 square feet at one time.
b. Always spread evenly. Do not overlap or spill materials.
c. Apply fertilizer only when foilage is dry to prevent sticking to the foilage.
d. Use granulated or pelleted material instead of pulverized material to prevent sticking to foilage.
e. Water immediately after application to remove fertilizer material from the leaves and put into the soil solution.

Suggested Student Activities:

1. Determine amounts of different analysis of fertilizers needed to apply the recommended amounts of nitrogen.

2. Fertilize a lawn.

Teaching Materials:

1. Lawn fertilizer applicator.

2. Samples of fertilizer and fertilizer forms.

3. Charts.

References:

"Your Lawn," O.S.U. Bulletin 271, pp. 9-11.

"Better Lawns," U.S.D.A., Home and Garden Bulletin No. 51, p. 15.

SOME FORMS OF LAWN NITROGEN FERTILIZERS

Type of Fertilizer	Common Name	Approximate Nitrogen Content	Pounds Needed To Supply One Pound Nitrogen
1. Soluble, inorganic	Ammonia Sulfate	20%	5
	Ammonia Nitrate	33%	3
	Nitrogen Solutions	24-32 %	4-3
2. Soluble organic forms	Urea	45%	2.2
3. Insoluble organic forms	Urea form	38%	2.6
	Soybean Meal	5-10 %	10-20
4. Activated sewage sludge		5%	20

EXAMPLES OF LAWN FERTILIZER GRADES

A	B	C	D	E	F
15-15-15	20-10-10	15-10-5	20-5-5	10-3-7	20-0-0 Ammonia Sulfate
12-12-12	16-8-8	20-10-5	20-8-8	12-5-7	33-0-0 Ammonia Nitrate
10-10-10	14-7-7	23-12-6		15-5-5	45-0-0 Urea
	12-6-6	16-8-4			38-0-0 Urea Form
	10-5-5				5-5-0 Activated Sewage Sludge
	10-6-4				

PROBLEM III:

WEED CONTROL IN ESTABLISHED LAWNS

Items to Consider:

1. Using management practices to control weeds.
2. Chemicals for controlling annual grass weeds.
3. Chemicals for controlling perennial grass weeds.
4. Chemicals for controlling broadleaf weeds.

Related Information:

1. Management practices to control weeds.

Weeds in lawns are usually the result of poor management practices. This might be in soil preparation before seeding, fertilization, improper mowing or impurity in the grass seed. Producing a dense, healthy stand of turf grass is the most satisfactory method of controlling lawn weeds. This can be produced by (a) fertilizing at the proper time with the right materials, and (b) mowing at the recommended height.

Since perfect maintenance is seldom achieved on all lawns in the neighborhood and since weeds can spread from one lawn to another, it is sometimes necessary to use herbicides to control certain weeds.

2. Chemicals for controlling annual grass weeds.

Annual grasses are those which grow from seeds each year. Some of the annual grasses that are found in Ohio lawns are: crabgrass, foxtail, barnyard grass and goosegrass. Of these,the crabrass is the most common and the herbicides that control it will usually give some control of the other annual grass weeds.

There are two basic ways of controlling crabgrass with herbicides: (a) the pre-emergence sprays and (b) the post-emergence sprays. The pre-emergence application should be made in the late winter or early spring before the crabgrass seeds germinate. This will be before April 1 in southern Ohio and April 15 in the northern part of the state. Materials containing Dacthal or Zytron have resulted in excellent control in several years of tests at the Ohio Agricultural Experiment Station. Bandane at the rate of one pound per 1000 square feet has also given good crabgrass control without injury to the established lawn grasses. Combinations of these materials are available commercially and should be used as directed on the label of the container.

Post-emergence herbicides should be used as soon as the crabgrass is seen in the turf. Make applications about a week apart until the crabgrass is killed. The two most effective and widely used post-emergence herbicides are DMA (disodium methylarsonate) and AMA (octyl-doedcyl ammoniummethyl-arsenate). Kentucky bluegrass may be slightly discolored with these materials, but no serious injury should result.

3. Chemicals for controlling perennial grass weeds.

Perennial grasses are those that come back from roots or stems each year. Most lawn grasses are perennials, but there are several which may be objectionable in lawns. Two of the most common of these are quackgrass and orchardgrass with timothy and tall fescue causing trouble in come lacalities. These grasses can be killed by dissolving 1/4 pound of Dalapon in a gallon of water and applying this solution to the individual plants or infested areas. (Lawn grasses are also killed by this spray, so care must be used to hit only the spots desired.) The Dalapon will disappear from warm moist soil within three to six weeds and slightly slower in cool or dry soils. These areas can then be reseeded or resodded after this waiting period.

A summer grass, nimblewill, can usually be controlled by using liquid Zytron at the rate of 15 pounds per acre. This material, when mixed with water, should be applied in May and again in June. In some tests at Columbus in 1962 and 1963 this treatment resulted in good control with little injury to Kentucky bluegrass.

4. Chemicals for controlling broadleaf weeds.

Most common broadleaf weeds can be eliminated with one or more applications of 2,4-D. Fall is the best time for general treatment with 2,4-D When the weeds are killed the lawn grass has a chance to fill the vacant space before crabgrass germinates in the spring. The amine formulations should be used since they are less folatile and will not drift as much as the ester formulations. Spraying should be done only when the wind is quiet,and direct contact with all flowers, vegetables, trees and shrubs should be avoided.

A standard lawn solution of 2,4-D is one tablespoon of four pounds per gallon amine formulation in one gallon of water. Apply to wet the weeds to the point of run-off. On an acre basis, this is one pound per acre. On lawns containing bentgrass the rate should be reduced by 50%.

Not all broadleaf weeds commonly found in some lawns will be killed with 2,4-D. Silvex is suggested for trial use for any broadleaf weed that is not killed by the 2,4-D. Use the rate suggested on the label which is about 1 1/2 pounds per acre. Do NOT use on bentgrass lawns.

(See chart on following page.)

SOME COMMON LAWN WEEDS AND CHEMICAL CONTROLS

Weeds	Chemical to Use	Time of Application
Black medic	Silvex	early spring
Carpetweed	2, 4-D	spring
Carrot, wild	2, 4-D	spring
Chickweed	Silvex	spring or fall
Chicory	2, 4-D	spring
Dandelion	2, 4-D	fall or spring
Dock, curly	2, 4-D	fall or spring
Garlic or onion	2, 4-D (ester	late fall or early spring
Ground ivy	Silvex	summer or fall
Knotweed	2, 4-D or Dicamba*	spring or early fall
Pigweed	2, 4-D	summer
Plantain, buckhorn	2, 4-D	fall or spring
Plantain, common	2, 4-D	fall or spring
Poison ivy	2, 4, 5-T or Silvex	spring or summer
Red sorrel	Silvex of Dicamba*	spring, summer or fall
Spurge, spotted	Silvex	spring
Thistle	2, 4-D	spring and fall
White clover	Silvex	spring or fall
Wood sorrel	Silvex	spring
Yarrow	Silvex	spring

*Available only to professional turf men.
----"Your Lawn," O.S.U. Bulletin 271, p. 17.

Suggested Student Activities:

1. Identification of broadleaf and grass weeds found in lawns.
2. Demonstrate the proper use of spraying equipment.
3. Practice calculation on how to mix herbicides for proper application.
4. Practice calibration of granular spreaders.

Teaching Materials:

1. Mounted weed specimens or live specimens.
2. Knapsack sprayer and granular spreader.
3. Colored slides of common weeds.

References:

"Your Lawn," O.S.U. Bulletin 271, pp. 13-17.

"Better Lawns," U.S.D.A., Home and Garden Bulletin No. 51, p. 15.

Norman K. Hoover, Approved Practices in Beautifying the Home Gr nds, p. 106.

"Twelve Weeds Found in Your Lawn," The Ohio State University, Department of Agricultural Education, Ohio Vocational Agriculture Instructional Materials Service, 1964.

PROBLEM IV:

DISEASE CONTROL IN LAWNS

Items to Consider:

1. Cause of lawn diseases.
2. Prevention of common lawn diseases.
3. Chemicals for controlling lawn diseases.
4. Identification of common lawn diseases.

Related Information:

1. Causes of lawn diseases.

Fungi cause most of the serious diseases in lawns. These organisms usually produce seeds (technically called spores) that are spread by wind, water, mowers, infected grass clippings and numerous other ways. These fungus "seeds" need moisture and proper air temperature before they can cause infection. Diseases of lawns are therefore most common and harmful during warm, humid seasons. Although the temperature is virtually impossible to control, diseases may be started by too frequent watering during dry summer months.

Most of the fungi that attack lawn grasses occur in the form of microscopically small filaments or threads. This mass of threads, which sometimes has a cobwebby appearance, are called mycelium. Only those fungi that get their nutrients from a living host are true disease organisms. Such organisms cause Helminthosporium leafspot, fading-out, brown patch, rust, grease-spot, dollar spot and snow mold.

Mushrooms and slime mold in lawns are other examples of fungi, but they are not true disease organisms. They do not attack the lawn grasses directly, but they are a common lawn problem.

2. Prevention of common lawn diseases.

Proper lawn maintenance practices can help prevent many of the common diseases by eliminating the ideal conditions for their establishment. Practically all parasitic fungi of grasses can become established in the damp mulch from clippings. Here they flourish and attack healthy grass growing through the mulch. To guard against this, do not allow the clippings to accumulate more than 1/4 inch.

Since moisture is also necessary for fungi to become established, it is best to irrigate early in the day so the plants and clippings have a chance to dry before night. It is desirable to irrigate to a greater depth of penetration and less frequently rather than a little water at close intervals.

3. Chemicals for controlling lawn diseases.

The use of fungicides on lawn diseases is very expensive and time consuming due to the number of times they must be applied during the growing season. Some of the materials are poisonous and must be handled with extreme care, even to the extent of keeping children and pets off the grass until after a rain or irrigation.

When spraying fungicides use pressures as high as possible (up to 300 psi) to insure good penetration and distribution of materials. Using a wetting agent will also help to give a better coverage of all plants. Some of the materials containing mercury should not be used during hot weather.

Some of the common lawn diseases and the chemicals to use are:

a. Helminthosoporium Leaf Spot (Melting-out, Fade-out, Dying-out) --- Spray every two to three weeks with Captan 50%, Dyrene 50%, Kromad or Zineb 75%.

b. Brown Patch --- Spray weekly with Cal-lor, Tersan OM or Kromad plus Calocure.

c. Rust --- Spray with Acti-dione Ferrated (40 to 60 ppm in two gallons of water), Acti-dione + Thiram or Zineb.

d. Snow Mold --- Spray with Tersan OM, Calocure or Cal-clor before the first heavy snow; spray during the growing season as for Melting-out.

4. Identification of common lawn diseases.

a. Helminthosoporium Leaf Spot --- Thinning out of the grass in scattered areas with a brownish undercast caused by the dead grass leaves. Close examination reveals spots on the leaves. These spots are usually brown, purple or brown with a purple border.

b. Brown Patch --- This disease appears as somewhat circular brown patches up to several feet in diameter. The grass leaves first appear watersoaked and dark, but they soon dry, wither and turn light brown.

c. Rust --- Redish-brown or orange spots on the grass blades with this rusty colored material easily rubbing off onto fingers or shoes. It is most likely to become a problem in August or September following extended hot and dry periods. Severely rusted lawns may winterkill more easily. Merion bluegrass and ryegrass are particularly susceptible.

d. Snow Mold --- Common systems are patches of whitish, bleached, dead areas of grass which may be as large as several feet in diameter. In the spring a whitish pink or dirty gray to black mold growth may be present.

e. Dog Injury --- A lawn discoloration which may sometimes be mistaken for a disease is dog injury. These are normally small spots about three inches in diameter, straw colored and often within a short distance of the house or in certain areas of the lawn.

TROUBLE SHOOTING FOR LAWN DISEASES

Condition	Problem
1. Small, oblong purplish to brown spots on leaves. Turf appears thin with reddish-brown undercast in the summer.	Helminthosporium Leaf Spot
2. Small yellow to orange or reddish-brown pustules on leaves. Rust color.	Rust
3. A fine, gray-white, flour-like deposit on the grass blades.	Powdery Mildew
4. A gray to black, soot-like mold or white or yellow masses on the leaves.	Slime Mold
5. Long, yellow-green streakes or gray to black color in the leaf. tissue. Mainly on Merion bluegrass.	Stripe Smut
6. Dark green grass in a circular pattern.	Fairy Ring.
7. Patches of whitish, dead, bleached areas of grass. May be several feet in diameter. Whitish pink or dirty gray to black mold growth often present in spring.	Snow Mold
8. Small spots - 3 inches in diameter, straw color, often within 30 to 40 feet of the house or in certain areas of the lawn.	Dog Injury

---"Your Lawn," O.S.U. Bulletin 271, p. 21.

Suggested Student Acitvities:

1. Demonstration on use of wetting agents.

2. Identification of common lawn diseases.

Teaching Materials:

1. Knapsack type tank sprayer.

2. Wetting agents for fungicide application.

3. Colored slides showing common diseases.

4. Chart "Trouble Shooting for Diseases."

References:

"Lawn Diseases," United States Department of Agriculture, Home and Garden Bulletin No. 61, 1960, p. 4.

"Lawn Diseases in the Midwest," North Central Regional Extension Publication No. 12, Agricultural Extension Service, 1961, p. 3.

"Your Lawn," O.S.U. Bulletin 271, p. 21.

PROBLEM V:

INSECT AND PEST CONTROL IN LAWNS

Items to Consider:

1. Damage caused by lawn insects and pests.
2. Chemicals to control insects and pests.
3. Safety measures when using insecticides.

Related Information:

1. Damage caused by lawn insects and pests.

Many insects and insect like pests damage lawns and other turf areas. They may cause the grass to turn brown and die or they may build many unsightly mounds that may smother the grass. Some of the pests infest the soil and attack the plant roots; some feed on the plant leaves and stems; others suck juice from the plants.

White Grubs --- These are usually thick, sluggish, white-bodies "worms" with yellowish-brown heads and legs. When full grown the grubs are 3/4 to 1 1/2 inches long. They are the larval stage of Japanese, May or June beetles. The grubs feed on the roots of the grass just below the soil surface, causing areas of dead grass.

Cutworms --- These are the larval stages of night-flying moths called "Owlet Moths." The caterpillars are smooth, nearly naked, dull colored and marked with spots and stripes. They vary in length from one to two inches when fully grown. Cutworms feed mostly at night and are present in the lawn from spring until late summer. Cutworms damage the grass by chewing off the leaves and sometimes the entire stem. The injury appears as tunnels of dead grass, which may be six inches in length.

Sod Webworms --- These are usually short, rather thickbodies, spotted, coarsely haired and active worms from 1/2 to 3/4 inch long. In early morning when the dew is present, white webs are easily seen in the lawn. They cut circular or irregular areas around their holes.

Ants --- These insects will build nests in the ground and usually form mounds around the openings. These anthills may smoother the surrounding areas. Roots of the grass may also be destroyed.

2. Chemicals to control lawn insects and pests.

All insects and insect like pests can be controlled with insecticides such as chlordane, DDT, aldrin, dieldrin, heptachlor and malathion. These can be

purchased in various types of formulations and concentrations. Dusts and granules are ready-to-use formulations that can be applied with a dusted of fertilizer spreader. Wettable powders and emulsifiable concentrates must be mixed with water to make a spray. These sprays can be applied with a tank type garden sprayer.

Ground moles can be controlled by spraying the lawn to kill the white grubs. If the white grubs are killed, the moles are usually not a problem since the grubs are the source of food for the moles.

3. Safety measures when using insecticides.

Most insecticides or pesticides are poisonous and should be handled with extreme care. Do not apply any insecticide to a lawn when people or animals are on it; do not allow the material to drift to an area where it might injure people or pets. After an insecticide has been applied to a lawn the grass should be sprinkled before allowing children or pets to be on it.

USE PESTICIDES CAUTIOUSLY

Always read the label before using a pesticide. Note warnings and cautions each time before opening the container. Read and follow directions for use.

Keep pesticides away from children, pets, and irresponsible people.

Store pesticides in a secure place in their original labeled containers.

Do not smoke while using insecticides.

Do not breathe spray mist or dust.

Do not get pesticides in eyes, or on skin or clothing. If spilled on skin or clothing, wash thoroughly with soap and water and change clothes.

Wash hands and face thoroughly before partaking of food.

Dispose of empty containers so they pose no hazard to humans, animals or valuable plants.

Sweep dusts or granules from sidewalks and driveways.

Use a hose to thoroughly water-in any insecticide application so that residues do not remain on the grass blades or the granules or dusts remain on the surfact of the soil. However, certain herbicides and fungicides should remain on the foilage for effectiveness. FOLLOW ALL DIRECTIONS ON THE LABEL.

Suggested Student Activities:

1. Inspect a lawn or other turf for insect damage.

2. Inspect for white grubs by peeling back a strip of sod.

3. Demonstrate the application of dusts and granules.

Teaching Materials:

1. A dust applicator.

2. Specimens of lawn insects.

3. Colored slides showing damage from insects.

References:

"Your Lawn," O.S.U. Bulletin 271, p. 20.

"Better Lawns," U.S.D.A., Home and Garden Bulletin No. 51. p. 19.

"Lawn Insects," United States Department of Agriculture, Home and Garden Bulletin No. 53, 1956, p. 23.

PROBLEM VI:

MAINTENANCE IRRIGATION

Items to Consider:

1. Water importance to growth.
2. Water requirements.
3. Drought tolerance of different grasses.
4. Frequency and amount of irrigation.

Related Information:

1. Water importance to growth.

Water is important to plant growth because:

a. A large percentage of the plant protoplasm is water.

b. Water is essential to photosynthesis and hydrolytic processes, such as digestion of sugar to starch.

c. Water is the solvent which carries nutrients from soil to plant cells.

d. Water maintains turgidity which stimulates opening of stomata (minute openings in leaves) and movement of flower parts and leaves. Lack of turgidity slows growth.

--- Only about 5% of water taken in is used for physiological process; 95% goes out through transpiration and must be replaced as it is lost.

2. Water requirements.

The daily consumption of water by turf varies widly, owing to differences in climatic and other conditions. Estimated quantities range from ten to sixty gallons per thousand square feet. From five hundred to six hundred pounds of water or more is needed for each pound of dry matter produced by grass, thus fast growing turfgrass species require more water than the slower growing ones.

3. Drought tolerance of different grasses.

	Drought Tolerance
High	Tall Fescue
↕	Red Fescue
	Kentucky Bluegrass
	Perennial Ryegrass
	Colonial Bentgrass
Low	Creeping Bentgrass

4. Frequency and amount of irrigation.

During periods of the growing seasons when light showers occur soils should be examined following a rain to check on penetration. If moisture has moved down to less than a three inch depth and the soil is dry below water should be applied.

You may water whenever the lawn needs it, whether the sun is shining or not. Wet the soil to a depth of six to eight inches. This may require that the sprinkler remain in one place for several hours. Do not apply water faster than the soil will absorb it. During rainless periods you should expect to water your lawn every week to ten days.

One inch of rain in 24 hours is considered heavy rain. Most lawn sprinklers apply water at the rate of at least one inch an hour: very few soils can absorb water this quickly. Penetration can be satisfactory without mechanical means by repeated light sprinkling. Let the sprinklers operate until water begins to run off, then turn them off for a while and repeat the process several times.

Suggested Student Activities:

1. Observe the water holding capacity of different types of soil.

2. Check different mechanical sprinklers for amount of water put on in one hour.

Teaching Materials:

1. Soil samples.

2. Different types of water sprinklers.

References:

"Your Lawn," O.S.U. Bulletin 271, p. 20.

Norman K. Hoover, Approved Practices in Beautifying the Home Grounds, p. 104.

Robert W. Miller, "Irrigation of Turf Grass," Mimeo.

Paul J. Kramer, "The Role of Water in the Physiology of Plants," Mimeo, Duke University, Durham, North Carolina.

PROBLEM VII:

RENOVATION

Items to Consider:

1. When to renovate.
2. Mechanical procedures to use.
3. Chemicals to use.

Related Information:

1. When to renovate.

Early fall is the best time to renovate a lawn. If less than 50 per cent of the lawn consists of desirable grasses it is usually best to get rid of all grasses, prepare a new seedbed and plant new grasses.

2. Mechanical procedures to use.

Here are the steps in lawn renovation:

a. Get rid of all weeds, leaves and undesirable grasses. Mow closely, rake to remove the clippings, leaves and other debris and then apply chemical weed killers to eliminate undesirable species.

b. Rake the lawn vigorously or cultivate it in such a way that the surface of the soil is loosened. This forms a rough seedbed for planting.

c. Fertilize, lime and plant in the same manner prescribed for establishing a new lawn.

3. Chemicals to use.

Experience has shown that the combination of a chemical and a tiller will give better kill of the unwanted plants than either used alone.

Some of the chemicals used in lawn renewing experiments are: Methyl bromide, SMDC (Vapam), Amitrol or Amitrol-T plus dalapon, Amitrol-T, Paraquat and Cacodylic acid.

New chemicals are being developed annually. For the most recent recommendation consult the latest information from the Ohio Agricultural Experiment Station, Wooster, Ohio.

Suggested Student Acitivities:

1. Make a count of desirable grasses in a lawn to determine if a lawn should be renovated.

2. Renovate a portion of school or other locally available lawn.

References:

"Your Lawn," O.S.U. Bulletin 271, p. 31.

"Better Lawns," U.S.D.A., Home and Garden Bulletin No. 51, p. 4.

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Miller, Robert W. "Some Characteristics of Various Turf Grasses," Mimeo, Department of Agronomy, Ohio Agricultural Experiment Station, Wooster, Ohio.

"Lawn Diseases in the Midwest," North Central Regional Extension Publication No. 12, Agricultural Extension Service, 1961.

"Your Lawn," The Ohio State University Bulletin 271, Cooperative Extension Service, Revised 1964.

"Better Lawns," United States Department of Agriculture, Home and Garden Bulletin No. 51, 1962.

"Lawn Diseases," United States Department of Agriculture, Home and Garden Bulletin No. 61, 1960.

"Lawn Insects," United States Department of Agriculture, Home and Garden Bulletin No. 53, 1956.

"Twelve Weeds Found in Your Lawn," The Ohio State University, Department of Agricultural Education, Ohio Vocational Agriculture Instructional Materials Service, 1964.

A Test for Students of Vocational Agriculture On Lawns

Name_____School_____Grade_____

General Instructions: This test includes 50 items of various types regarding the above topic. Directions are included at the beginning of each section.

SECTION I: True and False

Answer the following questions true or false. Place the symbol (+) in front of the true statements and the symbol (0) in front of the false statement.

__0__ 1. The best time to seed a lawn is usually in the month of April.

__0__ 2. Weeds such as ragweed and pigweed are a severe problem with fall seedings.

__+__ 3. Kentucky bluegrass is the basic lawn grass in Ohio.

__+__ 4. Bentgrass in a lawn will tend to crowd out Kentucky bluegrass.

__+__ 5. Ryegrass will establish itself much faster than Kentucky bluegrass.

__+__ 6. Tall fescue is one of the most wear-resistant grasses used in Ohio.

__0__ 7. Most lawns in Ohio would benefit from a higher percentage of ryegrass in the seeding.

__0__ 8. The plant food element needed most by lawns is potassium.

__0__ 9. Liquid fertilizers will produce much better results than the same plant nutrients applied in dry form.

__+__ 10. Lime is needed on a lawn if the pH is 6.5 or below.

__+__ 11. Small lawn seeds should be covered with not over 1/4" of soil.

__0__ 12. Mulch should always be removed after the lawn has become established.

__0__ 13. Rolling a lawn in the spring is an excellent practice to help smooth' uneven lawns.

__+__ 14. Merion bluegrass should be cut to a height of 1 to 1 1/2".

__+__ 15. Clipping should be done slightly higher with a rotary than with a reel type mower.

__+__ 16. Weeds will not usually be a serious problem if good lawn management practices are followed.

__+__ 17. 2, 4-D will control most broadleaved weeds.

__0__ 18. Management practices on lawns have little effect on fungus growths in the lawns.

__+__ 19. An insecticide which destroys white grubs will also rid a lawn of moles.

__+__ 20. No more than 2 pounds of Nitrogen per 1,000 square feet shoud be applied on a lawn at one time.

SECTION II: Multiple Choice

Select the answer which best completes the statement. Place the letter in the blank at the beginning of the statement.

__c__ 21. The most drought tolerant of the following listed grasses is:
a. Kentucky bluegrass.
b. Creeping bentgrass.
c. Tall fescue.
d. Perennial ryegrass.

__a__ 22. The grass which should be mowed the highest is:
a. Kentucky bluegrass.
b. Merion bluegrass.
c. Creepint bentgrass.
d. Tall fescue.

__c__ 23. In seeding new lawns use all of the following practices except:
a. Seed in both directions.
b. Rake the seed into the soil.
c. Mulch deep enough so no soil is visible.
d. Cover small seeds 1/8 to 1/4 inch deep and large seeds 1/4 to 3/8 inch deep.

__a__ 24. In preparing the seedbed for a new lawn a practice which is not desirable is:
a. Add a small amount of sand to the soil.
b. Add organic matter to the soil.
c. Slope the soil away from the house.
d. Allow subsoil to settle before adding topsoil.

__c__ 25. The fertilizing element most needed to stimulate root growth is:
a. Potassium.
b. Nitrogen.
c. Phosphorus.
d. None of these.

__a__ 26. The fertilizing element least likely to be lacking in lawns is:
a. Potassium.
b. Nitrogen.
c. Phosphorus.
d. None of these

__d__ 27. The grass most likely to grow well in shade is:
a. Tall fescue.
b. Kentucky bluegrass.
c. Perennial ryegrass.
d. Red fescue.

__b__28. The grass most likely to survive and grow well under close clipping is:
a. Red fescue.
b. Bentgrasses.
c. Perennial ryegrass.
d. Kentucky bluegrass.

__a__29. The grass most likely to survive under heavy wear is:
a. Tall fescue.
b. Red fescue.
c. Bentgrasses.
d. Kentucky bluegrass.

__b__30. A time of seeding in Central Ohio which would give the best chance of success is:
a. March 15 - April 15.
b. September 1 - 30.
c. October 15 - November 15.
d. December 1 - 30.

__c__31. Of the following stagements the one which does not apply to good lawn watering practices is:
a. Sands require irrigation more often than silts.
b. The deeper rooted the grass the less often you should water.
c. Water the lawn lightly at frequent intervals.
d. Silts require irrigation more often than clay.

__b__32. The amount of Kentucky bluegrass seed needed to seed 1,000 square feet:
a. 1/2 to 2 pounds.
b. 1 to 3 pounds.
c. 3 to 5 pounds.
d. 5 to 7 pounds.

__a__33. Which of the following lawn weeds if an annual?
a. Crabgrass.
b. Nimblewill.
c. Quackgrass.
d. Timothy.

__c__34. A fertilizer practice which will not help avoid plant burn is:
a. Water immediately after fertilizing.
b. Do not apply over 2 pounds Nitrogen per 1,000 square feet.
c. Use ammonium sulfate.
d. Use granulated rather than pulverized fertilizer.

__c__35. All of the following practices should be considered in lawn irrigation except:
a. Depth of water in the soil.
b. Amount of water runoff.
c. Whether or not the sun is shining at the time of irrigation.
d. Type of soil to be irrigated.

c 36. Lawns should be renovated if the per cent of lawn in desirable grasses is:
a. 25 - 40 per cent.
b. 10 - 25 per cent.
c. Less than 50 per cent.
d. Less than 75 per cent.

b 37. When killing weeds in lawns with 2, 4-D the formulation should be:
a. Ester.
b. Amine
c. Either ester or amine.
d. Neither ester nor amine.

c 38. Grass leaves affected with reddish-brown or orange spots on the blades have:
a. Leaf spot.
b. Brown patch.
c. Rust.
d. Fade-out.

c 39. A tool which removes a plug of soil from the lawn is used to:
a. Cool the soil.
b. Irrigate the soil.
c. Aerate the soil.
d. Compact the soil.

SECTION III: Matching

Place the letter that best describes the term in front of the number at the left.

d 40. Phosphorus.	a. Promotes hardiness and disease resistance.
b 41. Nitrogen.	b. Stimulates rapid growth.
a 42. Potash.	c. Supplied by manganese sulfate.
e 43. Lime	d. Promotes root growth.
	e. Raises soil pH test.

SECTION IV:

Complete the following mathematical problems. Show your work under the problem.

44. A lawn measures 90' x 100'. At a rate of 1 1/2 pound of bluegrass per 1000 square feet how much would the seed cost for this lawn if bluegrass seed costs $ .56 per pound?

Answer $ 7.56

45. A lawn is 60' wide and 120' deep. How many gallons of water are placed on this lawn when 3" of water are applies? (One cubic foot of water equals 7.5 gallons.)

Answer 13,500

SECTION V: Interpretation of Data

Place an A in front of each statement that is tru and can be proven by the data below. Place an O in front of each statement that may or may not be true but cannot be answered sufficiently from the data below. Place an I in front of each statement that is incorrect according to the data below.

Height of Mower Cut --- Merion Bluegrass

Mower type and height of cut	Per cent bare spots	Density*	Color**	Overall appearance ***
Reel 1" Rotary	2	9.5	4.8	8.2
Rotary 1"	6	8.0	2.2	5.0
Reel 2"	1	10.0	3.5	8.0
Rotary 2"	1	9.8	2.5	7.2

*Scale 1-10.....10 = very dense.....1 = bare soil
**Scale 1-5 ..... 5 = dark green.....1 = light green to brown
***Scale 1-10.....10 = good appearance....1 = unsatisfactory appearance

__A__ 46. The density of the lawn is greatest where a reel mower is used at a height of 2".

__I__ 47. The overall appearance of the lawns mowed with a rotary mower is better than those mowed with a reel type.

__O__ 48. Using a rotary mower on a bentgrass lawn hurts the color.

__A__ 49. Fewer bare spots are found with a 2" height of cut than with a " height.

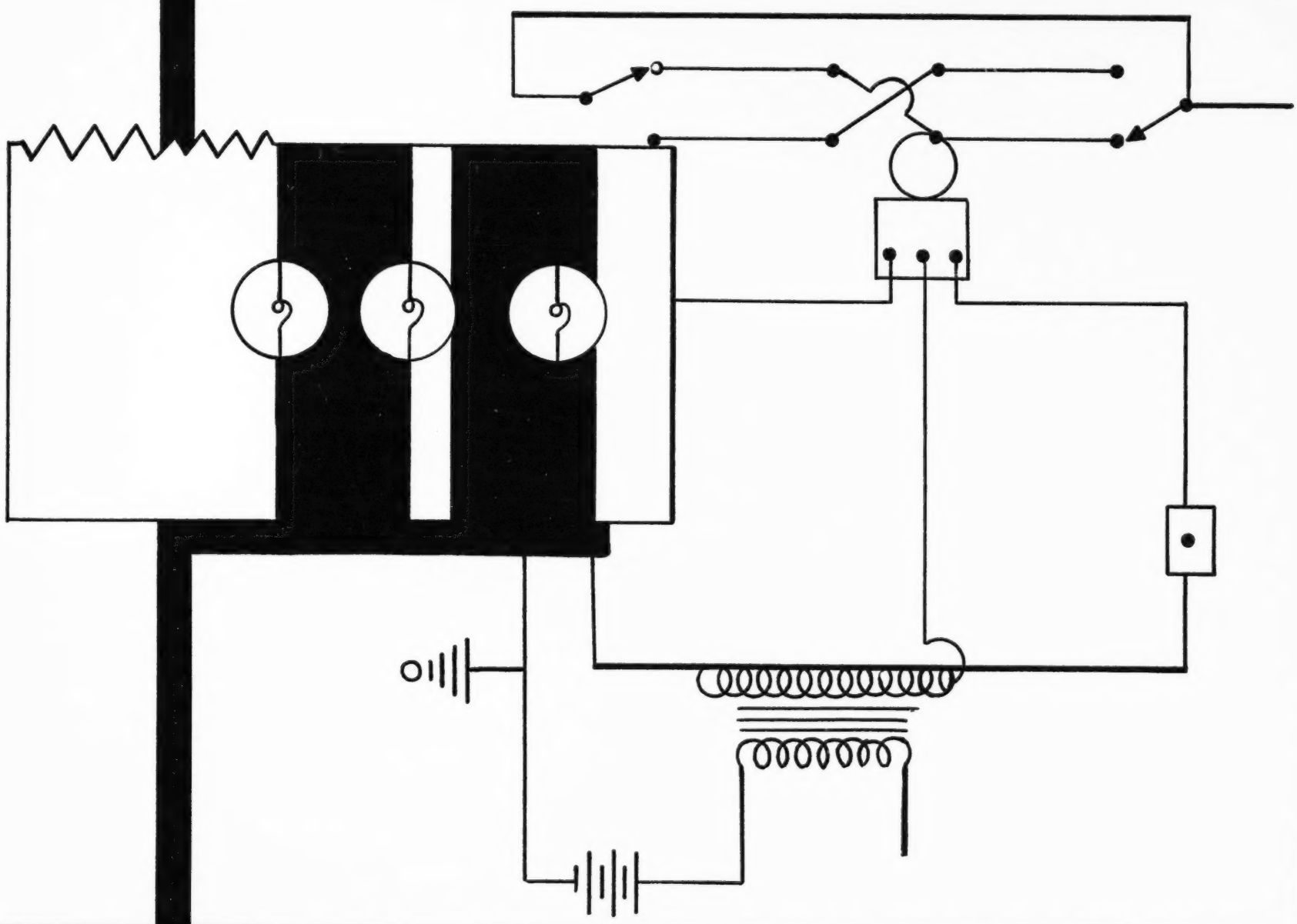
__A__ 50. A reel type mower leaves the lawn with a better color than the rotary type mower.

Lawn and Ornamental Day Report, September 15-16, 1964, O.A.E.S., Wooster, Ohio, p. 10.

ED013339

INDUSTRIAL ARTS

APPLIED ELECTRICITY



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INDUSTRIAL ARTS SERIES

APPLIED ELECTRICITY

1963

Issued by:

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and

Industrial Education Section
State Department of Education
Jefferson City, Missouri

FOREWORD

This course of study is designed to provide direct assistance to industrial arts teachers of Applied Electricity concerned with the teaching of the basic principles of electricity and their application to electrical devices.

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We also wish to acknowledge our indebtedness to Dr. H. H. London, Professor of Industrial Education at the University of Missouri, for his participation in promoting this publication and for directing and administering the Curriculum Materials Laboratory in which this publication was prepared, and to Mr. James B. Karnes, Instructor in Industrial Education at the University of Missouri, who supervised the preparation of the material and edited the manuscript. The content of this course of study was developed by an advisory committee representing power producers, the electrical industry, and industrial arts education. Credit is due to Mr. Robert J. Spinti, Research Assistant in Industrial Education at the University of Missouri, who compiled this material and prepared the assignment sheets.

HUBERT WHEELER

Commissioner of Education
State Department of Education

September 1963

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MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) James B. Karnes (Agency) University of Missouri at Columbia.

(Address) 103 Industrial Education Bldg., Columbia, Missouri

DATE: August 5, 1967

RE: (Author, Title, Publisher, Date) Industrial Education Dept., Univ. of Mo. at Columbia.
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Uses of Material Comprehensive course of study (including assignment sheets, testing & supplementar aid
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(4) Requirements for Using Material:
Teacher Competency Qualified teacher of basic electricity
Student Selection Criteria 8th or 9th grade level minimum; suitable fo initial instruction at post-secondary level.
Time Allotment 360 hours related instruction and laboratory experienc

Supplemental Media --
Necessary XX)
Desirable XX) (Check Which)

Describe p Required texts; supplementary references and instructio aids.

Source (agency) See attached list for required texts only. Others
(address) available various sources.

TEXTBOOKS AND REFERENCES FOR APPLIED ELECTRICITY

A. Buban, Peter, and Schmitt, Marshall L., Understanding Electricity and Electronics, McGraw-Hill Book Company, New York, N.Y., 1962.

B. Marcus, Abraham, Basic Electricity, Prentice-Hall, Inc., Englewood Cliffs, N.J., 1958.

C. Steinberg, William B., and Ford, Walter B., Electricity and Electronics - Basic, American Technical Society, Chicago, Illinois, 1961.

PREFACE

In a publication of this type there are numerous individuals and organizations that make contributions which are significant and it is difficult to give appropriate credit. In the development and publication of this course of study for Applied Electricity, the activities of the Missouri Farm Electric Utilization Council merit unusual and special recognition, for without their financial help this publication would have been impossible. For a number of years the education committee of this Council has been engaged in various activities concerned with improving the knowledge of electricity and its application.

An appraisal by the Industrial Education staff of the State Department of Education indicated that the lack of a well-organized course of study in Applied Electricity was a factor limiting the expansion of instruction in this area. Members of the Industrial Education staff of the State Department of Education and the Industrial Education Department at the University of Missouri met with the education committee of the Missouri Farm Electric Utilization Council and a means of producing such a publication wa discussed. The activities culminated in an approval by the Council of a plan whereby a grant of $2500 would be made to pay a part-time graduate student at the University of Missouri to prepare the course of study.

This course of study was prepared under the direction of an advisory committee representing the Council and professionally trained and experienced high school and college industrial arts teachers as well as representatives from the State Department of Education, all of whom played an important part in providing technical and professional direction to the work. The committee was composed of the following:

Mr. Paul Henson, Manager, Boone Electric Cooperative, Columbia, Missouri.
Mr. James B. Karnes, Instructor in Industrial Education, University of Missouri, Columbia, Missouri.
Mr. Harold F. Klaus, Power Use Advisor, Black River Electric Cooperative, Fredericktown, Missouri.
Dr. H. H. London, Professor of Industrial Education, University of Missouri, Columbia, Missouri.
Mr. Ken McFate, Associate Professor of Agricultural Engineering, University of Missouri, Columbia, Missouri.
Mr. Carl Shubert, Sales Representative, Kansas City Power and Light Company, Brunswick, Missouri.
Mr. W. J. Spinabella, Power Use Specialist, Sho-Me Power Corporation, Marshfield, Missouri.
Mr. Robert J. Spinti, Research Assistant in Industrial Education, University of Missouri, Columbia, Missouri.
Mr. Maurice L. Stewart, Supervisor of Industrial Education, State Department of Education, Jefferson City, Missouri.
Mr. William J. Streib, Instructor in Industrial Education, University of Missouri, Columbia, Missouri.
Mr. Merton Wheeler, Director of Industrial Education, State Department of Education, Jefferson City, Missouri.
Mr. Ray Wheeler, Rural Specialist, Missouri Power and Light Company, Jefferson City, Missouri.

Appreciation is expressed to Mr. Jarrel Hofer, Industrial Arts Instructor at Hickman High School, Columbia, Missouri, for the availability of teacher-made instructional aids which are illustrated in this publication.

The members of the committee drew upon the experiences and best practices of up-to-date programs in the teaching of electricity to decide upon the approach around which this course of study is organized rather than use the type of "take home" project which is traditionally found in such a course as an instructional vehicle. Research and best practices indicate that instruction which consists of experiments or activities presenting the principles and their application is the most effective instruction. Therefore, the nature of the activities assigned in this course has been designed to provide these concepts in the manner research indicates is the most effective presentation.

A wide variety of available books, laboratory manuals, and other instructional materials were examined and many which seemed to be most applicable were included either as basic or supplementary references.

The study of electricity is a broad and comprehensive undertaking and an attempt has been made in this course of study to provide enough detail by which the conscientious teacher can do a successful job of presenting the material.

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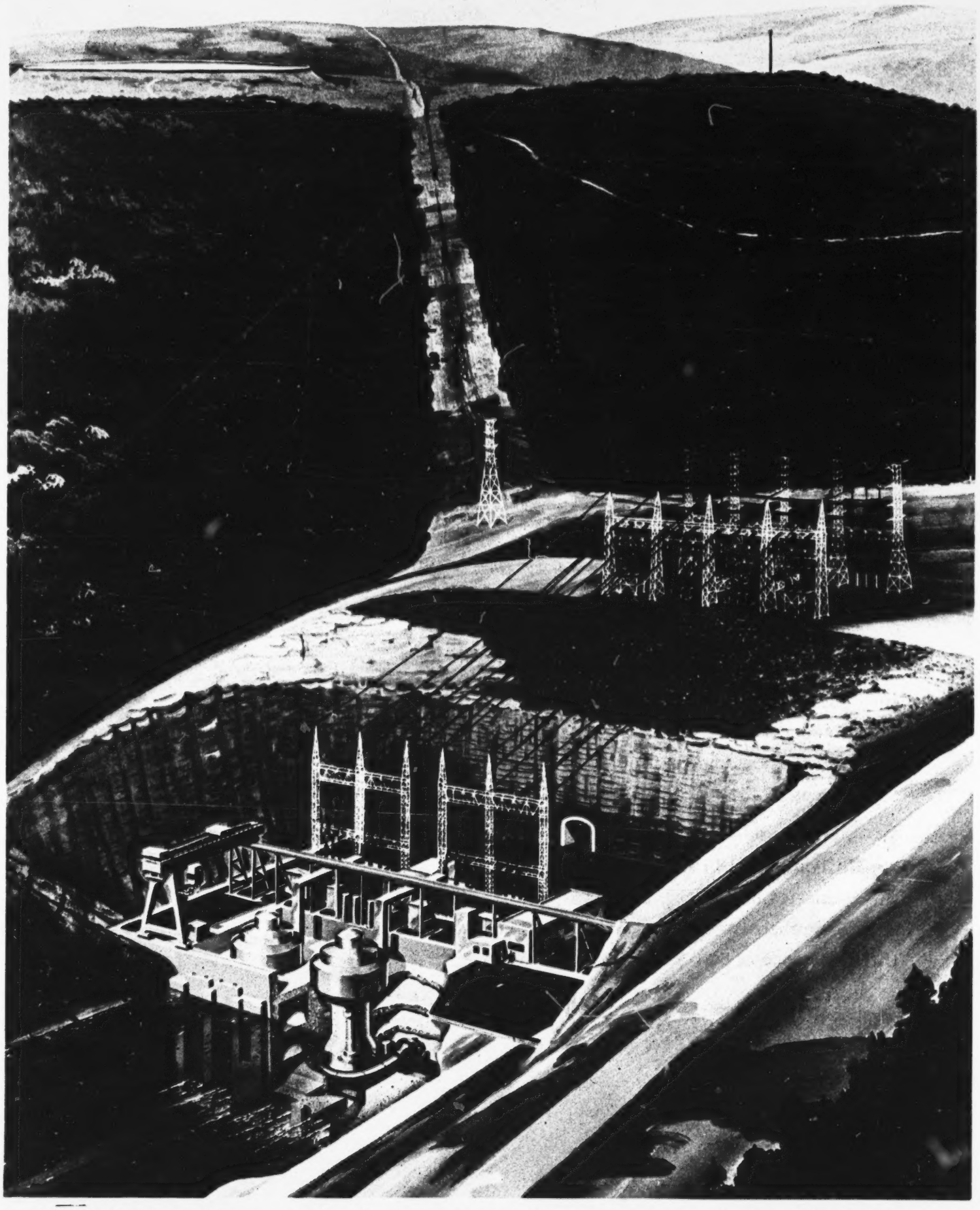


TAUM SAUK, Pumped Storage Hydro plant near Lesterville, Missouri, was developed by Union Electric Company at a cost of $50,000,000. Low-cost, off-peak steam generated electricity pumps water 300 feet "up hill" at night and on weekends to the large storage reservoir on top of Proffit Mountain (upper left). When consumer's demand for electricity is greater during daytime hours, the water in the reservoir is released and comes back "down the hill" to drive the reverse pump turbine (shown in cut away) which economically generates electricity used to meet these peak demands. (Courtesy of Allis-Chalmers, Milwaukee, Wisc., mfr. of pump turbines.)

INTRODUCTION

Many factors have contributed to the technological developments which are continually shaping modern industrial America. However, one of the prime influences in America's technological progress has been the harnessing of the natural phenomenon known as electricity. An understanding of electrical principles is fundamental to the advancements being made in the fields of communication, heat, light and power. From space exploration to microbiology, from the automatic washer to the automatically controlled machine tool, from the electrically controlled home workshop to the automated industrial production line, electricity and the principles which control its use are assuming increasing significance. There are few places where one could go and not find usable electricity made available by one of America's many electrical power distributors.

All of the people in your community are consumers of electricity and electrical products; the students in your school are affected by electricity each day. Many of them will someday be employed in occupations which are directly dependent upon electricity and most all of them will work in buildings that are lighted and climate controlled by electricity. Certainly all of them will be consumers of electricity and electrical products. Therefore, it is apparent that they should have sufficient knowledge and understanding of the field of electricity to permit safe and effective use of this valuable natural resource.

In view of the influence which electricity exerts, and will continue to exert, on the lives of all youth, no secondary school program can be considered adequate that does not provide for a systematic study of electricity and its uses.

OBJECTIVES OF APPLIED ELECTRICITY

The objectives or aims of a course should serve three purposes: as goals or end points to be attained, as guides in the selection and teaching of content, and as standards for evaluation of achievement.

It is believed that the following objectives conform to the generally accepted objectives of secondary education and to those of industrial arts education.

This course has been planned and organized to provide the student with opportunities to:

1. Develop interest in and an understanding of the role which electricity plays in his home, his community and in his industrial-technical world.
2. Acquire consumer knowledge which will permit effective selection, care, and use of various electrical products and testing devices.
3. Develop safe and efficient work habits and techniques relating to electricity and electrically powered equipment.
4. Acquire information and have exploratory experiences with various aspects of the electrical industry in order to gain a better understanding of occupational opportunities in the broad field of electricity.
5. Develop a depth of understanding of electrical principles and the competencies necessary to perform a wide variety of fundamental tasks in the electricity field.

SCOPE AND CONTENT OF COURSE

It is the purpose of this comprehensive course of study to provide direct assistance to the industrial arts teacher as he establishes or revises a course designed to teach the basic principles, their application to electrical devices, and the associated competencies essential to the safe use of electricity in the home, on the farm, as well as in business and industry.

This course is designed to provide instruction for the eleventh or twelfth grade except where local variations must be considered. The class should meet one hour a day five days a week for thirty-six weeks, and should carry one unit of credit. The sequence of the course is presented in the following major divisions:

Fundamentals of Electricity

Magnetism and Electromagnetism

Sources and Distribution of Electrical Energy:
- Electro-chemistry
- Mechanical
- Other

Electrical Conductors and Heat

Light from Electricity

Residential Wiring

Motors

Controls

Appliances

Automotive Electricity

Electronics

TEXTBOOKS AND REFERENCES

Textbooks:

It is difficult to select a single textbook for a course such as Applied Electricity which encompasses all of the planned content in the proportion and scope desired. There are several publications available that might serve equally well; however, most assuredly any one of them would have to be supplemented to a certain degree. It is also realized that teachers with varying backgrounds will be teaching Applied Electricity in courses with varying time allotments to students with varying abilities; therefore, recommendations were not limited to a single text in the hope that the teacher will select instructional materials which are most appropriate for the instructional situation at hand.

For implementing the content selected for this course, three books, any one of which could serve as a text, are suggested as basic references. Each of these books is preceeded by a code letter which is used throughout this course of study to designate the book.

A. Buban, Peter, and Schmitt, Marshall L., Understanding Electricity and Electronics, McGraw-Hill Book Company, New York, N. Y., 1962.
B. Marcus, Abraham, Basic Electricity, Prentice-Hall, Inc., Englewood Cliffs, N. J., 1958.
C. Steinberg, William B., and Ford, Walter B., Electricity and Electronics - Basic, American Technical Society, Chicago, Ill., 1961.

The teacher should not feel confined to one of the above books as there are several others listed below as supplementary references which provide good sources of information and are coded as such on the various job and information assignment sheets designed for the course.

Supplementary References:

Publications to which this course of study is keyed

D. Arnold, Joseph P., and Schank, Kenneth L., Exploratory Electricity, McKnight and McKnight Publishing Company, Bloomington, Ill., 1960.

E. Cleveland Graphite Bronze Division, Clevite Corporation, 232 Forbes Rd., Bedford, Ohio, Information on "Spark Pump."

F. Crow, Leonard R., Learning Electricity Fundamentals, Howard W. Sams, Inc., Indianapolis, Ind., 1957, $5.95.*

G. Gabbert, William L., Electrical Appliance Service Manual, Holt, Rinehart and Winston, New York, N. Y., 1954.

H. Gannon, Robert, "Spark Pump Fires Engine," Popular Science, July, 1961.

I. Information Sheets, this manual.

J. Gerrish, Howard H., Electricity and Electronics, Goodheart-Willcox Company, Chicago, Ill., 1964.

K. Graham, Kennard C., Fundamentals of Electricity, Fourth Edition, American Technical Society, Chicago, Ill., 1960, $4.75.

L. Graham, Kennard C., Interior Electric Wiring - Part I - Residential, American Technical Society, Chicago, Ill., 1961.

M. Jones, E. W., Fundamentals of Applied Electricity, Revised Edition, Bruce Publishing Co., Milwaukee, Wisconsin, 1956, $3.80.*

N. Lightning Facts and Figures, Lightning Protection Institute, 53 West Jackson Blvd., Chicago 4, Ill.

O. Lush, Clifford K., and Engle, Glenn E., Industrial Arts Electricity, Third Edition, Charles A. Bennett Company, Peoria, Ill., 1959.

P. Manual, SE-2 Kit, Brodhead-Garrett Co., Cleveland, Ohio.

Q. National Electrical Manufacturers Association, Manual for Electric House Heating, 155 East 44th Street, New York 17, N. Y., $ .50.

R. Panel of Consultants on Vocational Education, Education for a Changing World of Work, OE No. 80020, U. S. Government Printing Office, Washington 25, D. C., 1962, $ .30.

S. Richter, H. P., Wiring Simplified, Park Publishing Company, Minneapolis, Minn. (available from Montogomery-Ward, Inc.).

T. Sears, Roebuck and Company, Simplified Electric Wiring Handbook.

U. Turner, Rufus P., Basic Electricity, Second Edition, Holt, Rinehart and Winston. New York, N. Y., 1963.

V. Tustison, F. E., and Ruehl, Phillip W., Electrical Essentials, Bruce Publishing Co., Milwaukee, Wis., 1955.

W. U. S. Department of Defense, Graphical Symbols for Electrical and Electronic Diagrams, Part I, U. S. Government Printing Office, Washington 25, D. C., 1961, $ .40.

X. U. S. Department of Defense, Electrical Wiring Symbols for Architectural and Electrical Layout Drawings, Part III, U. S. Government Printing Office, Washington 25 D. C., 1961, $ .15.

Y. U. S. Department of Labor, Control of Electric Shock Hazards, Bulletin 216, U. S. Government Printing Office, Washington 25, D. C., 1960, $ .15.

Z. Wellman, William R., Elementary Electricity, D. Van Nostrand Co., Princeton, N. J., 1959.

Other publications suggested for additional information

Basic Electricity, Howard W. Sams, Inc., Indianapolis, Ind., 1959, $3.60.*

Bureau of Naval Personnel, Basic Electricity, U. S. Government Printing Office, Washington, D. C., 1960, $3.50.

Cornetet, Wendell H., and Cornetet, Wendell H. II, Principles of Electricity and Basic Electronics, McKnight and McKnight Publishing Company, Bloomington, Ill., 1963.

Crouse, William H., Electrical Appliance Servicing, McGraw-Hill Book Company, New York, N. Y., 1960.

Duff, John R., Alternating Current Fundamentals, Delmar Publishers, Inc., Albany, N. Y., 1961.

Hausman, Erich, Swoope's Lessons in Practical Electricity, Eighteenth Edition, D. Van Nostrand Company, Princeton, N. J., 1948.

Jones, E. W., General Electricity, Second Edition, McKnight and McKnight Publishing Company, Bloomington, Ill., 1954.

Loper, Orla E., Direct Current Fundamentals, Delmar Publishers, Inc., Albany, N. Y., 1959.

Matson, C. E., 30 Instruction Units in Basic Electricity, McKnight and McKnight Publishing Company, Bloomington, Ill., 1961.

McIntyre, R. L., A-C Motor Control Fundamentals, McGraw-Hill Book Company, New York, N. Y., 1960.

U. S. Department of Labor, Dictionary of Occupational Titles, U. S. Government Printing Office, Washington, D. C., 1949, $4.00.

U. S. Department of Labor, Occupational Outlook Handbook, U. S. Government Printing Office, Washington, D. C., 1961, $4.50.

Van Valkenburgh, Nooger, and Neville, Basic Electricity, John F. Rider, Inc., New York, N. Y., 1954. (Available as five separate volumes, $2.25 each or bound in one volume $2.75).

Zbar, Paul B., and Schildkraut, Sid, Basic Electricity, Second Edition, McGraw-Hill Book Company, New York, N. Y., 1958.

Zbar, Paul B., and Schildkraut, Sid, Basic Electronics, Second Edition, McGraw-Hill Book Company, New York, N. Y., 1958.

Zbar, Paul B., and Schildkraut, Sid, Instructor's Guide for Basic Electricity, Basic Electronics and Basic Radio and Radio-Receiver Servicing, Second Edition, McGraw-Hill Book Company, New York, 1958, no charge.

*This price is subject to school discount.

ANALYSIS OF APPLIED ELECTRICITY

MANIPULATIVE OPERATIONS: What the Student Should Be Able to Do	Assign. No.	INFORMATIONAL TOPICS: What the Student Should Know
	Fundamentals of Electricity	
	1	1. The variety of uses of electrical energy
	1	2. The relative cost per kilowatt hour of electrical energy
	1	3. The nuclear structure of matter
	1	4. The electron theory of electricity
	1	5. Principles involved in electric circuits
	1	6. Applications of Ohm's Law in D. C. circuits
7. Wire a series circuit	2	7. Characteristics of a D. C. series circuit
8. Connect and read an ammeter	2	8. Applications of and precautions to observe with ammeters
9. Connect and read a voltmeter	2	9. Applications of and precautions to observe with voltmeters
10. Connect and read an ohmmeter	2	10. Applications of and precautions to observe with ohmmeters
11. Read scales on a volt-ohm-milliameter	2	11. Principles of volt-ohm-milliameters
12. Wire a parallel circuit	2	12. Characteristics of a D.C. parallel circuit
13. Calculate power from volt and ammeter readings	3	13. Relationship of Watt's Law to D.C. circuits
14. Read a kilowatt-hour meter	3	14. Rate structure used by power distributors
15. Calculate an electric bill		
16. Convert horsepower to kilowatts	3	16. Principles of conversion power measurement
17. Convert kilowatts to horsepower		
18. Calculate the efficiency of an electrical device	3	18. Factors involved in efficiency of electrical equipment
19. Replace a cartridge fuse link	4	19. Function and operating principles of fuses
20. Place a fuse in a circuit	4	20. Types and uses of fuses
21. Place a circuit breaker in a circuit	4	21. Operating principles of circuit breakers
	4	22. Types and applications of circuit breakers

MANIPULATIVE OPERATIONS: What the Student Should Be Able to Do	Assign. No.	INFORMATIONAL TOPICS: What the Student Should Know
23. Identify an open circuit	4	23. Characteristics of an open circuit
24. Ground a circuit	4	24. Types of electrical grounds
25. Identify a grounded circuit	4	25. Characteristics of a grounded circuit
	4	26. Effects of electricity on the human body
27. Mouth-to-mouth artifical respiration	4	27. First aid for electrical shock
28. Read electrical wiring diagrams	5	28. Interpretation of symbols used in wiring diagrams
29. Draw electrical symbols		
30. Read electronic schematic symbols		
31. Draw electronic schematic symbols (make electronic schematic drawing)	5	31. Interpretations of electronic schematic symbols
32. Connect a potentiometer in a circuit	6	32. Principle of voltage dividers
33. Connect a potentiometer in a circuit as a rheostat	6	33. Operating principles of a rheostat
	Magnetism and Electromagnetism	
	7	34. Types of natural magnets
35. Trace magnetic fields for like and unlike fields	7	35. Artificial magnets and their applications
36. Construct an electromagnet	7	36. Factors influencing the strength of electromagnets
37. Connect and operate a relay	7	37. Applications of electro-magnets
	7	38. Basic principles of induction in D.C. circuits
	Sources and Distribution of Electrical Energy	
	A. Electrochemistry	
	8	39. Operation, application, and limitations of primary cells
40. Test a cell with a hydro-meter	8	40. Operation, application, and limitation of secondary cells
41. Test cell voltage under load		
42. Connect cells in series		
43. Connect cells in parallel		
44. Connect cells in a com-bination circuit	8	44. Types of cell connections
	8	45. Principles of electroplating
	8	46. Principles of electroforming

MANIPULATIVE OPERATIONS: What the Student Should Be Able to Do	Assign. No.	INFORMATIONAL TOPICS: What the Student Should Know
	8	47. Principles of electrorefining
	8	48. Principles of electrochemical cleaning
	B. Mechanical	
	9	49. Principles of an induced current and voltage
	9	50. Principles of A.C. generators
	9	51. Principles of D.C. generators
	9	52. Methods of driving generators
	9	53. Characteristics of alternating current
	9	54. Basic principles of polyphase power
	10	55. Principles of transformer operation
	10	56. Sizes, ratings and applications of transformers (include current)
	10	57. Power distribution from generators to transmission lines
	10	58. Power tools and interconnections (include metering)
	10	59. Reasons for using high voltage and safety precautions
	10	60. Power distribution from transmission lines to residences
	C. Other Sources	
61. Measure current and voltage from a solar cell	11	61. Principles and applications of solar batteries
62. Measure current from a thermocouple	11	62. Principles and applications of thermocouples
	11	63. Problems with and applications of static electricity
	11	64. Principles and applications of piezoelectricity (spark pump)
	11	65. Principles and applications of nuclear power
	Electrical Conductors and Heat	
66. Gage a conductor with a gage	12	66. Gage system for nonferrous metals and wire
67. Gage a conductor with a micrometer		
	12	68. Purpose and characteristics of stranded conductors

MANIPULATIVE OPERATIONS: What the Student Should Be Able to Do	Assign. No.	INFORMATIONAL TOPICS: What the Student Should Know
69. Solder a wire to a tie point	12	69. Factors influencing resistance
70. Make and insulate a rat rail splice	12	70. Types and characteristics of insulation material used on current carrying conductors
71. Measure IR drop in a cord	12	71. Factors influencing voltage drop in a conductor
72. Calculate power loss in a cord	12	72. Factors influencing power loss in a conductor
	12	73. Principles of electrical heat production and control
	12	74. Types of residential electric heating
	12	75. Factors to be considered when applying electric heat to residential buildings
	Light from Electricity	
	13	76. Principles of incandescent lamps
77. Wire a fluorescent lamp	13	77. Principles of fluorescent lamps
	13	78. Principles of vapor lamps
	13	79. Principles of electro-luminescence
	13	80. Types of special lamps and their uses
81. Replace a lamp cord	13	81. Lamp basing, sizes, coatings, and shapes and applications
82. Take light measurements	13	82. Selection and location of light sources
83. Operate a photo-electric device	13	83. Photo-electric principles
	Residential Wiring	
	14	84. Services of Underwriter's Laboratories
85. Replace a grounding type duplex convenience receptacle	14	85. Basic wiring devices
86. Replace a flush single pole switch		
87. Replace a flush 3-way switch		
88. Replace a flush 4-way switch		
	14	89. Safety considerations in residential wiring
90. Install a switch box		

MANIPULATIVE OPERATIONS: What the Student Should Be Able to Do	Assign. No.	INFORMATIONAL TOPICS: What the Student Should Know
91. Wire an outlet from an existing outlet	14	91. Electrical codes and regulations governing wiring
	14	92. Advantages and limitations of different wiring media
	14	93. Types of service entrances and basic considerations in their use
	14	94. Grounding procedures for residential wiring systems
	14	95. Factors affecting, number, location and grounding of convenience receptacles
	14	96. Circuit design and load capacity for appliance installation
	14	97. Selection and location of fixtures
	14	98. Factors affecting the use of outdoor wiring and other decorative lighting
	14	99. Conditions and considerations governing the use of temporary wiring
	14	100. Factors to consider in locating switches
	15	101. Principles and application of low voltage wiring
102. Wire two point control with low voltage activator		
	15	103. Principles of operation and location of telephones
104. Wire a door bell (or chime) for front and rear door control		
	15	105. Principles of intercommunication, signal and alarm systems
	Motors	
106. Assemble and operate an electric motor	16	106. Principles of operation of a series or universal motor
	16	107. Principles of operation of induction motors
	16	108. Principles of operation of repulsion motors
109. Reverse a split-phase induction motor	16	109. Principles involved in reversing motors
110. Reverse a three-phase motor		
111. Reverse a repulsion-start induction-run motor		

MANIPULATIVE OPERATIONS: What the Student Should Be Able to Do	Assign. No.	INFORMATIONAL TOPICS: What the Student Should Know
	16	112. Principles of wiring dual voltage motors
	16	113. Typical applications of split-phase induction motors
	16	114. Typical applications of capacitance-start induction motors
	16	115. Typical applications of repulsion-start induction-run motors
	16	116. Typical applications of shaded pole motors
117. Select a motor for a given application	16	117. Typical applications of universal motors
118. Wire a 120 volt motor for 240 volts or vice versa	16	118. Typical applications of three-phase motors
119. Determine the conductor size for a given motor a specified distance from a power source	16	119. Necessity of "over current" protection for motors
	16	120. Types and application of common motor controllers
	16	121. Common motor speeds
122. Mount and adjust a motor to a belt driven load	16	122. Speed adjustment and drive mechanisms
123. Record name plate data from a motor	16	123. The meaning of name plate data
124. Identify a motor with a faulty bearing	16	124. Main causes of motor trouble and maintenance procedures
125. Identify a motor with an open starter winding		
126. Identify a motor with a faulty starter switch		
127. Identify a motor with a grounded winding		
128. Identify a motor with a shorted capacitor		
129. Identify a motor connected for the wrong voltage		
130. Replace brushes in a universal motor		
	16	131. Safety considerations with motors
	Controls	
132. Wire a thermostat	17	132. Principles of heat controls
	17	133. Principles of limit controls
	17	134. Principles of pressure controls
135. Wire a time control	17	135. Principles of time controls

MANIPULATIVE OPERATIONS: What the Student Should Be Able to Do	Assign. No.	INFORMATIONAL TOPICS: What the Student Should Know
	17	136. Principles of velocity controls
	17	137. Principles of humidity controls
	17	138. Principles of photoelectric controls
	Appliances	
139. Replace an insulated cord on a heat producing appliance	18	139. Principles of operation and care for heating appliances
140. Ground an electric washing machine	18	140. Principles of operation and care of electric washing machines
141. Replace rollers on a conventional washer		
142. Clean out pump on an automatic washing machine		
143. Clean condenser coils on a compressor	18	143. Principles of operation and care of cooling appliances
144. Replace an air conditioner filter		
145. Level a major appliance	18	145. Principles of operation and care of motor operated appliances
	18	146. Typical causes of operating difficulties with electric appliances
	18	147. Factors to consider in determining whether or not an appliance is repairable
	18	148. Factors to be considered in selecting appliances for purchase
	18	149. Methods of venting clothes dryers
	18	150. Types and uses of power cords
151. Wire an extension cord including a feed-through switch	18	151. Types and uses of cord ends and caps
	18	152. Electrical shock hazards with appliances
	18	153. Characteristics of grounded and shorted circuits
154. Test a heating element for continuity	18	154. Principles of continuity testing
	Automotive Electricity	
	19	155. Principles of a common return conductor
	19	156. Components and principles involved in the automobile lighting system

MANIPULATIVE OPERATIONS: What the Student Should Be Able to Do	Assign. No.	INFORMATIONAL TOPICS: What the Student Should Know
	19	157. Principles involved in the starting motor
158. Replace the brushes on a generator	19	158. Operating principles and components of the battery recharging system
159. Identify and locate faults in an ignition system	19	159. Operating principles and components of the ignition system
	19	160. Characteristics and uses of special automotive circuits
	Electronics	
	20	161. Electronic principles involved in vacuum tube operation
	20	162. Principles affecting function of rectifiers
163. Test a vacuum tube with a tube tester	20	163. Principles of tube testing
	20	164. Principles of semi conductor
	20	165. Essentials of a radio receiver
166. Block diagram a radio receiver		
167. Block diagram a home music system		
168. Block diagram a public address system		
	20	169. Factors to consider in public address installations
170. Block diagram a T-V receiver		
	20	171. Shock hazards with T-V receivers
	20	172. Principles of F.M. transmission and reception
173. Diagram an antenna installation	20	173. Factors influencing the installation of an effective antenna system
	20	174. Principles of capacitance
	20	175. Principles and applications of ultra-sonics
	20	176. Avocational applications of electronics
	21	177. Occupational opportunities in the electrical industries

SUGGESTED TEACHING PLAN

Suggested Activities	Demonstrations	Topics for Class Discussion	Informational Assignments	Other Instructional Aids
		FUNDAMENTALS OF ELECTRICITY		
		Increased use and decreasing cost of electricity.	1	Film: "What is Electricity"
		Nuclear structure and electron theory.		
	Solve problems with Ohm's Law.	Ohm's Law.		
1. Wire a series circuit.	Read an ammeter.	Construction, use, and precautions with meters.	2	Film: "Series and Parallel Circuits"
	Read a voltmeter.	Characteristics of D.C. series circuits.		
	Read an ohmmeter.			
	Read a VOM.			
	Wire meters in circuits.			
2. Construct a voltage tester.				
3. Wire a parallel circuit.		Characteristics of D.C. parallel circuits.		
4. Calculate electric power.	Measure power with wattmeter, voltmeter, and ammeter.	Electric power in D.C. circuits.	3	Rate cards from power distributors.
		Rate structures.		
		Power unit conversion efficiency calculation.		
5. Operate overcurrent protective devices.	Overload a fuse.	Overcurrent protective devices.	4	Start a file on newspaper clippings dealing with electric shock.
		Safety precautions with electricity , first aid.		
		Grounding considerations.		Make a demonstration board with the various sizes and types of fuses.
		Open and closed circuits.		
				Films: "Electrical Safety in the Home" "How to do Rescue Breathing?"
		Electrical and electronic schematic symbols.	5	Chart of symbols: available from Eico.
				Architectural plans with wiring diagrams and schematic circuit drawings.

SUGGESTED TEACHING PLAN - continued

Suggested Activities	Demonstrations	Topics for Class Discussion	Informational Assignments	Other Instructional Aids
6. Wire variable resistors.	Limit current with a rheostat. Divide voltage with a potentiometer.	Limiting current with resistance. Voltage dividing principles.	6	Mock-up or parts of equipment showing use of rheostats and potentiometers.
MAGNETISM AND ELECTROMAGNETISM				
7. Study effects of permanent magnets.	Make a dipping needle. Magnetize a bar held in earth's field. Demagnetize by holding East-West and striking.	Natural magnets. Earth's magnetic field. Materials used for permanent magnets. Magnetic field properties. Magnetic induction. Diamagnetic materials. Magnetic shielding.	7	Slide film: "Magnetism, or Permanent Magnets"
8. Make an electromagnet.	Magnetic field around a conductor Field around a coil. Change in flux with a core, change in amount of core. Change in flux with a change in ampere turns.	Magnetic field around a current carrying conductor. Factors influencing the strength of an electromagnet. Applications of electromagnets.		
9. Wire a relay.		Principles of operation of relays. Type of relays. Applications of relays.		
SOURCES AND DISTRIBUTION OF ELECTRICAL ENERGY				
		A. ELECTROCHEMISTRY		
10. Connect and check batteries.	Make a primary cell with zinc and copper in mouth or citrus fruit deflecting a galvanometer.	Factor influencing current and voltage of a cell. Construction of primary cells.	8	Cut-away of primary cell. Old lead-acid cell with removable plates.

SUGGESTED TEACHING PLAN - continued

Suggested Activities	Demonstrations	Topics for Class Discussion	Informational Assignments	Other Instructional Aids
		Construction of secondary cells. Safety with lead acid cells. Types of cells commonly used include mercury, Edison, nickel-cadmium, advantages and limitations of each. Electroplating. Electroforming. Electrorefining. Electrochemical cleaning.		Film: "The Primary Cell"
		B. MECHANICAL		
	Induce a current by passing magnet through a coil (show influence of speed, angle, number of turns, strength of field.)	Principles of induced currents and voltages.	9	Show induced current on oscilloscope.
		A.C. & D.C. generator principles.		Materials -- coil, magnets, galvanometer.
		A.C. characteristics		Field trip: Power generating station.
	Change voltage with a step-up and step-down transformer.	Transformer principles.	10	Film: "My Pop's A Lineman"
		Power distribution practices.		Demonstration transformer.
		C. OTHER SOURCES		
11. Measure solar cell output.	Produce a current and voltage with a solar cell.	Solar cells and their uses.	11	Film: "Bell Solar Battery"
12. Make a thermocouple.	Produce a current and voltage with a thermocouple.	Principles of thermocouples and typical uses.		Film: "Electrostatics"
		Static electricity problems and uses. Lightning protection.		
	Produce a voltage with a "spark pump."	Piezoelectricity and applications.		
		ELECTRICAL CONDUCTORS AND HEAT		
13. Gage wire	Read a micrometer. Find wire size with gage.	Gaging systems. Factors that influence resistance. Types of insulation.	12	Film: "Wire Size and Voltage Drop" Your local power supplier may be able to obtain films on electric heat.

SUGGESTED TEACHING PLAN - continued

Suggested Activities	Demonstrations	Topics for Class Discussion	Informational Assignments	Other Instructional Aids
	Effect of current through a conductor.			Make a demonstration board with several common types of conductors and insulations. Include types S, SJ, SP, HPD, HPN, Cords; TW, R, VF, WP building wires; SCE, DCE, enameled formvar magnet wires; nichrome, aluminum and copper conductors.
14. Make an electrical splice.	Solder a terminal. Make a splice.	Essentials of a good splice. Joining wires in electronic circuits.		
15. Determine voltage drop and power loss.				
LIGHT FROM ELECTRICITY				
	Wire and operate lamp out of envelope.	Operation of incandescent lamps. Types of lamp bases and uses. Lamp coatings. Selection and location of light sources.	13	Demonstration board with several types of lamps using different bases.
16. Wire a fluorescent lamp.	Wire and operate a fluorescent lamp.	Principles of operation of fluorescent lamps. Operation and use of vapor lamps. Present status of electroluminescence.		
17. Repair a lamp.	Wire a lamp cord.	Considerations in repairing lamps.		
18. Wire a photoelectric cell.	Photo conductive tube operating a device through a relay.	Principles of photo tubes. Variations in color sensitivity.		
WIRING				
19. Replace an outlet.	Replace an outlet. Replace a switch.	Underwriter's Laboratories. Electrical codes & purposes. Necessity of proper grounding of system. Types of wiring systems, conduit, armored cable, etc. Considerations in locating outlets and types that should be used.	14	Samples of different types of electrical boxes. Catalogs from which students may become familiar with nomenclature. Sample 60 or 100 amp. cabinet. Demonstration board with SPDT Knife switches to show how 3-way switches operate.

SUGGESTED TEACHING PLAN - continued

Suggested Activities	Demonstrations	Topics for Class Discussion	Informational Assignments	Other Instructional Aids
20. Wire a switch.	Wire and operate 3-way and 4-way switches.	Decorative lighting. Locating switches.		
21. Install a switch box.	Wire and operate a low voltage switch.	Considerations with low voltage wiring.	15	Wiring panel with low voltage relay mounted with a medium base cleat receptacle.
22. Wire low voltage circuits.	Wire and operate a door chime.	Door bells, buzzers and chimes.		
		MOTORS		
23. Make an electric motor.	Motor principle with a compass and magnet.	Principles of operation of a series motor.	16	Induction motor with starter switch removed and leads brought out so the starters can be switched in by the instructor, also capacitor leads brought out so different sized capacitors can be used. (See pictures.)
24. "Trouble shoot" a motor.	Show effect of the starter windings on starting torque.	Operation and application of induction and repulsion motors.		
	Show effect of capacitor site on starting torque.	Reversing motors.		Field Trip: Examine motors around the school for type, speed, drive mechanisms, etc.
	Reverse a repulsion start-induction run motor.			
	Adjust a motor to line up with a load.	Motor speeds and drive mechanisms.		Samples of several motor driven devices.
		Preventative maintenance of motors.		
	Reverse a motor with two control stations.	Motor control devices.		
		CONTROLS		
25. Wire electrical controls.	Wire and operate a limit control.	Principles of the various types of electrically operated controls.	17	Mock-up of a complete furnace control with thermostat.
	Wire and operate time sequence control.			
		APPLIANCES		
26. Perform minor appliance maintenance.	Disassemble an electric iron.	Principles of operation and proper care for appliances.	18	
	Disassemble a conventional washer.	Typical troubles with appliances that can be repaired at home.		
		Considerations to be given in purchasing appliances.		
	Test for continuity.	Concept of continuity testing.		
	Properly ground an appliance.	Necessity for properly grounding appliances.		

SUGGESTED TEACHING PLAN - continued

Suggested Activities	Demonstrations	Topics for Class Discussion	Informational Assignments	Other Instructional Aids
		AUTOMOTIVE ELECTRICITY		
27. Locate automotive electric troubles.	Analyze and connect components of an automobile ignition system.	The automotive lighting system. The battery recharging system including alternator systems. The ignition system including transistarized systems. Other special electrical systems.	19	Mock-up of automotive electrical system.
		ELECTRONICS		
28. Make a crystal set. 29. Make a code oscillator.	Test a vacuum tube with a tube tester. Set up a public address system. (Include feed back and means of reduction.)	Vacuum tube and semiconductor principles. Principles of radio transmission and reception. Audio amplifier installations. Microphone impedance. Principles of TV antenna systems. Hobbies in electronics. Occupations in the electrical industry.	20 21	Oscilloscope to show half and full wave rectifier. Films: "Sending Radio Messages," "Receiving Radio Messages" Field trip: Radio and/or TV broadcasting station. Catalogs which students may examine to become familiar with electronic components and nomenclature. Field trip: Amateur radio station if none in school. Obtain local electrical contractor or electronic technician to give talk to the class.

JOB ASSIGNMENT SHEETS AND STUDENT ACTIVITIES

The curricular area of electricity differs from most other phases of industrial arts in that the majority of the instructional content is informational rather than manipulative in nature. This difference suggests some variation in the teaching approaches when one teaches a course in the area of electricity.

Traditionally, the constructional "take home" project has been the instructional vehicle in industrial arts classes; however, logic, experience and research* indicate that a broader interpretation of the term "project" will be needed if instruction in the area of electricity is to be most effective. Since most of the content in industrial arts electricity consists of principles and their application, there is some question as to the value of spending any significant amount of time building motors and fabricating similar devices or components. In addition to these factors, it must be borne in mind that the electricity-electronics industry is of a component assembly nature and that a realistic interpretation of this phase of industry cannot be gained through fabrication with metals, wood, and plastic.

In consideration of these things, most of the student activities for this course have been planned as experiments and independent exercises. The familiar job assignment sheet style has been modified to serve as the organizational guide to the student activities. Since there are several manufacturers of electrical equipment and circuit boards which would serve as a suitable medium for the planned activities, the circuits and other schematics drawn on the job assignment sheets are general and adaptable to any number of systems. The components and sizes specified are meant to be suggestive and will need to be varied in order to be compatible with the system being used. If the teacher desires to establish his own system of circuit boards, he may want to consult: Zbar, Paul B. and Schildkraut, Sid, Instructor's Guide for Basic Electricity, Basic Electronics, and Basic Radio and Radio Receiver Servicing.

Most industrial arts teachers can establish system circuit boards for a given course in applied electricity at less cost than those commercially available. However, it does take a considerable amount of time to develop these materials, and it may not be practical to construct circuit boards especially considering the pressures of time as the teacher initiates a new program.

The commercially available materials offer the advantages of being immediately usable with a minimum of instructor time involved, and some of these materials come with well-written laboratory manuals. The disadvantages of some may be their lack of flexibility, incompatibility with existing equipment and future expansion of the program as well as high cost.

It is suggested the following might be criteria to use in selecting the system to be adopted:

1. Initial cost.
2. Cost per student over a period of several years.
3. Probable life of the parts--how "boy proof" are they?
4. Ability to expand with intended development of the electricity-electronics program in the school.
5. Will they be usable in a second course?
6. Suitability of published material that is supplied or available and how well it is written.
7. The experience of others who have used the equipment.

Few projects, as such, have been included in this guide. The intention of these job assignment sheets is to provide an organized approach to activities that will increase understanding of certain basic concepts. The method of implementation is left to the instructor; therefore, it is quite conceivable that some instructors and students may use all of the job assignments while others may begin planning and solving supplementary problems after some initial experiences with the job assignments. Of course, if some of these exercises have been covered in previous courses, they should be omitted at the teacher's discretion. Many of the supplementary references have good project suggestions that are suitable to convey the information and develop the skill desired. Wherever feasible, the instructor should use completed projects, or those in the process of construction, when performing experiments. However, care should be exercised in selecting projects that involve a minimum of operations that are non-electrical. A list of projects which typify this suggested approach will be found below.

In some cases the instructor may want to use kits for projects. This is an acceptable practice since many kits enable a person to get excellent equipment at comparatively small cost. However, when kits are used, the instructor must be certain that the students understand the principles involved and the operation of the circuits. Currently available kits with step by step instructions can be assembled without a thorough understanding of the operational procedures involved. One method of avoiding this pitfall is to require a written or oral report, by the student, on the operation of the equipment.

*Johnston, J. L., Teacher-Demonstrations Versus Shop Activities In The Teaching of Electricity: An Experimental Comparison, Unpublished Doctor's Dissertation, University of Missouri, 1956.

SUGGESTED PROJECTS

The following projects are typical of what may be used in a course of this nature. Projects should be carefully examined for shock hazards before being approved for use.

"Shock coil," Steinberg, William B. and Ford, Walter B., Electricity and Electronics - Basic, pp. 123-124.

"Ignition tester," Steinberg, William B. and Ford, Walter B., Electricity and Electronics - Basic, pp. 176-177.

"Combination continuity tester and flashlight," Arnold, Joseph P. and Schank, Kenneth L., Exploratory Electricity, pp. 41-42.

"Model railroad signal," Gerrish, Howard H., Electricity, pp. 86-87, or Tustison, F. E., and Ruehl, P. W., Electrical Essentials, Appendix B.

"Circuit breaker," Gerrish Howard H., Electricity, pp. 91-92, or Buban, Peter and Schmitt, Marshall L., Understanding Electricity and Electronics, pp. 179-180.

"Code Oscillator," Gerrish, Howard H., Electronics, pp. 101-103.

"Rheostat," Tustison, F. E., and Ruehl, P. W., Electrical Essentials, Appendix D; or Jones, E. W., Fundamentals of Applied Electricity, p. 320.

"Continuity Tester," Buban, Peter and Schmitt, Marshall L., Understanding Electricity and Electronics, pp. 400-401.

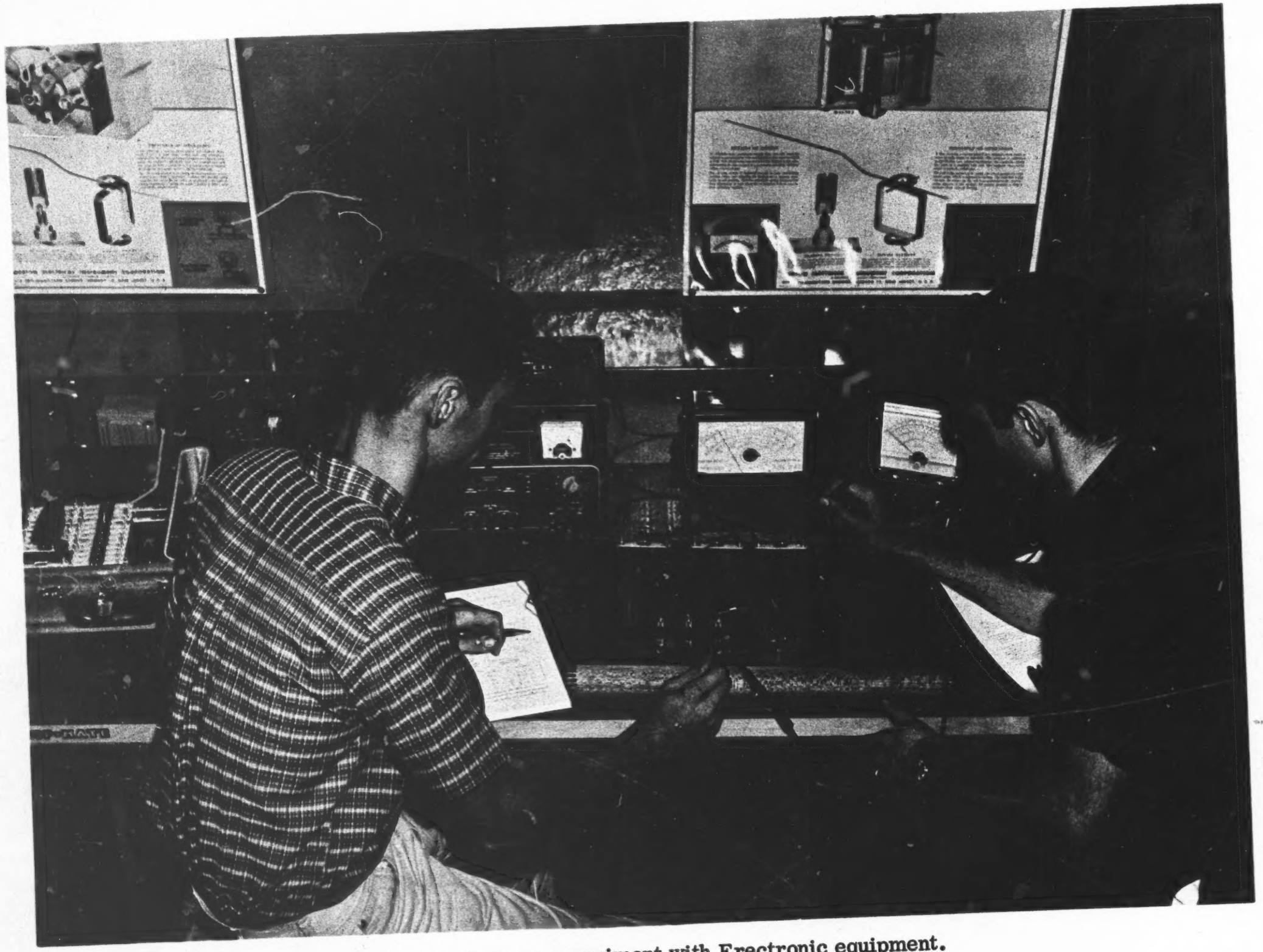
"T-V Antenna," Buban, Peter and Schmitt, Marshall L., Understanding Electricity and Electronics, p. 407.

"Compass, Magnetic," Buban, Peter and Schmitt, Marshall L., Understanding Electricity and Electronics, pp. 28-29, 390.

"Motors," Many of the books suggested in the list of references contain motors that are suitable for use as projects. There are also several kits available.

"Soldering Gun" or "Copper" - One of several kits available, such as Instruct-A-Kit S-1.

"Radio Receiver," such as Instruct-A-Kit No. 17, 5-tube Superheterodyne, AC/OC Radio Receiver.



Students setting up experiment with Erectronic equipment.

LIST OF JOB ASSIGNMENT SHEETS

Assignment Number	Title	Units Covered in Analysis
1	Wire a Series Circuit	7, 8, 9, 10, 11
2	Construct a Voltage Tester	7
3	Wire a Parallel Circuit	8, 9, 10, 11, 12
4	Calculate Electric Power	13
5	Operate Overcurrent Protective Device	19, 20, 21, 23, 24, 25
6	Wire Variable Resistors	32, 33
7	Investigate Permanent Magnets	35
8	Make an Electromagnet	36
9	Wire a Relay	37
10	Connect and Check Batteries	40, 41, 42, 43, 44
11	Measure Solar Cell Output	61
12	Make a Thermocouple	62
13	Gage Wire	66, 67
14	Make an Electrical Splice	70
15	Determine Voltage Drop and Power Loss	71, 72
16	Wire a Fluorescent Lamp	77
17	Repair a Lamp	81
18	Wire a Photo-electric Cell	82, 83
19	Replace an Outlet	85
20	Wire a Switch	86, 87, 88
21	Install a Switch Box	90, 91
22	Wire Low Voltage Circuits	101, 102
23	Construct an Electric Motor	106
24	"Trouble Shoot" a Motor	109-130
25	Wire Electrical Controls	131-133
26	Perform Minor Appliance Maintenance	139, 140, 141, 142, 143, 144, 145, 146, 149, 150
27	Locate Automotive Electrical Troubles	158, 159
28	Construct a Crystal Set	164, 173
29	Construct a Code Oscillator	165

APPLIED ELECTRICITY

Job Assignment 1
Covering Units 7-11

Name _____
Due _____

WIRE A SERIES CIRCUIT

Any electrical circuit has certain elements that operate according to series circuit principles. Therefore, one should develop an understanding of the operation of a series circuit. In this assignment you are to connect and study a series circuit.

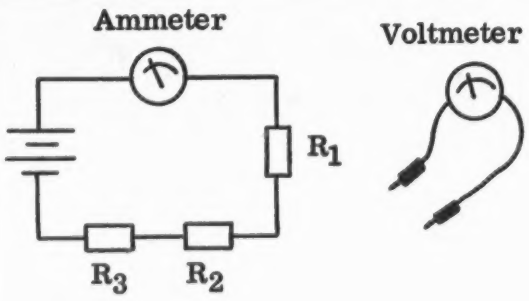
Objective: To develop an understanding of the operation of a series circuit.

Directions: Read this entire assignment sheet. Read the reference(s) assigned and work out the problem by following the steps of procedure.

References:

A. Buban, Peter, and Schmitt, Marshall L., Understanding Electricity and Electronics, pp. 146-147, 238-244.
B. Marcus, Abraham, Basic Electricity, pp. 40-42, 85-91, 95-98.
C. Steinberg, William B., and Ford, Walter B., Electricity and Electronics - Basic, pp. 60-62, 65-66, 95-96, 99-101.

Specifications:



Note to instructor: The sizes of components are suggestive only and may be changed to suit local conditions. If desired, lamps could be substituted for the resistors. (If lamps are used the "cold" resistance may be different than that observed when the lamps are lit.)

Bill of Material:

Quantity	Description
1	Ohmmeter
1	0-1 amp. D.C. Ammeter
1	0-15 volt D.C. Voltmeter
1	R_1 Resistor 40" of #24 nichrome
1	R_2 Resistor 20" of #24 nichrome
1	R_3 Resistor 56" of #24 nichrome
2	Dry Cells

Steps of Procedure:

_____ 1. Obtain the components, meters, and other equipment needed as listed in the bill of material.
_____ 2. Using the ohmmeter measure the resistance of each resistor and record in the appropriate place in the chart below. (A-243-244, B-97-98)

Comp.	Meas. Res.	Meas. Volt Drop	Cur.	Calc. Res.	Volt w/R_2 Disc.
R_1			*		
R_2			*		
R_3			*		
R_{Total}	Ohm-meter	Voltmeter		Ohm's Law	
	R_1+ R_2+ R_3=	E_1+ E_2+ E_3=		R_1+ R_2+ R_3=	

Circuit Checked _____

Readings Approved _____

*DO NOT MOVE THE AMMETER TO MAKE THESE MEASUREMENTS. Ascertain them from your knowledge of series circuits.

_____ 3. Connect the resistors in series with each other. Measure and record the total resistance with an ohmmeter.
_____ 4. Connect the ammeter and power source into the circuit. DO NOT TURN ON POWER! (A-239-240)
_____ 5. Have your instructor check your circuit.
_____ 6. Take and record the voltage readings called for in the chart above. Your hand should only be touching one meter lead at a time. (A-241-142)
_____ 7. Record the total current flow. (A-240)
_____ 8. Remove one lead of R_2 from the circuit.
_____ 9. Have your instructor check your readings.
_____ 10. Disassemble your circuit and return all parts to their proper places.
_____ 11. Calculate the resistances and voltages as called for on your chart.
_____ 12. Answer the questions below.

Checking Understanding:

1. Suggest reasons why the nominal resistance and measured resistance were not the same.
2. Why wasn't there any voltage drop across R_1 when R_2 caused an open circuit?

35

APPLIED ELECTRICITY

Job Assignment 2
Covering Unit 7

Name _____
Due _____

CONSTRUCT A VOLTAGE TESTER

A very useful and quite inexpensive voltage tester can be made by connecting a 200,000 ohm resistor in series with a small neon lamp. The neon lamp can then be used to test for direct and alternating current volts from about 65 to 500.

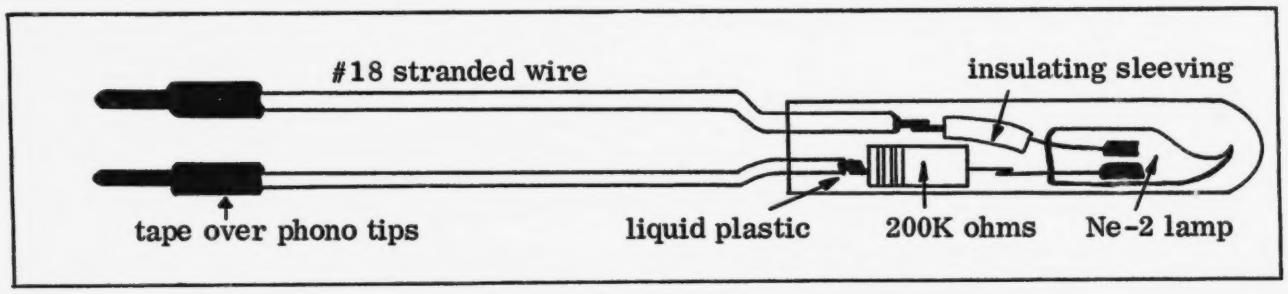
Objective: To develop an understanding of current and voltage in a series circuit and ionization of a gas.

Directions: Read the entire assignment sheet. Consult the reference listed below and follow the steps of procedure. Perform the suggested activities.

Reference:

A. Buban, Peter, and Schmitt, Marshall L., Understanding Electricity and Electronics, p. 400.

Specifications: Use the components listed on the bill of material and assemble as indicated on the drawing.



Bill of Material:

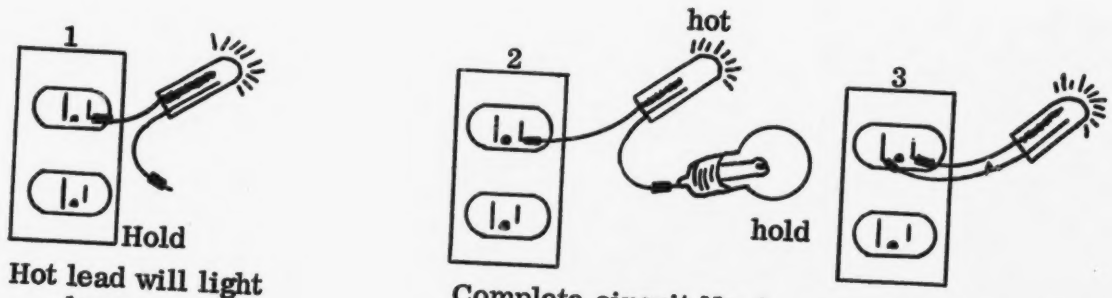
Quantity	Description
2	Phono tips
8 inches	Wire, stranded rubber covered, Belden #8200 or equal
1	Resistor, fixed carbon 200K $\frac{1}{2}$w ±20%
1	Lamp, Ne-2 Neon
$\frac{1}{4}$ inch	Insulating sleeving for #18 wire
2 inch	Tape, Plastic Elect.
1	Test Tube 12mm x 75mm
1 tsp.	Cold setting liquid plastic and hardener (may be obtained from the Castolite Co., Woodstock, Ill.)

Steps of Procedure:

_____ 1. Secure tools and materials.
_____ 2. Strip insulation from both ends of leads (wire).
_____ 3. Cut component leads to length.
_____ 4. Place piece of insulating sleeving over longer lead of lamp.
_____ 5. Tin leads of conductors and quickly sweat solder the joints. Caution: Prolonged heat will expand and crack the resistor.
_____ 6. Sweat solder the phono tips to each lead.
_____ 7. Place a piece of plastic tape around the larger part of each phono tip to remove the shock hazard.
_____ 8. Try tester in an outlet.
_____ 9. Mix casting plastic and hardener in a paper cup (follow the directions on the can). (Some use the outside casing from Type S heavy duty cord or fiber tubing rather than the plastic.)
_____ 10. Pour casting plastic in test tube with tester.
_____ 11. Set aside for a day or two for hardening.
_____ 12. Remove test tube. Caution: In cracking test tube do not apply pressure at the end where the Ne-2 lamp is, as it will crack.
_____ 13. Perform the suggested activities.

Suggested Activities:

1. Identify the "hot" (ungrounded conductor) of a 115 volt outlet.
2. Test the continuity of a lamp filament.
3. Test for an A.C. and D.C. voltage.



Hot lead will light lamp
Neutral (grounded) no light

Complete circuit Ne-2 lamp lights
Open circuit (broken filament) no light

A.C. both electrodes light
D.C. only one electrode lights

Test of Workmanship:

1. Does the tester work as shown under suggested activities?
2. Are the solder joints smooth?
3. Is the resistor cracked?
4. Are both leads the same length?

APPLIED ELECTRICITY

Job Assignment 3
Covering Units 8-12

Name _____
Due _____

WIRE A PARALLEL CIRCUIT

The parallel circuit is quite commonly used, in fact, this is the way our homes are wired. If we were able to see the household circuits from the point where the power enters the home we would find that the radio, lights, motors, and various other electrical appliances are all connected in parallel with each other. Some of the concepts of a parallel circuit may seem a bit difficult at first; however, after working with a parallel circuit and observing the basic principles, you will find them to be quite easy to understand.

Since parallel circuits are used so frequently, a clear understanding of their operation is essential to further work in electricity. In this assignment you will construct and take measurements in a parallel circuit.

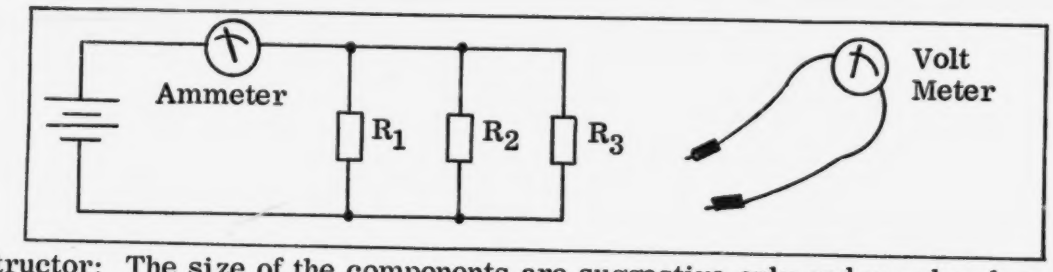
Objective: To develop an understanding of the operation and characteristics of a parallel circuit.

Directions: Read this entire assignment sheet. Read the reference(s) assigned and follow the steps of procedure.

References:

A. Buban, Peter, and Schmitt, Marshall L., Understanding Electricity and Electronics, pp. 147-149.
B. Marcus, Abraham, Basic Electricity, pp. 43-44.
C. Steinberg, William B., and Ford, Walter B., Electricity and Electronics - Basic, pp. 96-99.

Specifications:



Note to the instructor: The size of the components are suggestive only and may be changed to suit local conditions. If desired, lamps could be substituted for the resistors. (If lamps are used the "cold" resistance will be different than that observed when the lamps are lit.)

Bill of Material:

Quantity	Description
1	Ohmmeter
1	0-1.5 amp. Ammeter, D.C.
1	0-150 v. Voltmeter, D.C.
1	R_1 Resistor 40" of #24 nichrome
1	R_2 Resistor 20" of #24 nichrome
1	R_3 Resistor 56" of #24 nichrome
2	Dry Cells

Steps of Procedure:

_____ 1. Obtain components, meters, and other equipment needed as listed in the bill of material.
_____ 2. Connect the circuit as specified in the diagram except do not complete the connections of R_2 and R_3.
_____ 3. Have the circuit checked by your instructor.
_____ 4. Record the current through R_1 and the voltage across it. (A-240-242)
_____ 5. Disconnect R_1 and connect R_2.
_____ 6. Record the current through R_2 and the voltage across it. (A-240-242)

_____ 7. Disconnect R_2 and connect R_3.
_____ 8. Record the current through R_3 and the voltage across it. (A-240-242)
_____ 9. Connect R_1, R_2, and R_3 in the circuit and record the total current and voltage.

Component	Nominal Ohmmeter Resistance	Measured Voltage Drop	Measured Current	Calculated Resistance
R_1				
R_2				
R_3				
R_T	Measured		$I_1+I_2+I_3$	

Circuit Checked _____

Readings Checked _____

_____ 10. Have your instructor check your readings.
_____ 11. Disassemble your circuit and return parts to their proper places.
_____ 12. Calculate the current and resistances as called for above.
_____ 13. Answer the questions below.

Checking Understanding:

1. What would be the total resistance of a circuit with only R_1 and R_2? How does this compare with the resistance of the circuit with R_1, R_2, and R_3?
2. What would happen to the total resistance if another resistance were added in parallel?

APPLIED ELECTRICITY

Job Assignment 4
Covering Unit 13

Name _____
Due _____

CALCULATE ELECTRIC POWER

Any time current flows through a device, heat is generated. The energy thus transformed is called power and in electricity the unit of measurement is the watt. In this assignment you will make some computations with Watt's Law.

Objective: To develop an understanding of Watt's Law as applied to series and parallel circuits.

Directions: Read this entire assignment sheet. Read the reference(s) assigned and follow the steps of procedure.

References:

A. Buban, Peter, and Schmitt, Marshall L., Understanding Electricity and Electronics, pp. 153-155.
B. Marcus, Abraham, Basic Electricity, pp. 29-31.
C. Steinberg, William B., and Ford, Walter B., Electricity and Electronics - Basic, pp. 89-91.

Specifications: Use the data obtained from Job Assignments 1 and 2.

Bill of Material: None.

Steps of Procedure:

_____ 1. Enter the data from Job Assignments 1 and 2 in the proper spaces in the chart below.

Component	Measured Voltage	Measured Current	Calculated Resistance	Calculated Power
R_1 series				
R_2 series				
R_3 series				
$R_{Tot.}$ series				
Power Total $P_1 + P_2 + P_3$				
R_1 parallel				
R_2 parallel				
R_3 parallel				
$R_{Tot.}$ parallel				
Power Total $P_1 + P_2 + P_3$				

_____ 2. Calculate the power consumed by each resistance and the total in each case. (A-154, B-30, C-90)

_____ 3. Determine the total power in series, and in parallel by adding the individual power consumptions.

_____ 4. Answer the questions below.

Checking Understanding:

1. What two things must be known about a resistor before it can be used in a circuit?
2. With a given voltage two resistors of equal value are connected in series. Would the power consumption be more, less, or the same than if either resistor were used alone. Support your answer with a sample computation.
3. Referring to the problem presented in question 2, what would be the situation if the two were connected in parallel? Support your answer with sample computations.

APPLIED ELECTRICITY

Job Assignment 5
Covering Units 19-25

Name _____
Due _____

OPERATE OVERCURRENT PROTECTIVE DEVICES

To help reduce the danger of fire or damage to electrical equipment, various methods are used to limit the amount of current that can flow in a circuit. One method is to use a piece of metal with a low melting temperature in the form of a fuse. Often a form of circuit breaker is used; one type of which is operated on a thermal principle, the other on an electromagnetic principle. In this assignment you will experiment with the principles involved in these two types of circuit breakers.

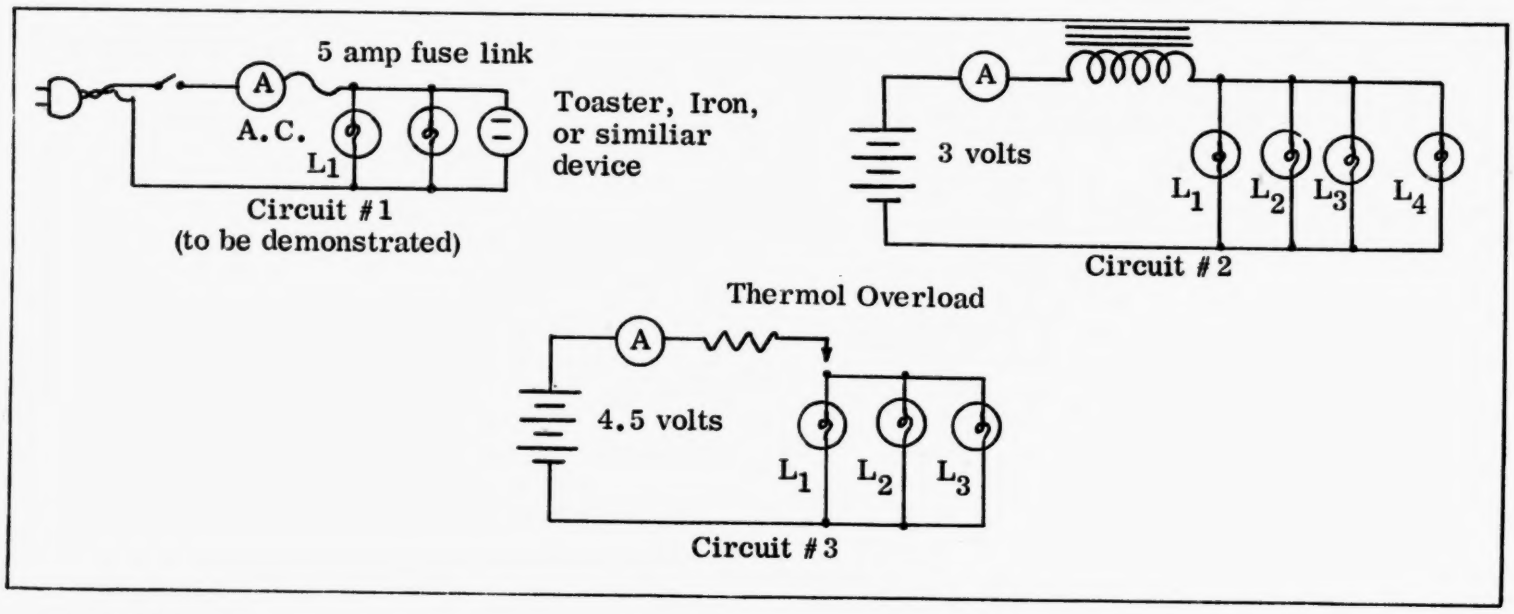
Objective: To develop an understanding of the operation of fuses and circuit breakers.

Directions: Read this entire assignment sheet. Read the reference(s) assigned and complete the assignment by following the steps of procedure.

References:

A. Buban, Peter, and Schmitt, Marshall L., Understanding Electricity and Electronics, pp. 179-180.
C. Steinberg and Ford, Electricity and Electronics - Basic, pp. 130-132.
P. Manual with SE-2 kit.

Specifications:



Bill of Material:

Quantity	Description
3	Dry Cells
1	Ammeter, 0-.5 amp. D.C.
5	Lamps, #222 or similar pilot lamps
1	Thermostat, Bimetalic strip with several turns of nichrome wire wrapped around it (Brodhead-Garrett SE-2 Kit)
1	Coil with removable core--This may be the coil in the SE-2 Kit or one that is made by wrapping 56 feet of #24 formvar on a $\frac{1}{4}$" I.D. x $1\frac{1}{4}$" coil form. Use a $\frac{1}{4}$" x $1\frac{1}{4}$" soft iron rod for the core. The coil may be used as part of a project such as the model railroad signal given in supplementary reference (J) or (V). In this case it should be designed around specifications contained therein.
	Lamp receptacles and assorted leads

For Demonstration Only:

1	Fuse link, 5 ampere
1	Toaster, iron or other device that draws more than 4 amperes
2	Lamps, 150 watt

Steps of Procedure:

_____ 1. Your instructor will demonstrate circuit #1 to the class. Record the current flowing through lamp 1 in the proper blank. Do the same with lamps 1 and 2 in parallel. Record the current flowing with all three devices connected.

	L 1	L 2 (calculate)	L 1 & 2	Total	High Wattage Load (calculate)
Current					

_____ 2. Obtain materials listed in the bill of material
_____ 3. Wind coil (if it is to be wound by the student). (A-p. 179)
_____ 4. Connect components as in circuit #2.
_____ 5. Have your instructor check your circuit.
_____ 6. Place the core in the coil with half of it sticking out.
_____ 7. Screw in the lamps, one at a time.
_____ 8. Record the current as each lamp is screwed in.
_____ 9. Record the current flow at which the core is pulled into the coil.

	L 1	L 1 & 2	L 1, 2, & 3	L 1, 2, 3, & 4	Core Pulled In
Current					

Circuit Checked _____

_____ 10. Disconnect circuit 2 and connect circuit 3.
_____ 11. Have your instructor check your circuit.
_____ 12. Screw in the lamps, one at a time.
_____ 13. Record the current as each lamp is screwed in. Allow time between screwing in lamps for the thermostat to heat up.
_____ 14. Record the current at which the bimetalic contacts open.

	L 1	L 1 & 2	L 1, 2 & 3	Contacts Open
Current				

Circuit Checked _____

_____ 15. Replace all components in proper storage place.
_____ 16. Answer the questions below.

Checking Understanding:

1. List the steps of procedure in replacing a fuse link in a renewable cartridge fuse. Start with unscrewing the two ends. Why shouldn't one put more than one fuse link in a fuse holder?
2. How could the solenoid used in the experiment be adapted for use as a circuit breaker?
3. What change would have to be made in the thermostat used to adapt it as a circuit breaker?
4. Which of the two types of breakers would you expect to be the faster acting?

APPLIED ELECTRICITY

Job Assignment 6
Covering Units 32, 33

Name _____
Due _____

WIRE VARIABLE RESISTORS

There are many applications of the principles of variable resistance in the devices we use every day. Whenever you change the intensity of the dash lights on your car or change the volume level on your radio or TV, you use a variable resistor.

Important electrical principles are involved in the use of variable resistors so one should be familiar with them. In this assignment you will connect a rheostat as well as a potentiometer and experiment with the effects they can have in a circuit.

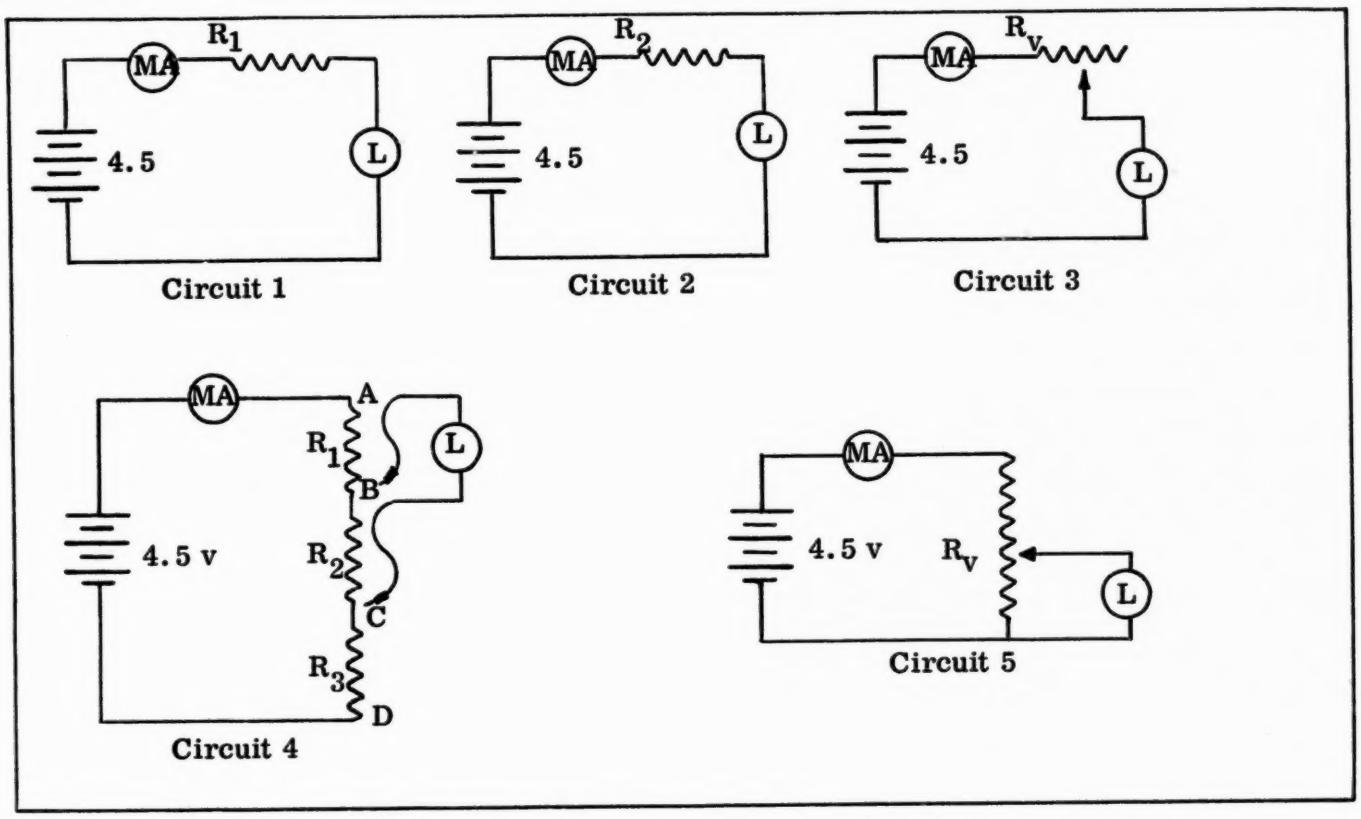
Objective: To develop an understanding of current limiting and voltage dividing with resistance.

Directions: Read this entire assignment sheet and the reference(s) assigned below and follow the steps of procedure.

References:

A. Buban, Peter, and Schmitt, Marshall L., Understanding Electricity and Electronics, pp. 133-134, 250.
V. Turner, Rufus P., Basic Electricity, pp. 44-45, 58-60.

Specifications:



Bill of Material:

Quantity	Description
1	Power source
1	R_1 resistor 56" of # 24 nichrome
1	R_2 resistor 40" of # 24 nichrome

1	R_3 resistor 20" of #24 nichrome
1	Lamp, 222 or similar pilot lamp
1	Ammeter 0-1 amp.
1	Voltmeter 0-15 volts
1	R_v Potentiometer 500 ohms 2 watt
3	Dry Cells

Steps of Procedure:

_____ 1. Obtain the components needed.
_____ 2. Connect circuit number 1.
_____ 3. Record the current flow and the potential across R_1 and the lamp in the chart below.
_____ 4. Remove R_1 and replace it with R_2 as in circuit #2.
_____ 5. Record the current flow and the potential across R_2 and the lamp in the chart below.
_____ 6. Remove R_2 and replace it with R_v using one outside terminal and the center terminal.
_____ 7. Adjust the rheostat so that the current readings in the chart are obtained. Record the voltage across the lamp for each setting.

	Circuit #1	Circuit #2	Circuit #3		
Current			200 ma.	150 ma.	100 ma.
Voltage across R_1					
Voltage across R_2					
Voltage across lamp					
Total voltage					
Total circuit resistance I X E					

_____ 8. Disassemble circuit and connect circuit #4.
_____ 9. Record the voltage and current as called for in the chart below.
_____ 10. Connect the lamp across R_3 (Points A and B) and record the voltage across it in the chart below.
_____ 11. Remove R_3, R_4, and R_5 and replace them with R_v connecting one outside terminal to the milliammeter and the other to the power source. Connect the lamp to the center terminal and one of the outside terminals as in Circuit #5.
Caution: Have the potentiometer $\frac{1}{2}$ way between the two extremes. Do not exceed the voltage rating of the lamp.
_____ 12. Adjust the potentiometer to obtain the voltage readings called for in the chart below and indicate the current in each case.

	Current	Voltage R_3	Voltage R_4	Voltage R_5	Lamp
Circuit #4					
Circuit #5					
Lamp voltage		.5	1.0	1.5	
Current					

APPLIED ELECTRICITY

Job Assignment 7
Covering Unit 35

Name _____
Due _____

INVESTIGATE PERMANENT MAGNETS

Permanent magnets are important in everyday life. We find many uses for them. The speakers in your radio and/or television receivers have them. Many types of meters use them. The principles involved are fundamental to the use and understanding of electricity.

Objective: To develop an understanding of the principles of magnetic fields.

Directions: Read this entire assignment sheet. Read the reference assigned and complete the activity by following the steps of procedure.

Reference:

V. Tustison, F. E., and Ruehl, P. W., Electrical Essentials, Instruction Sheet # 8.

Specifications: None.

Bill of Material:

Quantity	Description
2	Bar Magnets
1	Horseshoe Magnet
1 piece	Steel for making a permanent magnet
1 assortment	Assorted pieces of aluminum, copper, brass, iron, plastic
1 container	Iron Filings
1 box	Steel Tacks, carpet
1 sheet	Plastic or paper (to keep filings off magnets)
1	Compass
1	Source of heat

Steps of Procedure:

_____ 1. Obtain the components needed.
_____ 2. Magnetize the steel rod or needle by stroking it with one of the permanent magnets.
_____ 3. Pick up some tacks with the magnetized rod. Note the number of tacks.
_____ 4. Remove the tacks from the rod and suspend the rod on a piece of thread. Note the position it assumes.
_____ 5. Take the compass and compare its direction with that of the steel rod.
_____ 6. Bring a permanent magnet close to the suspended rod. What happens?
_____ 7. Heat the steel rod until it is red hot.
_____ 8. Try to pick up tacks with it now. What position does it take when suspended in air?
_____ 9. Place the two bar magnets with two poles that attract each other far enough apart so they will not pull together.
_____ 10. Place a piece of paper or plastic over the magnets and sprinkle the iron filings on the paper or plastic. Note the pattern.
_____ 11. Pull the paper or plastic off the magnets so the filings cannot come in contact with the magnets.
_____ 12. Turn one of the magnets 180 degrees and replace the paper or plastic over the magnets.
_____ 13. Tap the paper gently and note the pattern of the filings.
_____ 14. Remove the paper or plastic with the filings and place over the horseshoe magnet. Note the pattern when the paper or plastic is tapped gently.
_____ 15. Using one of the permanent magnets, determine which of the pieces of metal are attracted to the magnet.
_____ 16. Return all of the items to their proper storage place.
_____ 17. Answer the questions below.

Checking Understanding:

1. How many tacks could you pick up with a magnetized rod? How many after it was heated?

2. What position did the rod assume when it was suspended? How did it compare with the compass? Why wasn't the rod horizontal?
3. What happened when a magnet was brought close to the suspended rod?
4. How do the magnetic fields of a bar magnet compare with those of a horseshoe magnet? Which is stronger?
5. Which pieces of metal were attracted to the magnet?
6. How should one store a horseshoe magnet? Bar magnet?

APPLIED ELECTRICITY

Job Assignment 8
Covering Unit 36

Name _____
Due _____

MAKE AN ELECTROMAGNET

The principles of electromagnetism have many applications in the field of electricity. They are used in generating electricity and in operating many electrical devices. In this assignment you will experiment with several electromagnetic effects.

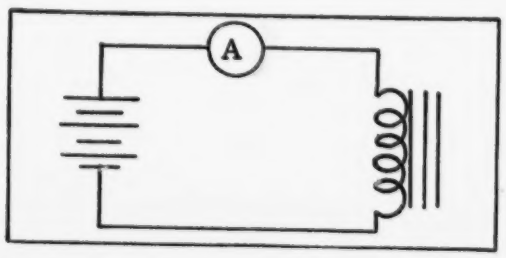
Objective: To establish an understanding of some of the magnetic effects of an electric current flowing through a conductor.

Directions: Read this entire assignment sheet. Read the references assigned and complete the activity by following the steps of procedure.

References:

A. Buban, Peter, and Schmitt, Marshall L., Understanding Electricity and Electronics, pp. 170-181.
C. Steinberg and Ford, Electricity and Electronics - Basic, pp. 25-31.

Specifications:



Bill of Material:

Quantity	Description
1	Compass, Magnetic
3	Dry cells
2	Coils and cores same as used in Job Assignment 4
	Ammeter 0-1.5 amps.
1	Assorted carpet tacks

Steps of Procedure:

_____ 1. Obtain the materials listed in the bill of material.
_____ 2. Place the compass under a piece of wire and use the conductor to "short" one cell momentarily. Note what happens to the compass needle.
_____ 3. Connect the circuit as shown in the specifications.
_____ 4. Without the core try picking up some tacks.
_____ 5. Bring the compass near the conductor and note the effect.
_____ 6. Place the core in the coil and note how many tacks can be picked up. Open the circuit and note the effect.
_____ 7. Connect a second cell in series with the first. Note the current. How many tacks can be picked up now?
_____ 8. Connect a second coil in series with the first coil and place them so the two ends are together with the cores inside. How many tacks can be picked up now? What happened to the current?
_____ 9. Turn one coil 180 degrees. How many tacks can be picked up now?
_____ 10. Connect another cell in series with the two in use. How many tacks can be picked up now? What happened to the current?
_____ 11. Replace the components to their storage place.
_____ 12. Answer the questions below.

Checking Understanding:

1. Make a generalized statement concerning the number of turns with a given current flow and the strength of the magnetic field.
2. Make a generalized statement concerning the current with a given number of turns of wire and the strength of the magnetic field.
3. What effect did the core have on the strength of the magnetic field.
4. What is meant by ampere-turns?
5. What is meant by coils connected in series aiding? Series opposing?
6. What factors other than the ampere-turns and amount of core will influence the strength of the electromagnetic field?

APPLIED ELECTRICITY

Job Assignment 9
Covering Unit 37

Name _____
Due _____

WIRE A RELAY

One of the important applications of electromagnetic principles is in relay systems. Such systems are the means by which one can control one voltage or current by a separate or different voltage and/or current.

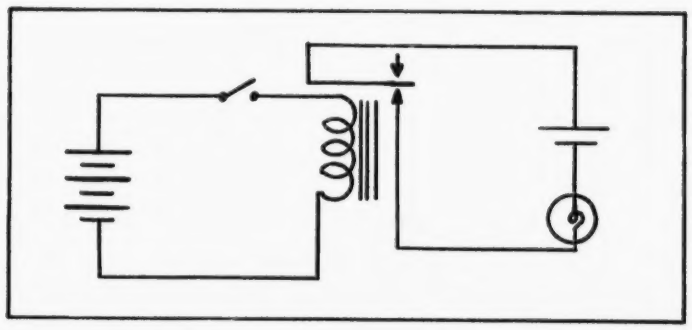
Objective: To understand the principles of operation of a relay.

Directions: Read this entire assignment sheet. Read the reference assigned and complete the activity by following the steps of procedure.

Reference:

U. Turner, Rufus, Basic Electricity, First Edition, pp. 80-83.

Specifications:



Bill of Material:

Quantity	Description
1	Relay (similar to the one in Broadhead-Garrett SE-4 Kit or Science Electronics IA300)
4	Dry Cells
1	Switch
1	Lamp and base
	Assorted leads

Steps of Procedure:

_____ 1. Obtain components listed in bill of material.
_____ 2. Connect the circuit as shown in the diagram.
_____ 3. Operate the relay by closing the switch.
_____ 4. Replace the components to their proper storage places.
_____ 5. Answer the questions below.

Checking Understanding:

1. Is the relay connected so that it is normally open or normally closed?
2. How could this relay be connected so it would operate in the opposite manner?
3. What limitations would be placed on the current and voltage that the contacts of the relay can safely control?

APPLIED ELECTRICITY

Job Assignment 10
Covering Units 40-44

Name _____
Due _____

CONNECT AND CHECK BATTERIES

The electric cell is an important source of electricity in many situations. Portable radios, space exploration, and the automobile all depend on this source for some of their power.

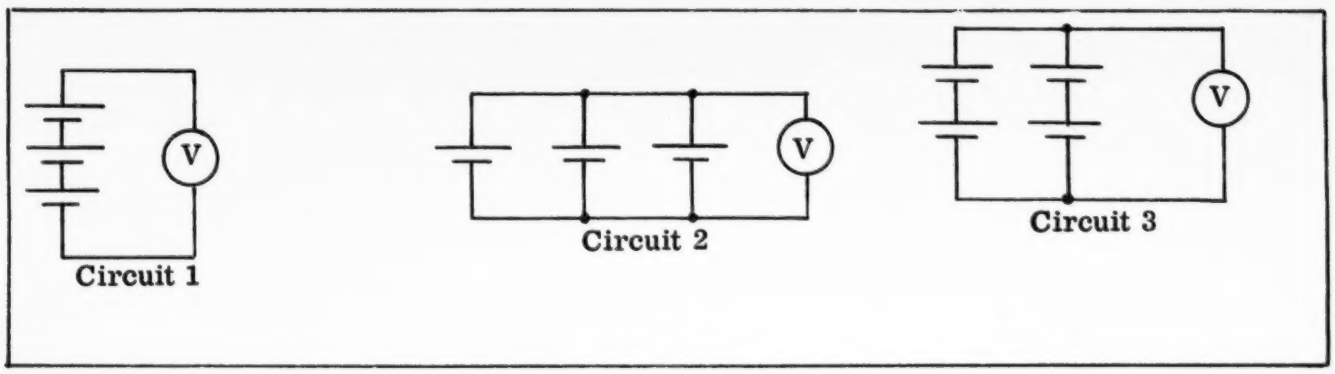
Objective: To test cells to determine if they should be recharged or replaced, and to connect cells in parallel, series and combination.

Directions: Read this entire assignment sheet. Read the reference assigned and complete the assignment by following the steps of procedure.

Reference:

A. Buban, Peter, and Schmitt, Marshall L., Understanding Electricity and Electronics, pp. 203-218.

Specifications:



Bill of Material:

Quantity	Description
4	Dry cells
1	Dry cell, #6 (if not used above)
1	Voltmeter 0-8 volts D.C.
1	Hydrometer
1	Cell tester
1	Voltmeter for load testing cells
1	Lead acid battery
1	Battery tester (similar to Simpson Model 379)
	Assorted leads

Steps of Procedure: (The steps may be done in any order as equipment is available.)

_____ 1. Obtain needed components.
_____ 2. Using the hydrometer determine the specific gravity of the cells of the lead-acid battery. (A-214)

	Cell 1	Cell 2	Cell 3
Specific gravity			
Voltage			
Condition of cell			

_____ 3. Using the load testing voltmeter, record the voltage of each cell. Caution: Do not touch the shorting bar of the meter. Do not short the cell any longer than needed to take your reading.

_____ 4. Test the #6 dry cell with the cell tester. It reads _____ amperes. If a #6 reads less than 17 amperes on a short circuit it is to be replaced. A new cell can deliver between 30 and 35 amperes. (A-216)

_____ 5. Connect circuit 1 and record the voltage below.

_____ 6. Reconnect the cells as in circuit 2 and record the voltage below.

_____ 7. Reconnect the cells as in circuit 3 and record the voltage below.

	Circuit 1	Circuit 2	Circuit 3
Voltage			

_____ 8. If time permits make a coin cell by using a penny and a nickel or dime separated by a piece of blotting paper. Wet the piece of blotting paper with a salt water solution. What is the voltage? Connect several cells in series and measure the voltage. (A-217)

_____ 9. Return components to their proper storage place.

_____ 10. Answer the questions below.

Checking Understanding:

1. Indicate in the appropriate blank what you think the condition of each cell is in step 2.
2. Must the temperature of the electrolyte be considered when taking the specific gravity of a cell? Why?
3. Suggest a reason why a #6 cell is replaced when the short circuit current drops to approximately 17 amperes.
4. What is "galvanic action"? Where might one find this a problem? How can it be reduced?
5. What kind of current is needed for charging a battery?
6. Which leads from a battery charger are connected to which terminals on the battery?
7. What precaution must be observed when disconnecting a battery charger from a battery?
8. List some rules to follow in order to receive maximum life from a storage battery.
9. What could happen if a battery were charged at too rapid a rate?

APPLIED ELECTRICITY

Job Assignment 11
Covering Unit 61

Name _____
Due _____

MEASURE SOLAR CELL OUTPUT

One source of electrical energy is light. This source has increasing applications in space exploration, as well as in more common place applications such as a photographer's light meter. In this assignment you will have an opportunity to measure the current and voltage from a "sun battery".

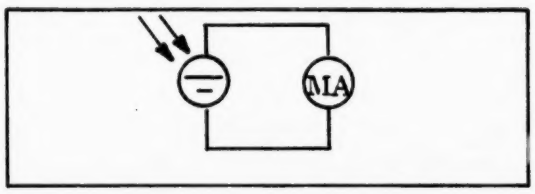
Objective: To obtain a knowledge of the influence of varying light intensities on a solar cell.

Directions: Read this entire assignment sheet. Read the reference assigned and solve the problem by following the steps of procedure.

Reference:

A. Buban, Peter and Schmitt, Marshall L., Understanding Electricity and Electronics, pp. 228-230.

Specifications:



Bill of Material:

Quantity	Description
1	Solar Cell (B2M or similar style)
1	Volt-Ohm Milliammeter

Steps of Procedure:

_____ 1. Obtain the components listed in the bill of material.
_____ 2. Connect the solar cell across the VOM with the meter on the 1 milliamp scale. Caution: This scale is very sensitive so do not connect the leads to anything other than the solar cell. Note the change in current as the cell is moved around and varying light intensities strike it. Record the amperage when the cell is on the bench. _____ ma.
_____ 3. Change the VOM to the voltage scale (2.5 v. or less) and note the change in voltage as the cell is moved around. Record the voltage when the cell is in the same position as in step 1. _____ volts.
_____ 4. Replace the components to their proper storage place.
_____ 5. Answer the questions below.

Checking Understanding:

1. What power would the cell deliver with the above readings? Assume no load other than the meter.
2. How could one obtain more power from solar cells?
3. If the current from this cell were to be used to operate some other device, how could it be done?

APPLIED ELECTRICITY

Job Assignment 12
Covering Unit 62

Name _____
Due _____

MAKE A THERMOCOUPLE

The thermocouple is a source of energy very often used to measure temperature. You will have an opportunity to use several dissimilar metals and see the effects of heat on the coupling.

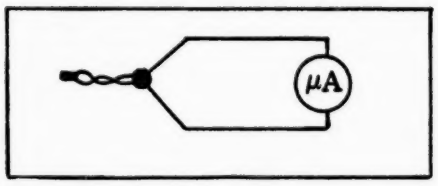
Objective: To obtain an understanding of the principle of a thermocouple.

Directions: Read this entire assignment sheet. Read the references assigned and complete the assignment by following the steps of procedure.

References:

A. Buban, Peter and Schmitt, Marshall L., Understanding Electricity and Electronics, p. 235.
C. Steinberg, William B. and Ford, Walter B., Electricity and Electronics - Basic, pp. 53-54.

Specifications:



Bill of Material:

Quantity	Description
1	Volt-Ohm Milliammeter
	Assorted pieces of wire: michrome, copper, iron, brass, aluminum
1	Bunsen burner or candle

Steps of Procedure:

_____ 1. Obtain needed components.
_____ 2. Twist about $1\frac{1}{4}$ inch of two wires together. (A-235)
_____ 3. Using the 80 microampere or lower scale measure the current flow as the coupling is heated.
_____ 4. Try the same procedure with each of the possible wire combinations. Record the maximum current for each coupling.
_____ 5. Return the items to their proper storage place.
_____ 6. Answer the questions below.

Checking Understanding:

1. Which combination gave the highest current?
2. What is the relationship between the current and the temperature of the thermocouple?

APPLIED ELECTRICITY

Job Assignment 13
Covering Units 66, 67

Name _____
Due _____

GAGE WIRE

If one is going to work with electricity, one should have a familiarity with wire sizes and methods of determining wire size.

Objective: To develop an ability to determine wire size.

Directions: Read this entire assignment sheet. Read the reference assigned and complete the assignment by following the steps of procedure.

Reference:

A. Buban, Peter, and Schmitt, Marshall L., Understanding Electricity and Electronics, pp. 43-48.

Specifications: None.

Bill of Material:

Quantity	Description
4 pieces	Assorted conductor sizes and insultations

Steps of Procedure:

_____ 1. Obtain several pieces of wire from your instructor.
_____ 2. Determine the insulation on each sample.
_____ 3. Gage each piece with a micrometer caliper. On those conductors with insulation do not remove the insulation at this time.
_____ 4. Gage the size of each conductor with a wire gage. Remove any insulation. (A-44)

	Sample 1	Sample 2	Sample 3	Sample 4
Type of insulation				
Diameter with insulation				
Gage number				

_____ 5. Replace the micrometer and gage to their proper storage place.
_____ 6. Answer the questions below.

Checking Understanding:

1. Why must one remove the insulation before gaging the conductor?
2. In some wire tables the diameters will be listed as nominal diameter in inches. What is meant by the term nominal as used here? Why might the diameter of two conductors of the same gage vary slightly?
3. Look at a wire table. Number 24 wire has a circular mil area of 404 CM. What size wire could you use if you wanted to double the circular mil area? Try this with several other sizes and note it always comes out approximately the same.
4. In the original wiring of a motor # 22 wire was used. If a person wanted to rewire this motor but didn't have any # 22, but did have some # 23, 24, 25, 26 and 28, can he rewire this motor from his stock? How?

APPLIED ELECTRICITY

Job Assignment 14
Covering Units 69-70

Name _____
Due _____

MAKE AN ELECTRICAL SPLICE

Many times in electrical work it is necessary to join wires together. Any electrical joint has to meet two requirements. It must first of all be mechanically secure and secondly it must be electrically secure. In the case of splices, the wires are twisted together to make the joint machanically secure. To meet the second requirement, the wires are often soldered or spliced through the use of approved solderless connectors. On some new equipment special wrapping machines are being used that wrap the conductors around the terminals in a manner that makes soldering unnecessary. In cases where the wire is fastened to terminals, it is twisted around the terminal to meet the first requirement.

When wiring electronic circuits it is necessary that all joining of conductors be done on objects that are securely fastened to the chassis. This is often done by using tie points.

Objective: To familiarize the student with the proper method of making a splice and fastening a conductor to a tie point.

Directions: Read this entire assignment sheet. Read the reference assigned and complete the assignment by following the steps of procedure.

Reference:

C. Steinberg, William B., and Ford, Walter B., Electricity and Electronics - Basic, pp. 83-85.

Specifications: None.

Bill of Material:

Quantity	Description
2 pieces	#14 TW Wire 6" long
	Rubber Electrical Tape
	Friction Tape
1 piece	#20 solid hook-up wire 4" long
1	Tie point
	Solder, rosin core
1	Soldering Copper - electric
1	Side cutting pliers
1	Needle nose pliers

Steps of Procedure:

_____ 1. Obtain the needed equipment and supplies.
_____ 2. Strip $1\frac{1}{2}$ inches of insulation from one end of each piece of #14 wire. (C-83)
_____ 3. Twist the two stripped conductors together tightly. (C-83)
_____ 4. Cut off the ends of the two conductors (about $\frac{1}{4}$ inch). (C-83)
_____ 5. Solder the joint making sure the joint is heated hot enough to permit the solder to flow completely through the joint. (C-83)
_____ 6. Tape the joint with the rubber splicing compound (tape). Be sure to stretch the tape as it is applied.
_____ 7. Wrap the joint with friction tape.
_____ 8. Strip about $\frac{1}{4}$" from one end of the hook-up wire.
_____ 9. Wrap the stripped conductor around the tie point through the hold. Use a complete wrap to provide mechanical strength.
_____ 10. Solder the joint making sure there is sufficient heat to permit the solder to flow through the complete joint.
_____ 11. Return components to their proper place and turn in your two joints. Make sure your name is attached to them.

Job Assignment 15
Covering Units 71-72

Name _____
Due _____

DETERMINE VOLTAGE DROP AND POWER LOSS

Any time current flows through resistance there will be a voltage drop. This is a simple application of Ohm's law. Every conductor has some resistance and the smaller its diameter the greater is its resistance. If the current is great enough and the conductor long enough, the voltage drop could be sufficient to affect the operation of an electrical device.

Another reason to be concerned about conductor size and length, is that there is also power being consumed as the current flows through the conductor. The power thus consumed is wasted, but it must be paid for, nevertheless.

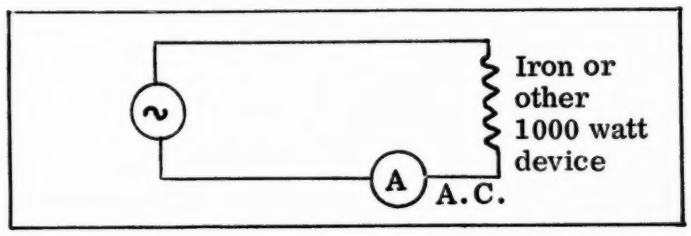
Objective: To become familiar with the problem of voltage drop and power loss when using extension cords.

Directions: Read this entire assignment sheet. Read the reference assigned and solve the problems by following the steps of procedure.

Reference:

M. Jones, E. W., Fundamentals of Applied Electricity, pp. 28-29, 95.

Specifications:



Bill of Material:

Quantity	Description
1	AC Ammeter 0-25 amperes
1	AC Voltmeter (use VOM) 0-150 volts
1	Extension cord 18-2 SP-1 100 ft. long
1	Extension cord 14/2 S 100 ft. long
1	Electric iron or other device that consumes about 1000 watts.

Steps of Procedure:

_____ 1. Obtain needed components.
_____ 2. Connect the circuit according to the specifications using the #18 wire. Do not plug the device in at this time.
_____ 3. Record the voltage at the source and at the end of the extension cord in the proper blank below.
_____ 4. Plug in the load and again record both voltages and the current. Note: SP-1 cord should not carry more than seven amperes, but disregard this limitation for this exercise.
_____ 5. Replace the extension cord with the #14 cord.
_____ 6. Repeat the same procedures as for the #18 wire.
_____ 7. Return the materials to their storage places.
_____ 8. Complete the chart below.
_____ 9. Answer the questions.

	18/2 no load	18/2 with load	14/2 no load	14/2 with load
voltage at source				
voltage at load				
voltage drop in line				
amperage (load)	X		X	
wattage at source (IXE)	X		X	
wattage of device (IXE)	X		X	
power loss	X		X	

Checking Understanding:

1. How many feet of conductor were in each of the extension cords?
2. What would happen to the voltage drop if the length of the cords were doubled? The power loss?
3. A three per cent voltage drop is usually considered maximum. Which of these two cords would satisfy this requirement?

APPLIED ELECTRICITY

Job Assignment 16
Covering Unit 77

Name _____
Due _____

WIRE A FLUORESCENT LAMP

A popular form of lighting in the modern home is fluorescent lighting. This form of lighting gives a good quality of light, and it also gives more light per watt than a normal incandescent lamp.

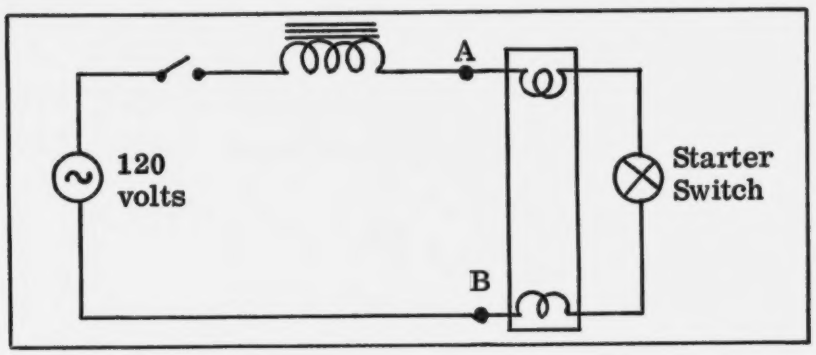
Objective: To wire and examine the operation of a fluorescent lamp.

Directions: Read this entire assignment sheet. Read the reference assigned and work out the problem by following the steps of procedure.

Reference:

Z. Wellman, William R., Elementary Electricity, pp. 273-281.

Specifications:



Bill of Material:

Quantity	Description
1	SPST switch
1	Fluorescent lamp 15 watt
1 pair	Lamp holders (one with starter and holder). (Note to instructor: Remove the metal cover from the starters.)
1	Voltmeter 0-150 Volts A.C. (use VOM)
1	Ballast
1 set	Leads

Steps of Procedure:

_____ 1. Obtain needed materials.
_____ 2. Wire the circuit as given in the specifications. Connect a voltmeter across points A and B on the 0-150 volt scale.
_____ 3. Have your instructor check the circuit before plugging in.
_____ 4. Operate the lamp several times. Note the voltage as the lamp goes through the starting cycle. Also observe the starter.
_____ 5. Return the components to their proper storage place.
_____ 6. Answer the questions below.

Checking Understanding:

1. What two purposes does the ballast serve?
2. The line voltage was about 120 volts, but the voltage across the lamp was less. What happened to the remainder of the voltage?

APPLIED ELECTRICITY

Job Assignment 17
Covering Unit 81

Name _____
Due _____

REPAIR A LAMP

A common repair job around the home is replacing a lamp cord. At the first sign of a lamp cord fraying or the rubber insulation cracking it should be replaced. Fires have started from shorted lamp cords.

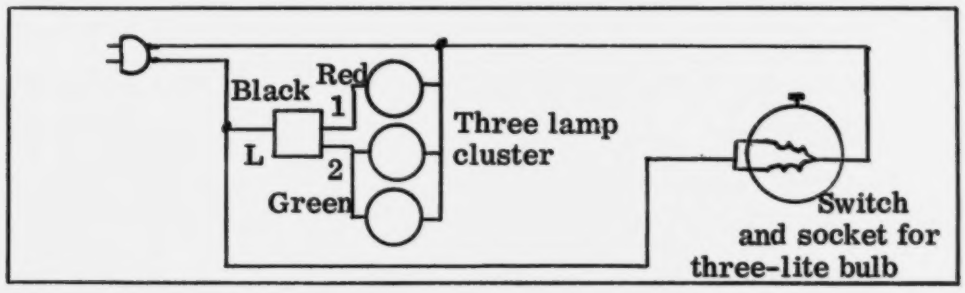
Objective: To understand how to wire and repair a lamp.

Directions: Read this entire assignment sheet. Read the reference assigned and complete the assignment by following the steps of procedure.

References:

U. Turner, Rufus P., Basic Electricity, pp. 238-239.
V. Tustison, F. E. and Ruehl, Phillip W., Electrical Essentials, Instruction Sheet 23.

Specifications:



Bill of Material:

Quantity	Description
1	Plug lead
1 piece	SP-1 cord
1	Cap (plug)
1	Key socket with nonconducting bushing
1	Switch for three lamp cluster
3	Lamps, 25-50 watt
1	Three-lite lamp base with switch (mogul or medium base)
1	Three-lite lamp, wattages to fit the above base.

Steps of Procedure:

_____1. Obtain needed components.
_____2. Wire as given in the specifications. (V Instruction Sheet 23)
_____3. Operate the lamps. The three lamp cluster should go on in the following order: one lamp, two lamps (not the one that went on alone), and then all three. If they do not operate in this order, rewire the switch.
_____4. Have your instructor observe the operation of the lamps.
_____5. Take the lamp assembly apart.
_____6. Wire the plug and socket as an extension cord. Use an underwriter's knot in the socket. (V - 238)
_____7. Attach your name to the cord and turn in. (Note to Instructor: Examine the cord assembly by taking apart and returning components to storage.)
_____8. Return equipment to proper storage.
_____9. Answer the questions below.

Checking Understanding:

1. What is the purpose of the underwriter's knot?
2. What is the reason for using the non-conducting bushing where the cord enters the socket?
3. Why should a conductor always be put under a screw in a clock-wise direction?

APPLIED ELECTRICITY

Job Assignment 18
Covering Units 82, 83

Name _____
Due _____

WIRE A PHOTO-ELECTRIC CELL

There are many applications of photo-electric devices which have become commonplace in the lives of all of us. In many places lights are turned on, doors are opened, objects are counted, sorted, and otherwise identified through photo-electric devices.

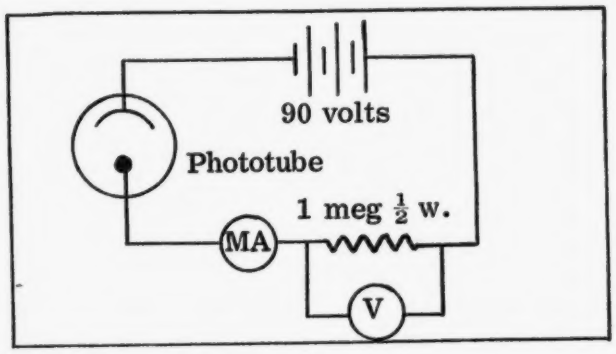
Objective: To gain an understanding of how a photo-electric tube operates and to use a light meter to determine the light intensity on a work station.

Directions: Read this entire assignment sheet. Read the reference assigned and solve the problem by following the steps of procedure.

Reference:

A. Buban, Peter, and Schmitt, Marshall L., Understanding Electricity and Electronics, p. 233.

Specifications:



Bill of Material:

Quantity	Description
1	Phototube, Type 930, 918 or similar tube and socket
1	Resistor 1 megohm ½ watt
1	Volt-Ohm Milliammeter
1	Power Supply, 90 v. D.C.
1	Light Meter
1	Flashlight

Steps of Procedure:

_____1. Obtain needed components.
_____2. Using a light meter record the light intensity at your work station as called for in the chart below. (A-233-234)

	On bench	1 ft. above bench	2 ft. above bench
Light intensity (ft. candles)			

_____3. Connect the circuit as shown in the specifications.
_____4. Note and record the current flow in the circuit with room light._____ ma.
_____5. Turn the flash light on and aim the light beam on the cathode (curved electrode) and record the current flow._____ma. Measure the voltage drop across the resistor. _____ volts. (A-233)
_____6. Turn off the flash light and using a box or your hands cover the photo tube. Note the current flow._____ma. What is the voltage across the resistor?_____volts (A-233).
_____7. Return the equipment to their proper storage places.
_____8. Answer the questions below.

Checking Understanding:

1. What statement can be made concerning the light intensity as you get further from the source?
2. What happened to the current when the photo tube was in semidarkness?
3. What additional equipment would be needed to have the photo tube operate a light?

Job Assignment 19
Covering Unit 85

Name _____
Due _____

REPLACE AN OUTLET

Replacing an outlet is relatively simple, but there are a few precautions that must be observed. In this assignment you will replace a duplex convenience outlet.

Objective: To understand how to wire a duplex convenience outlet.

Directions: Read this entire assignment sheet. Read the reference assigned and work out the problem by following the steps of procedure.

Reference:

S. Richter, H. P., Wiring Simplified, pp. 63-67.
I. Information Sheet No. 1 (page 57)

Specifications: None

Bill of Material:

Quantity	Description
1	Duplex convenience receptacle, grounding type
1	Screwdriver
1	Voltmeter or test light
1	Needle nose pliers

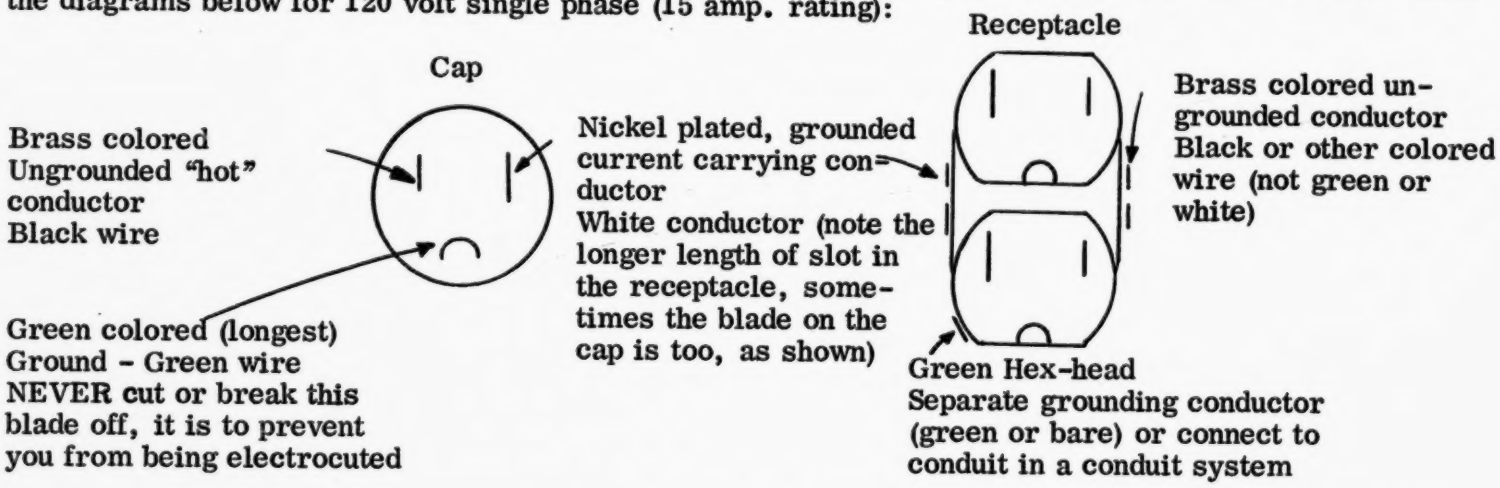
Steps of Procedure:

_____ 1. Obtain needed materials.
_____ 2. Turn off the power to the outlet to be replaced.
_____ 3. Check the outlet with a voltmeter or test light to make sure the power is off.
_____ 4. Remove the cover from the outlet. Do not lose the machine screw.
_____ 5. Remove the receptacle from the box.
_____ 6. Note the wiring. A white conductor is wired to the nickel plated screw, a green or bare conductor is connected to the hex head green grounding screw and another colored wire is connected to the remaining or "hot" terminal. Note also the size of the slots connected to the nickel plated screw and those of the "hot" lead.
_____ 7. Remove the receptacle from the wiring by unscrewing the terminals.
_____ 8. Wire the new receptacle. (Richter-65)
_____ 9. Push the receptacle back into the box being careful with the placement of the wires.
_____ 10. Replace the cover plate.
_____ 11. Return the old outlet and tools to their proper places.

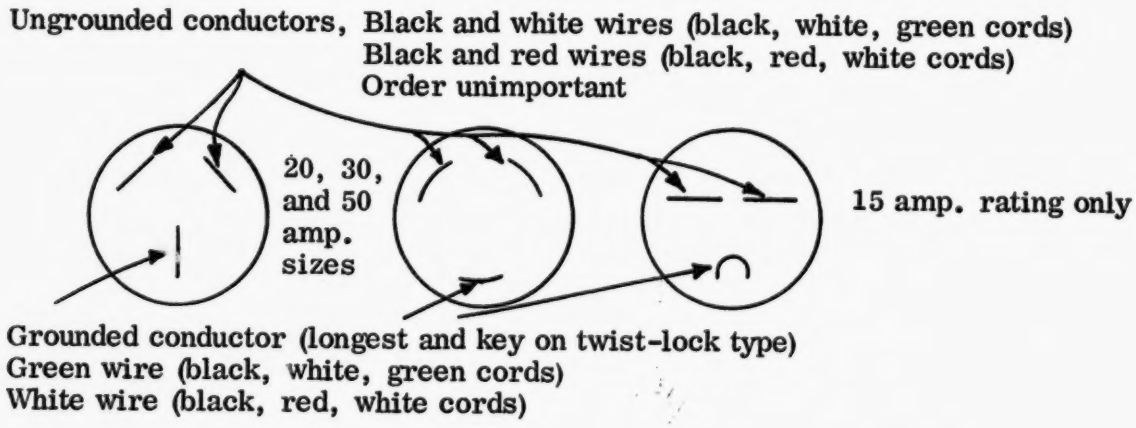
Information Sheet No. 1

PROPER WIRING FOR CAPS AND RECEPTACLES

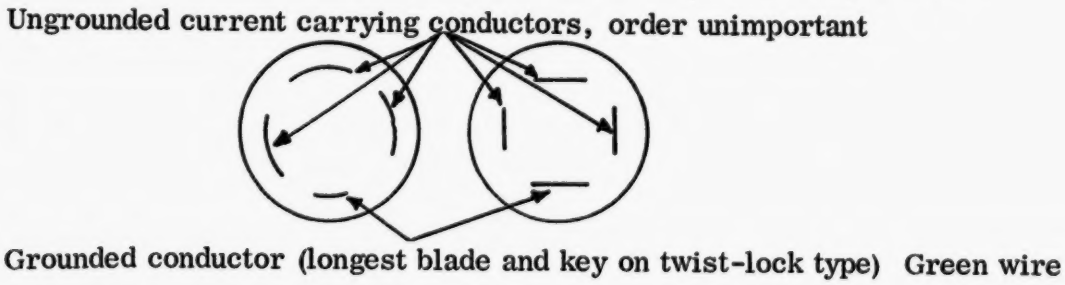
The National Electrical Code specifies that non-current-carrying parts of portable equipment MUST be grounded (NEC 250-59). This regulation is normally implemented by using a three conductor cord containing white, black, and green conductors. The green conductor must be connected to the frame of the piece of equipment. The black conductor should be connected to the switch, and the white conductor to the other current carrying conductor of the device. The cap (plug) and receptable should be wired as in the diagrams below for 120 volt single phase (15 amp. rating):



The common 240 volt single phase caps should be wired as shown below: (NEVER use any of these for three phase)



Three phase devices should use either of the caps below, when not permanently wired:



GREEN must never be used for anything except GROUNDING with any system. White is normally the grounded current carrying conductor.

APPLIED ELECTRICITY

Job Assignment 20
Covering Units 86-88

Name _____
Due _____

WIRE A SWITCH

One of the more confusing things in residential wiring is working with three- and four-way switches. The purpose of these switches is to wire a lamp so that it may be controlled from two or more places.

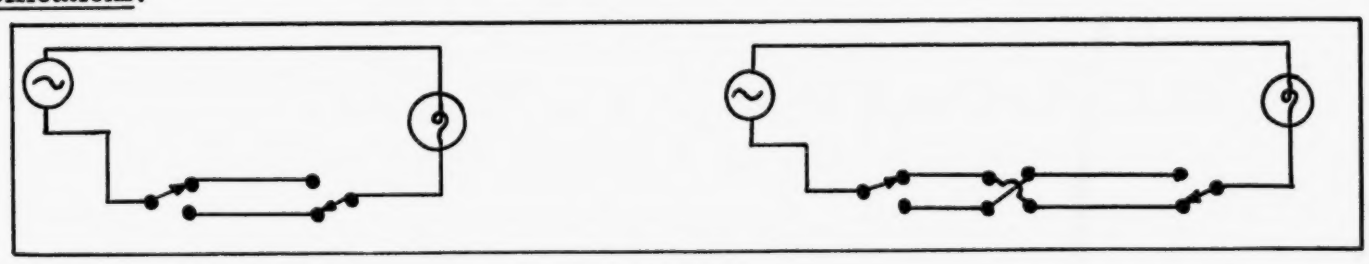
Objective: To understand how a lamp or other device can be controlled from more than one point.

Directions: Read this entire assignment sheet. Read the references assigned and solve the problem by following the steps of procedure.

References:

A. Buban, Peter, and Schmitt, Marshall L., Understanding Electricity and Electronics, pp. 273-274.
O. Lush, Clifford R., and Engle, Glenn E., Industrial Arts Electricity, p. 97.

Specifications:



Bill of Material:

Quantity	Description
2	3 way switches
1	4 way switch
1	Lamp and receptacle
	Plug leads
	Assorted leads

Steps of Procedure:

_____1. Obtain needed components.
_____2. Wire the two three-way switches to control the lamp. The switch terminal that is a different color from the other two is the common terminal and is connected either to the source (ungrounded conductor) or the lamp, depending upon which switch it is; (A-273-274)
_____3. Plug in and try operating the lamp. You should be able to turn the lamp off or on from either switch.
_____4. When you have it operating properly, demonstrate it to your instructor.
_____5. Place a four-way switch between the two three-way switches. One can determine the switch terminal arrangement by using an ohmmeter. The two terminals that do not have continuity between them with the switch in either position should be connected to the two "dummy" leads from one three-way. The other two terminals are then connected to the leads from the other three-way. (A-273-274)
_____6. Operate the lamp. You should have complete control of the lamp from any of the three switches. If not, you wired it incorrectly. Correct it.
_____7. Demonstrate the proper operation to your instructor.
_____8. Disconnect and return all equipment to the proper storage place.

APPLIED ELECTRICITY

Job Assignment 21
Covering Units 90-91

Name _____
Due _____

INSTALL A SWITCH BOX

Often one wishes to have an additional outlet around the home. This can often be done quite easily by extending a cable from an existing outlet, installing a switch box and wiring the new outlet in this box. One should be sure the local building codes permit this practice. In some communities you must have a permit before doing such wiring; other places may require that it be done by a licensed electrician.

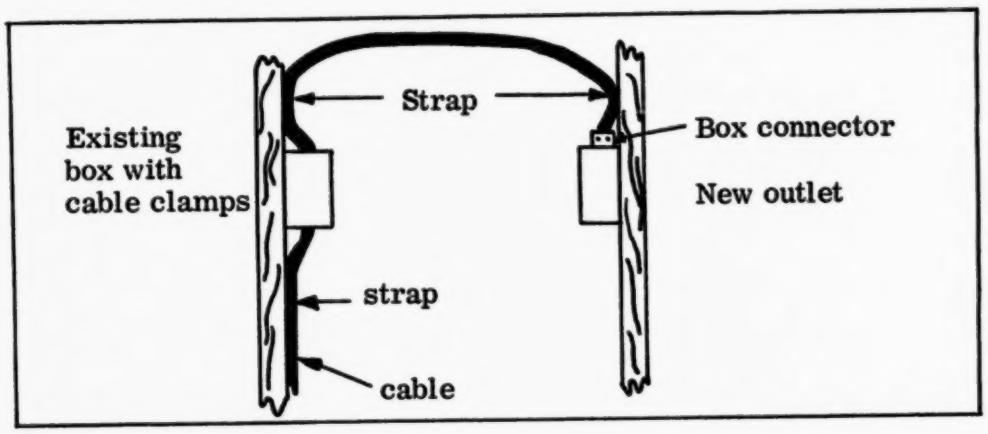
Objective: To gain an understanding of some of the considerations in wiring an outlet.

Directions: Read this entire assignment sheet. Read the reference assigned and complete the assignment by following the steps of procedure.

Reference:

A. Buban, Peter and Schmitt, Marshall L., Understanding Electricity and Electronics, pp. 272-273.

Specifications:



Bill of Material:

Quantity	Description
2	Cable straps
1 piece	12/2 non-metalic sheathed cable with ground. (May use armored cable if local codes require.)
1	Switch box without cable clamps
1	Romex connector 3/8" (fit ½" conduit knockout)
1	Duplex convenience outlet
1	Duplex cover plate
1	Pliers, side cutting
1	Screwdriver
1	Knife
1	Voltmeter or test light

Steps of Procedure:

_____ 1. Obtain needed items.
_____ 2. Turn off power to the outlet that will be extended.
_____ 3. Check with a voltmeter or test lamp to make sure power is off.
_____ 4. Locate box for new receptacle and mount. The front edge of the box should be flush with the finished wall.
_____ 5. Remove cover and duplex receptacle from the existing box.
_____ 6. Remove 8" of sheathing from one end of the cable. (Do not strip insulation from conductors)
_____ 7. Install end of cable in either box keeping the 8" of cable that has been stripped extending through the box with the cable clamp compressed against the sheathing. Do not tighten so tight as to damage the conductor insulation.

_____ 8. Within 12" of the box fasten the cable with a strap.
_____ 9. Run the cable to the second box and cut allowing at least 8" of conductor in the box. Remember it is easier to cut one or two inches extra off than to try and add it on later.
_____ 10. Strip 8" of sheathing off the free end of the cable and install in the box.
_____ 11. Fasten the cable within 12" of the box with a strap.
_____ 12. Strip the conductors and install the new receptacle. Be sure the white conductor is fastened to the nickel plated screw.
_____ 13. Mount the outlet in the box and put on the cover plate.
_____ 14. Attach the wires to the existing outlet making sure to observe polarity.
_____ 15. Replace the outlet and cover plate.
_____ 16. Turn on power and test new outlet.
_____ 17. Return tools to proper storage.

APPLIED ELECTRICITY

Job Assignment 22
Covering Units 101-102

Name _____
Due _____

WIRE LOW VOLTAGE CIRCUITS

Because there is less fire hazard and shock hazard with wiring systems requiring less than 30 volts, different rules govern this wiring. The transformers used for door bells and chimes, remote control wiring and other control systems are designed to limit the current to safe values.

In this assignment you will wire a door bell-buzzer and a low voltage two point lamp control.

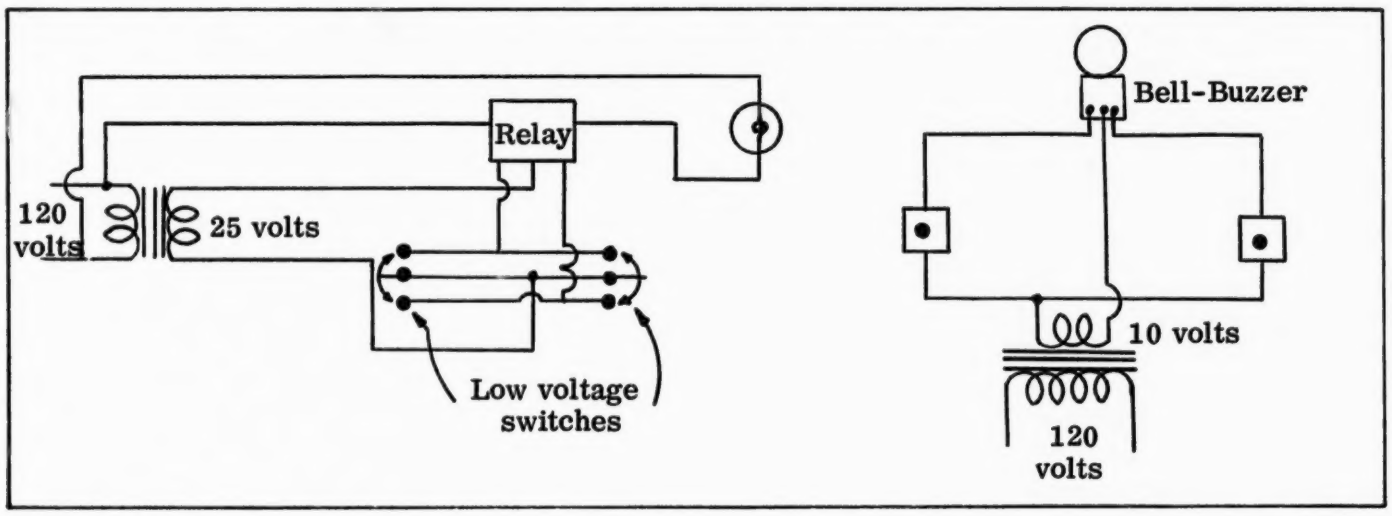
Objective: To familiarize the student with the principles of low voltage wiring.

Directions: Read this entire assignment sheet. Read the reference assigned and complete the assignment by following the steps of procedure.

Reference:

S. Richter, H. P., Wiring Simplified, pp. 79-82.

Specifications:



Bill of Material:

Quantity	Description
1	Transformer 120 v: 25 volt
2	Low voltage switches
1	Lamp and receptacle
1	Low voltage relay
	Assorted leads
1	Transformer door bell 120 v.: 10 v.
2	Push button switches
1	Door bell-buzzer combination

Steps of Procedure:

_____ 1. Obtain needed components.
_____ 2. Wire the low voltage lamp control as in the diagram. Be sure you do not have the high and low voltage leads mixed. (S - 81)
_____ 3. Have your instructor check your circuit before turning on any power.
_____ 4. Operate the lamp several times from the two switches.
_____ 5. Disassemble the circuit.
_____ 6. Wire the bell-buzzer as in the diagram. (Note to the instructor: Have the door bell transformer primary leads wired directly to a 120 volt plug so the students will not be able to wire the high voltage to the bell-buzzer.) (S - 79-80)
_____ 7. Operate the circuits several times.
_____ 8. Disassemble the circuit and return all materials to their proper storage places.

APPLIED ELECTRICITY

Job Assignment 23
Covering Units 106

Name _____
Due _____

CONSTRUCT AN ELECTRIC MOTOR*

One method of developing an understanding of the operation of an electric motor is to construct one. There are many types of motors that can be built, but all operate on the same basic principles.

Objective: To develop an understanding of the operation of an electric motor.

Directions: Read this entire assignment sheet. Read the reference assigned and follow the steps of procedure to complete the project.

Reference:

M. Jones, E. W., Fundamentals of Applied Electricity, pp. 309-311.

Specifications: (see attached diagram)

Bill of Material:

Quantity	Description	Kind of Material	Size	Cost

Estimated time to do job _____ hrs;
Actual time required _____ hrs.

Steps of Procedure:

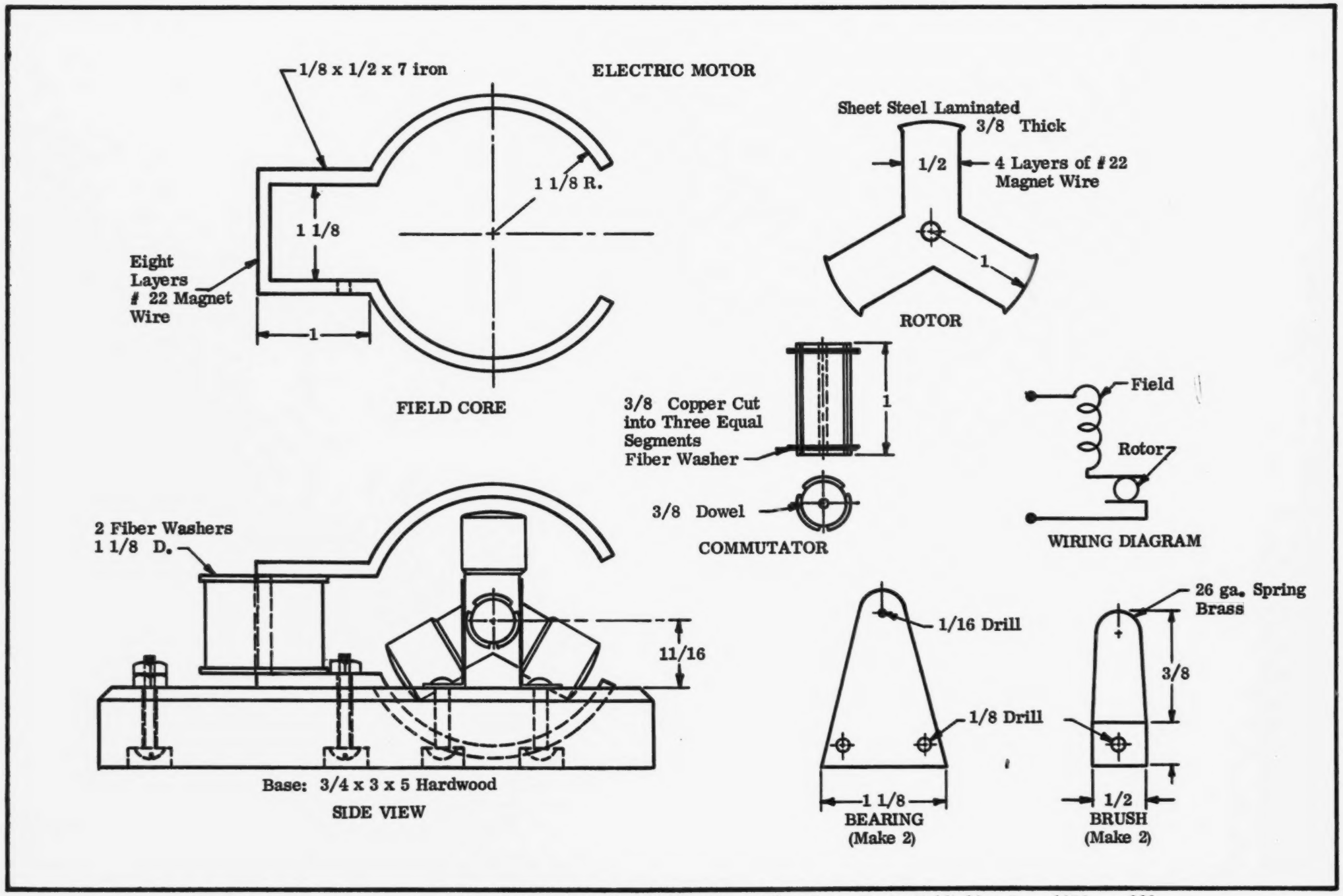
_____1. Make out the bill of material. (Jones-309-311)
_____2. Obtain materials required.
_____3. Cut rotor stock to size and smooth rough edges. (Jones-310)
_____4. Make commutator. (Jones- 310)
_____5. Assemble the rotor and commutator on the shaft. (Jones-310-311)
_____6. Wind the rotor coils. (Jones-310)
_____7. Construct the field core. (Jones-310)
_____8. Wind the field coil. (Jones-310)
_____9. Construct the rotor bearing supports and brushes. (Jones-311)
_____10. Make the base for the motor. (Jones-309)
_____11. Assemble the motor. (Jones-311)
_____12. Apply the test of workmanship.
_____13. Submit to your instructor for a grade.

Test of Workmanship:

1. Are all dimensions the same as on the drawing?
2. Are your coils wound smoothly and neatly?

*Adapted from: Jones, E. W., Fundamentals of Applied Electricity, Bruce Publishing Company, Milwaukee, Wisconsin, 1956.

3. Are solder joints smooth and electrically sound?
4. Is the rotor symmetrical and balanced?
5. Is clearance between rotor and stator proper?
6. Does the motor run?
7. What changes would you make if you were to do it again?



Adapted from: Jones, E. W. Fundamentals of Applied Electricity. Milwaukee: Bruce Publishing Co., 1956, p. 309.

APPLIED ELECTRICITY

Job Assignment 24
Covering Units 109-130

Name _____
Due _____

"TROUBLE SHOOT" A MOTOR

With proper maintenance an electric motor will give years of trouble free service. However, since it is a mechanical device there are parts that can eventually wear out. There are a number of routine things that can be done with a motor to increase its productive life.

Objective: To learn to identify common troubles with electric motors, how to reverse the direction of rotation of a motor, change voltage and make minor repairs.

Directions: Read this entire assignment sheet. Read the reference assigned and solve the problems by following the steps of procedure.

Reference:

I. Information sheet No. 2 (following this assignment)

Specifications: None

Bill of Material:

Quantity	Description
1	Voltmeter (use VOM)
1	Screwdriver
1	Wrench, adjustable or nutdriver
1	AC ammeter 0-25 amp.
6	Motors as follows: 1 with a shorted capacitor 1 with a bad starter winding 1 with a bad starter switch 1 with a bad bearing 1 dual voltage motor to change voltage and reverse direction of rotation 1 with a grounded winding Since you can only work on one motor at a time, take only one at a time.

Steps of Procedure:

_____ 1. Obtain tools, a motor and other needed items.
_____ 2. Record the nameplate data for the motor on the attached form.
_____ 3. Examine the motor and note its construction.
_____ 4. Determine the type of motor.
_____ 5. Read the complaint against the motor.
_____ 6. Determine if the rotor is free to turn.
_____ 7. If the rotor can be turned by hand, plug the motor in to see if it operates.
_____ 8. Determine what the probable cause of the trouble is by consulting the information sheet attached.
_____ 9. Write a description of the fault, and indicate what should be done to remedy the fault.
_____ 10. On the motor to be reversed and voltage changed steps 6-9 are omitted. On this motor change the voltage connections and reverse the motor rotation.
_____ 11. Return the motor and obtain another with a different type of fault.
_____ 12. Repeat the above procedures until all types of trouble have been investigated.
_____ 13. Mount the motor with the shorted capacitor to a load with a V-belt. Line it up and tighten the motor mounting. Have your instructor check it.
_____ 14. Turn the motor on. Can it start the load?
_____ 15. Return all materials to their proper storage places.
_____ 16. Answer the questions below.

Checking Understanding:

1. What voltage was used when using the ohmmeter scales on the VOM? Would all breakdowns of insulations at 120 volts show up at this voltage?

2. A one horsepower motor operating on 120 volts requires 14 amperes. It is going to operate 500 feet from the power source. If the voltage drop of the line is not to exceed 3% or 3.6 volts for the line, what size wire should be used? Remember that the 500 foot length includes 2 conductors. Use a wire table to determine the resistance per foot and use Ohm's law.

3. Why should a motor be lined up with its load when using a V-belt drive?

APPLIED ELECTRICITY

Name _____

DATA SHEET

No._____ Make of Motor_____ Serial No._____ Temp. (^{o}C.)_____
Frame and/or Style No._____ H. P. _____ Voltage _____ Phase _____
Current_____ Frequency_____ R.P.M._____ Type of Motor:
Split-phase Induction ( ); Capacitor Start ( ); Three Phase Induction ( ); Repulsion Start-Induction Run ( ); Universal ( ); Other_____
Probable Trouble: _____
_____
Suggested Remedy: _____
_____

No._____ Make of Motor_____ Serial No._____ Temp. (^{o}C.)_____
Frame and/or Style No. _____ H. P._____ Voltage _____ Phase _____
Current_____ Frequency_____ R.P.M._____ Type of Motor:
Split-phase Induction ( ); Capacitor Start ( ); Three Phase Induction ( ); Repulsion Start-Induction Run ( ); Universal ( ); Other_____
Probable Trouble:_____
_____
Suggested Remedy:_____
_____

No._____ Make of Motor_____ Serial No._____ Temp. (^{o}C.)_____
Frame and/or Style No._____ H. P._____ Voltage _____ Phase _____
Current_____ Frequency_____ R.P.M. _____ Type of Motor:
Split-phase Induction ( ); Capacitor Start ( ); Three Phase Induction ( ); Repulsion Start-Induction Run ( ); Universal ( ); Other_____
Probable Trouble: _____
_____
Suggested Remedy: _____
_____

No._____ Make of Motor_____ Serial No._____ Temp. (^{o}C.)_____
Frame and/or Style No. _____ H. P._____ Voltage _____ Phase _____
Current_____ Frequency_____ R.P.M._____ Type of Motor:
Split-phase Induction ( ); Capacitor Start ( ); Three Phase Induction ( ); Repulsion Start-Induction Run ( ); Universal ( ); Other_____
Probable Trouble:_____
_____
Suggested Remedy:_____
_____

No._____ Make of Motor_____ Serial No._____ Temp. (^{o}C.)_____
Frame and/or Style No._____ H. P._____ Voltage _____ Phase _____
Current_____ Frequency_____ R.P.M. _____ Type of Motor:
Split-phase Induction ( ); Capacitor Start ( ); Three Phase Induction ( ); Repulsion Start-Induction Run ( ); Universal ( ); Other_____
Probable Trouble: _____
_____
Suggested Remedy: _____
_____

USE THIS SECTION FOR THE MOTOR YOU REVERSE

No._____ Make of Motor_____ Serial No._____ Temp. (^{o}C.)_____
Frame and/or Style No._____ H. P._____ Voltage _____ Phase _____
Current_____ Frequency_____ R.P.M._____ Type of Motor:
Split-phase Induction ( ); Capacitor Start ( ); Three Phase Induction ( ); Repulsion Start-Induction Run ( ); Universal ( ); Other _____
Direction of Rotation When You Obtained Motor (When looking at it from the end opposite the drive):
(Check appropriate blank) Clockwise ( ); Counter Clockwise ( ). It was connected for 120 Volts ( ); 240 Volts ( ) when obtained.

Information Sheet No. 2

ELECTRIC MOTOR TROUBLESHOOTING

There are many possible troubles that can develop in a motor. Some of these can be repaired by the owner; others should only be done by an experienced motor repairman. Occasionally the trouble will be such that it is best to replace the motor with a new one.

In order to determine the extent of the repair needed, a logical procedure should be followed. One can not make a generalized procedure to follow in all types of motor analysis, but the one below will be adequate for most situations you will come in contact with.

A. Perform a visual inspection of the motor. This may require some cleaning of the motor.

1. Record all name plate data of the motor for future reference. This information may be needed to order parts.
2. Read the complaint against the motor. Often this will give a good indication of what the trouble may be.
3. Examine the motor carefully for:

   a. Cracked bell housing. If this is the case, it often is best to get a new motor on smaller motors. On larger ones it should be welded or replaced.
   b. Worn bearings. This can be done by checking for "play" in plane at a right angle to the axis of the shaft. Repair: replacement of bearings should be done by a repair shop so the bearings can be carefully reamed.
   c. Excessive end play of shaft. Normally there should not be more than 1/16 of an inch. If it is excessive, additional washers should be added.
   d. Bent shaft. Usually means replacement of rotor or complete motor.
   e. Binding of rotor. Several things can cause this. It may be badly worn bearings, bell housing not properly tightened, bell housing not replaced properly, starter switch or windings in the way and several other causes that would have to be investigated in each case. It is difficult to predict the repair needed. It may be new bearings, proper placement and tightening of the bell housing, repair of switch, or rewinding. In some cases the best solution may be a new motor. Do not plug in a motor if the rotor is not free to turn.
   f. Poor electrical connections. Check the condition of the plug, cord and connections in the motor. Often this is the only repair needed. If the cord is to be replaced, it is highly recommended that you use a three conductor cord for replacement and a grounding type plug. Inform the users of the motor why this is done and the importance of the grounding conductor. When rewiring the motor, the green conductor is fastened to the frame of the motor.
   g. Size of the motor too small for the load.

B. If the rotor is free to turn, operation test the motor.

1. Plug in the motor and turn on the power.

   a. If it does not operate or start, check for:

      (1) An open line cord.
      (2) A defective switch on the motor.
      (3) A defective overload device.
      (4) Open main and starter leads.
      (5) Improper wiring on the terminal block.

   b. If it does not operate, but hums, particularly when under load, and will operate when started by hand, check for:
      (1) Defective starter switch. The contacts may be burned, bent, or otherwise damaged, necessitating replacement.
      (2) Open or burned out starter winding. Rewind the starter windings.
      (3) Open or shorted capacitor on capacitor start motors. Check with a capacitor checker or replace with a new one. A quick way to check for a shorted capacitor is to connect it across a 120 volt A.C. line protected by a circuit breaker. If the breaker trips, the capacitor is shorted and should be replaced. One

should be careful when handling electrolytic capacitors as the electrolyte can be dangerous. They can make a mess if they blow.

(4) Spacing washers may all be on one end of shaft so starter switch can't operate.

(5) Overloaded motor. A motor may be overloaded by having drive belt tension too tight as well as too much of a load.

(6) Check the following if the motor is a repulsion or repulsion start-induction run type:

(a) defective brush mechanism. Check to see that the brush mechanism is free to operate.

(b) brushes stuck in brush holders.

(c) worn brushes.

(d) brushes in wrong position.

c. If the motor starts but overheats, check:

(1) Motor is too small for the load.

(2) Starter windings shorted to the mains.

(3) Main windings shorted to each other.

(4) Improper ventilation of motor. Vent holes plugged or motor mounted where air can not properly circulate.

d. If the motor blows a fuse, check for:

(1) A shorted plug, line cord, or connections on terminal block.

(2) Shorted windings - main and/or starter.

(3) Grounded windings.

(4) A shorted capacitor on capacitor start motors.

(5) Badly worn bearings.

(6) Motor wired for wrong voltage.

e. If the motor smokes while operating, check for:

(1) Shorted windings - starter and/or mains.

(2) Starter switch does not open after starting which may be caused by (3).

(3) Overloaded motor.

(4) A grounded winding.

f. If the motor looses speed and power, check the following:

(1) A shorted running winding.

(2) The starter windings remain in the circuit.

(3) The motor is wired for the wrong voltage.

(4) If the motor has just been rewound one winding may have the wrong polarity.

(5) If a repulsion type motor, the brush mechanism may need repair or cleaning.

This list is not intended to be complete but covers some of the more common difficulties that will be encountered.

Job Assignment 25
Covering Units 131-135

Name _____
Due _____

WIRE ELECTRICAL CONTROLS

Electricity is used to control the flow of gases and liquids. It is also used to control and regulate devices on the basis of time, temperature, humidity, light and other factors.

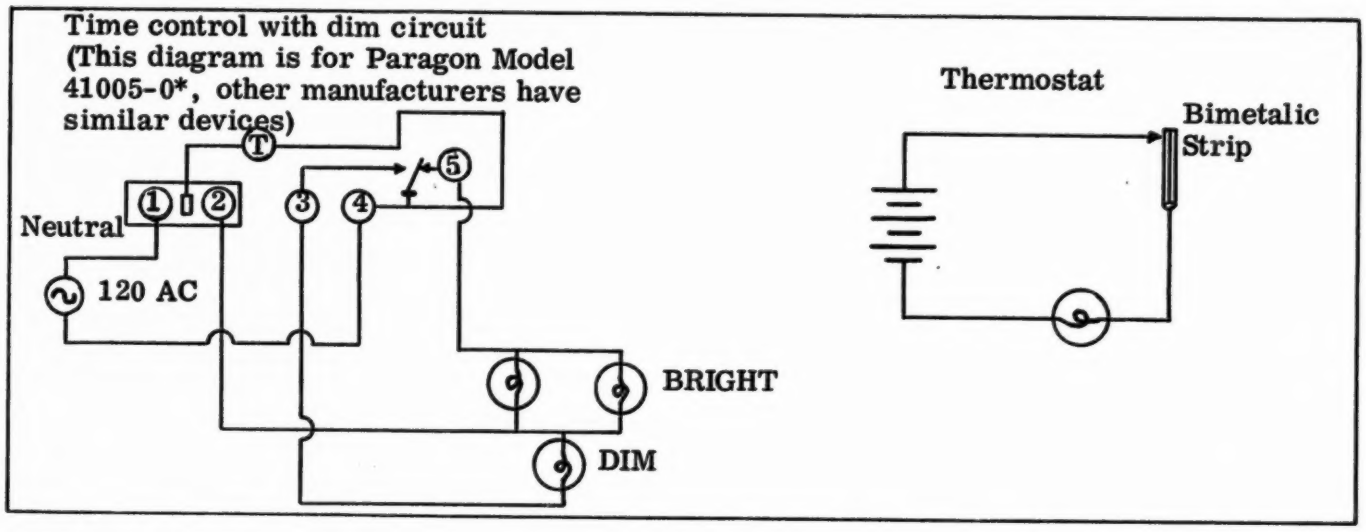
Objective: To obtain an understanding of how certain electrical controls operate and some of their limitations.

Directions: Read this entire assignment sheet. Read the references assigned and solve the problems by following the steps of procedure.

Reference:

L. Graham, Kennard C., Interior Electric Wiring-Part I-Residential, pp. 190-199.

Specifications:



Bill of Material:

Quantity	Description
1	Time control
3	Light bulbs and bases
1	Single phase magnetic motor control
1	Start-stop station for above control
1	Motor to operate with controller
1	Thermostat
2	Drycells
1	Lamp and receptacle to control with thermostat (represents load)
	Assorted leads

Steps of Procedure:

Note: These three circuits may be completed in any order.

A. Motor Control

_____ 1. Obtain materials for the motor controller.
_____ 2. Wire the motor controller to the motor and power source (make sure the power is off!). Wire the start-stop station as given on the diagram inside the cover of the motor controller.
_____ 3. Check the name plate current on the motor.

*Used with permission of Paragon Electric Company, Inc., Subsidiary of American Machine & Foundry Company.

_____ 4. Check the number on the heater in the controller and the current for this number inside the cover of the controller. If they are not the proper size, obtain the proper size and install them.

_____ 5. Have your instructor check the circuit.

_____ 6. Replace the covers on all of the equipment.

_____ 7. Turn the power on and operate the motor several times.

_____ 8. Turn the motor on from the start-stop station. While the motor is running turn off the power source (not the start-stop station).

_____ 9. Turn the power back on (do not touch the start-stop station). Does the motor start?

_____ 10. Disassemble the circuit and return the components to their proper storage place. Make sure you turn the power off before you start disassembly.

B. Thermostat Control

_____ 1. Obtain a thermostat and other materials needed for the thermostat.

_____ 2. Wire the circuit as given in the specifications.

_____ 3. Adjust the thermostat so it will just operate the lamp at room temperature.

_____ 4. Heat the bimetalic strip with a match or other method. Note the bimetalic strip and the light.

_____ 5. Remove the heat and allow the thermostat to cool. Note what happens.

_____ 6. Repeat several times.

_____ 7. Disassemble and return parts to their proper storage.

C. Time Control

_____ 1. Obtain parts needed for the time control.

_____ 2. Wire the time control as given in the specifications or the diagram furnished with the controller.

_____ 3. Have your instructor check the circuit.

_____ 4. Set the timer so it reads the proper time and adjust the time stops so the lights will be on when you plug the unit in and will go on the dim circuit within a few minutes after plugging in.

_____ 5. Plug in the unit and watch the operating sequence. During the dim sequence you can be answering the questions below.

_____ 6. After the clock has run through the dim sequence and is off, turn off the power and disassemble. Return all equipment to its proper storage place.

_____ 7. Answer the questions below.

<u>Checking Understanding:</u>

1. What happened to the motor when the power was turned off at the source? What happened when the power was turned on? Why didn't the motor start again? Why might this feature be an advantage?
2. For what reason are the heaters located in the controller? What would happen if they were too small for the motor? What might happen if they were too large?
3. How would you add another start-stop station so the motor could be controlled from two locations?
4. How could you wire the thermostat so it would operate a machine for cooling?
5. Suggest some places where a time switch might be used. List at least four.

APPLIED ELECTRICITY

Job Assignment 26
Covering Units 139-150

Name _____
Due _____

PERFORM MINOR APPLIANCE MAINTENANCE

There are many minor appliance repairs that can easily be done at home. There are also certain minor maintenance procedures that can be done by the appliance owner that will increase the life and efficiency of appliances.

Objective: To familiarize the student with some of the minor maintenance procedures that can be used with electrical appliances.

Directions: Read this entire assignment sheet. Read the references assigned and complete the assignment by following the steps of procedure.

References:

D. Arnold, Joseph P., and Schank, Kenneth L., Exploratory Electricity, pp. 41-42.
G. Gabbert, William L., Electrical Appliance Service Manual, pp. 58-76, 251-296.
O. Lush, Clifford K., and Engle, Glenn E., Industrial Arts Electricity, pp. 87-89.

Specifications: None

Bill of Material:

Quantity	Description
1	Electric iron in need of new cord (obtain one from home or a neighbor)
1	Cord assembly for an electric iron
1	Washing machine (conventional)
1	Refrigeration compressor (air conditioner)
1	Vacuum cleaner
1	Screwdriver
1	Wrench, adjustable
1	Level, 2 foot
1	Volt-Ohm-Milliammeter
1	Side cutting pliers
1	Cap (plug)
1	Cord end
1	Feed through switch
1	Length of SP-1 cord
1	Thin wall conduit (E.M.T.) $\frac{1}{2}$" x 5"
1 piece	Sheet brass or steel $\frac{1}{2}$" diameter (gage)
2	Pen light cells
6 inches	Test Lead #18 rubber covered
1	No. 1 rubber stopper, 1 hole
1	Alligator clip (Mueller #70)
1	Nail 10 d
1	Lamp, 2.5 volt, screw base
2 inches	Stove wire

Steps of Procedure:

_____ 1. Construct a combination continuity tester and flashlight. (Arnold & Schank, pp. 41-42)
_____ 2. Obtain an electric iron that needs a new cord and a replacement cord.
_____ 3. Using an ohmmeter determine if there is a continuous circuit through the iron heating element. If the cord is broken this can be done at the terminals where the cord is attached to the iron (do after step 5). Make sure the iron thermostat is in an on position.
_____ 4. Examine the iron and determine how to take it apart to get at the cord terminals.
_____ 5. Remove the necessary parts to get at the terminals.
_____ 6. Remove the screws holding the cord conductors. Caution: Hold the iron so the screws will not fall into the iron, where they can be difficult to get out and may cause short circuits.
_____ 7. Install the new cord, again being careful to keep the screws from falling into the iron.

_____ 8. Replace the iron handle and/or other parts that were removed.
_____ 9. Test the iron for operation.
_____ 10. Obtain a conventional washing machine.
_____ 11. Examine the wringer arrangement and remove the cover.
_____ 12. Remove the top wringer roll and note the bearing arrangement as it is removed.
_____ 13. Examine the condition of the rolls and the bearings.
_____ 14. Replace the wringer rolls, bearings and cover.
_____ 15. Examine the water pump on the machine and determine how it might be removed for cleaning.
_____ 16. Remove the pump cover or pump from the machine as the case may be. (Note to the instructor: Try to use a machine from which the pump can be easily removed.)
_____ 17. Examine the pump to see that it is not clogged.
_____ 18. Replace the pump.
_____ 19. Determine the best way to ground the machine and ground it.
_____ 20. Obtain an air conditioner or other refrigeration unit.
_____ 21. Examine the unit and determine the best way to get to the condenser coils.
_____ 22. Make sure no power is on and remove any necessary covers. Be careful not to damage any of the coils or other tubing.
_____ 23. Using a vacuum cleaner, clean the dirt from the condenser coils. Note the location of the fan and other components.
_____ 24. Replace all guards and covers.
_____ 25. Remove the air filter and determine its condition.
_____ 26. Replace the filter if it is still effective, if not replace it with a new one.
_____ 27. Level the piece of equipment your instructor has assigned you.
_____ 28. Determine the best places to place the level.
_____ 29. Test the piece of equipment and determine the approximate amount of material needed to level it.
_____ 30. Place the leveling blocks under the legs and check.
_____ 31. Use shingles or other material to finish leveling.
_____ 32. Obtain the parts needed for making the extension cord.
_____ 33. Strip 3/8" of insulation from each conductor on one end of the cord.
_____ 34. Attach the cap to the cord. Be sure the leads come around the plug blades and under the screw in a clockwise direction as shown in your reference.
_____ 35. Strip 3/8" of insulation from each conductor on the other end of the cord.
_____ 36. Attach the cord end, again making sure the conductor goes under the screw in the proper direction.
_____ 37. Assemble the cord end.
_____ 38. Close to one end of the cord cut <u>one</u> conductor and separate the conductors 2 3/8" (1 3/16" on each side of the cut).
_____ 39. Strip each end of the cut conductor.
_____ 40. Disassemble the feed-through switch.
_____ 41. Fasten the conductors under the terminal screws making sure they are in the proper direction.
_____ 42. Locate the conductors in the switch so they follow the proper path and assemble the switch.
_____ 43. Test the cord assembly.
_____ 44. Turn in with your name attached. (The instructor should check the cord by taking it apart and returning the components to storage.)
_____ 45. Return all equipment to their proper storage places.
_____ 46. Answer the questions below.

<u>Checking Understanding:</u>

1. Why should special types of cords be used with heating appliances?
2. Why are wooden bearings used on wringers?
3. How can one keep wringer rolls from getting a soap film on them?
4. What is the purpose of the fan on the refrigeration compressor?

APPLIED ELECTRICITY

Job Assignment 27
Covering Units 158-159

Name _____
Due _____

LOCATE AUTOMOTIVE ELECTRICAL TROUBLES

There are many troubles in the automotive electrical system that can be repaired with very little equipment. In this assignment you will have an opportunity to test and repair parts of the automotive electrical system.

Objective: To enable the student to analyze and correct some of the troubles that commonly develop in the automobile electrical system.

Directions: Read this entire assignment sheet. Read the references assigned and solve the problems by following the steps of procedure.

References:

A. Buban, Peter and Schmitt, Marshall L., Understanding Electricity and Electronics, pp. 292-301.
C. Steinberg, William B. and Ford, Walter B., Electricity and Electronics - Basic, pp. 167-176.

Specifications: None

Bill of Materials:

Quantity	Description
1	Automobile generator
1	Automobile ignition coil
1	Automobile distributor
1	Set of generator brushes
1	Capacitor checker
1	Volt-Ohm-Milliammeter

Steps of Procedure:

_____ 1. Obtain a generator, screwdriver, and set of brushes.
_____ 2. Examine the condition of the commutator. (A-296, C-170)
_____ 3. Remove the brushes.
_____ 4. If the commutator is dirty, it can be cleaned with carbon tetrachloride. If it is badly worn and pitted, the armature should be removed and the commutator cut down on a lathe.
_____ 5. Replace the brushes in the generator.
_____ 6. Return the generator and extra brushes to their proper storage places.
_____ 7. Obtain an ignition coil.
_____ 8. Ascertain the primary and secondary leads of the coil. (A-298, C-173)
_____ 9. Check the primary for continuity with an ohmmeter.
_____ 10. Check the secondary for continuity with an ohmmeter.
_____ 11. Return the coil to the proper storage place.
_____ 12. Obtain a distributor and capacitor checker.
_____ 13. Remove the distributor cap and note the placement of parts and their function. (A-298, C-173)
_____ 14. Look at the points. Are they badly pitted?
_____ 15. Remove the capacitor and check it for capacitance and voltage break down.
_____ 16. Replace the capacitor.
_____ 17. Replace the distributor cap.
_____ 18. Return all equipment to the proper storage places.

APPLIED ELECTRICITY

Job Assignment 28
Covering Units 164-173

Name _____
Due _____

CONSTRUCT A CRYSTAL SET

A radio receiver that requires no external power and is easily made is a crystal set. The parts of this simple receiver contain the essentials for any radio receiver: antenna-ground system, turner, detector, and reproducer.

For this assignment you will design and construct your own crystal set.

Objective: To develop an understanding of the function of the basic essentials of a radio receiver.

Directions: Read this entire assignment sheet. Read the reference assigned. Design a crystal set and make a bill of material for the set. Make an outline of the procedure you will follow. Have your instructor approve your design and then build it.

Reference:

A. Buban, Peter and Schmitt, Marshall L., Understanding Electricity and Electronics, pp. 312-325.

Specifications: Drawn by student.

Bill of Material: Developed by student.

Steps of Procedure: Determined by student.

Test of Workmanship:

1. Does the crystal set work?
2. Are all solder joints smooth and heated through?
3. Are leads adequately insulated from the chassis?
4. Are all electrical connections made on tie points or firmly mounted components?

APPLIED ELECTRICITY

Job Assignment 29
Covering Unit 164

Name _____
Due _____

MAKE A CODE OSCILLATOR*

Morse code is a widely used method of communication. Any amateur radio operator must have a thorough knowledge of this code before receiving an operating license. Also, knowledge of this code is a requirement for advancement in Boy Scouts. The best way to learn the code is by listening to it. This project is a device that can be used for this purpose.

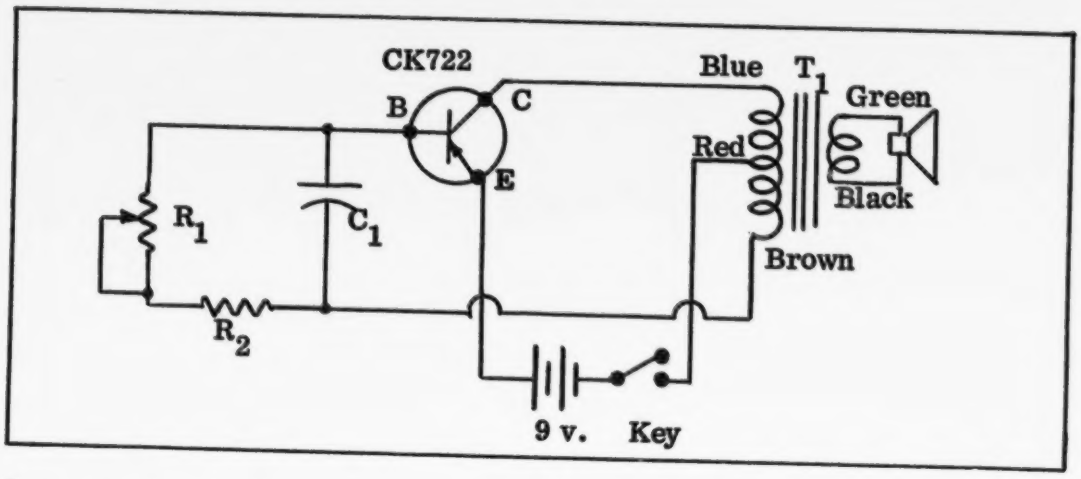
Objective: To develop a familiarity with transistors and to gain experience in wiring an electronic circuit.

Directions: Read this entire assignment sheet. Read the reference assigned and construct the project by following the steps of procedure.

Reference:

J. Gerrish, Howard H., Electricity and Electronics, pp. 211-216, 227.

Specifications:



Bill of Material:

Quantity	Description
1	R_1 - Potentiometer, 25,000 ohms
1	R_2 - Resistor, fixed carbon 6800 ohms $\frac{1}{2}$ watt
1	C_1 - Capacitor, paper, .5 mf. 200 volts
1	T_1 - Transformer, output, (AR 119 or Thordarson TR 27)
1	Transistor CK 722
1	Speaker, PM $1\frac{1}{2}$ inch
1 piece	Grill cloth
1	Battery 9 volt
1	Terminal strip or plug jack for key
1	Knob (for potentiometer)
1	Tie point, 4 lug
1	Box, 4 x 2 x $2\frac{1}{4}$

Steps of Procedure:

_____ 1. Obtain needed components.
_____ 2. Layout the components on the chassis so as to utilize the space to best advantage. Keep lead lengths as short as practicable. (J - 102-103)
_____ 3. Center punch and drill all mounting holes.

*This project is adapted from Gerrish, Howard H., Electricity and Electronics, Goodhart-Wilcox, Chicago, Illinois, 1964, p. 227.

_____ 4. Mount all components. Note the mounting of the capacitor and transistor in figure 17-32 on page 102 in the reference. It is essential that the transistor be connected properly. The marked lead is the collector. (J - 102-103)

_____ 5. Check your wiring with the schematic diagram.

_____ 6. Solder all connections. Caution: Heat can damage transistors. Use a "heat sink" by grasping the transistor lead to be soldered with a needle-nose pliers between the joint and the transistor before soldering. The pliers will conduct the heat away from the transistor.

_____ 7. Connect the battery in the circuit and a key.

_____ 8. Close the key and adjust the potentiometer for a pleasing tone.

_____ 9. Disconnect the key and put the bottom on the chassis.

_____ 10. Apply the test of workmanship.

_____ 11. Put all tools away.

_____ 12. Place your name on your project and turn into your instructor.

_____ 13. Answer the questions on page 103 in Gerrish, Electronics.

Test of Workmanship:

1. Does the oscillator work?
2. Are all solder joints smooth and heated through?
3. Are leads adequately insulated from the chassis?
4. Are all electrical connections made on tie points or on firmly mounted components?

Osage Hydro-Electric Power Plant, Bagnell Dam

The Osage hydro-electric power plant has been in operation since 1931. Average yearly output is 440,000,000 Kilowatt hours. There are eight generators, each with a capacity of 21,500 Kilowatts. (Courtesy of Union Electric Co., St. Louis, Mo.)

PREPARATION AND USE OF INFORMATIONAL ASSIGNMENT SHEETS

The study of electricity involves a considerable amount of technical information. An effective way of developing a student's competency with this knowledge is through the use of demonstrations and other visual aids reinforced through the use of informational assignment sheets. The primary purpose of informational assignment sheets is to place the responsibility for learning upon the student.

The informational assignment sheets which follow have been prepared as guides by focusing attention on the more important course content. They are offered as sample guides for the teacher to use in preparing others which will provide additional coverage.

These informational assignment sheets should serve three purposes. First, they should serve to guide the student in his reading of the selected reference (s). Second, it is suggested that the student write out the answers to the questions so that he may organize his thoughts concerning the questions. Third, they serve as a guide to class discussion.

Several books have been listed as possible texts. The instructor should select one of these, or one of the others listed as related references, for use in the class. The teacher should only list those references on his informational assignment sheet that he will be having the students use. On several assignment sheets other references are offered since they contain equivalent content; however, the teacher may or may not want the student to use these. The instructor will find these suggested references to be an excellent resource for the topic under discussion. Some of these references should be made available to the students, particularly the bulletins and pamphlets. For example, on informational assignment sheet number 4 the U.S. Department of Labor Bulletin should be made available to the students.

NOTE: In preparing the informational assignment sheets it is suggested that the teacher allow space between each question providing room for the student to write his answer and make notes.

LIST OF INFORMATIONAL ASSIGNMENT SHEETS

Assignment Number	Title	Instruction Units Covered From Analysis
1	Basic Electrical Concepts	1-6
2	Series and Parallel Circuits	7-12
3	Electric Power	13-18
4	Overcurrent Protection and Safety	19-27
5	Electrical-Electronic Symbols	28-31
6	Potentiometers and Rheostats	32-33
7	Magnetism and Electro Magnetism	34-38
8	Electrochemistry	39-48
9	Generators	49-54
10	Transformers	55-60
11	Electricity from Light, Heat, Friction, Pressure, and Nuclear Energy	61-65
12	Conductors, Insulators, and Heat	66-75
13	Light from Electricity	76-83
14	Home Wiring	84-100
15	Low Voltage Wiring	101-105
16	Electric Motors	106-131
17	Electrical Control Systems	132-138
18	Electrical Appliances	139-154
19	Automotive Electricity	155-160
20	Electronics	161-176
21	Occupations in the Electrical Industries (assigned earlier in the year)	177

APPLIED ELECTRICITY

Informational Assignment 1
Covering Units 1-6

Name _____
Due _____

BASIC ELECTRICAL CONCEPTS

Probably the most basic and widely used commodity in this country is electrical energy. In a modern home, farm, or business almost anything one attempts to do involves the use of some electrically powered device.

The demand for electrical service has increased the production of electricity from 95,287,390,000 kilowatt-hours in 1935 to 753,350,271,000 kilowatt-hours in 1960, in the United States. During this same period, in which utilization of electricity has increased, the average cost of 250 KWH decreased from $8.91 in 1935 to $7.48 in 1962. (The instructor should obtain and have available this information for the local area from the local power distributor.)

The study of electricity is fascinating, partly due to the fact that its nature is not completely understood. We do know it will do certain things under given conditions, and we do have theories regarding the nature of electricity.

In this unit you will explore these theories and study the basic law of all electricity - Ohm's Law.

Assignment:

1. Read the reference (s) assigned below.
2. Study the questions and problems listed below and write you answers. Use complete sentences.
3. Be prepared to discuss these problems and questions in class.

References:

A. Buban, Peter and Schmitt, Marshall L., Understanding Electricity and Electronics, pp. 1-13, 18-20, 121-124, 144-145.
B. Marcus, Abraham, Basic Electricity, pp. 1-11, 22-29, 31-40.
C. Steinberg, William B. and Ford, Walter B., Electricity and Electronics - Basic, pp. 1-10, 32-34, 58-77, 86-89, 242.

Problems and Questions:

1. Make a list of all of the electrical appliances and other electrically operated devices in and around your home. How many of these were not in your home five years ago? Is it likely that new electrical equipment will be added to your home this year?
2. Suggest some reasons why the average cost of electrical energy has gone down while the consumption has gone up. Do you think the cost of electricity will continue to decrease? Why?
3. What was the power consumption in your area last year? Ten years ago? What has been the change in cost?
4. What are the essentials of any electrical circuit?
5. What is meant by an open circuit? A closed circuit?
6. What is the basic unit used to measure electro-motive-force? What unit is used to measure current or intensity? What is the unit of resistance?
7. Give Ohm's Law in its three symbolic forms.
8. What is an electric current, as explained by the electron theory of electricity?
9. What does the prefix milli mean? Kilo?
10. What electrical charge do electrons have?
11. How much current will flow through a lamp that has a resistance of 240 ohms when it is connected across 120 volts? What would happen to the current flow if this lamp were connected across 240 volts by mistake?
12. What voltage would be impressed across a 1000 ohm resistor having 0.1 ampere flowing?
13. What is the resistance of a heating element that permits 10 amperes to flow when connected across 120 volts?

(The teacher may want to add more problems on Ohm's Law.)

APPLIED ELECTRICITY

Informational Assignment 2
Covering Units 7-12

Name _____
Due _____

SERIES AND PARALLEL CIRCUITS

There are two basic types of electrical circuits, series and parallel. All other circuits are variations of these. It is important that one understands the characteristic of each of these types of circuits.

Anyone who works with electricity must understand the basic units of electrical measurement and how these are calculated if he is to work intelligently.

In this assignment you will become familiar with these basic electrical circuits and the basic units -- ohms, volts, and amperes.

Assignment:

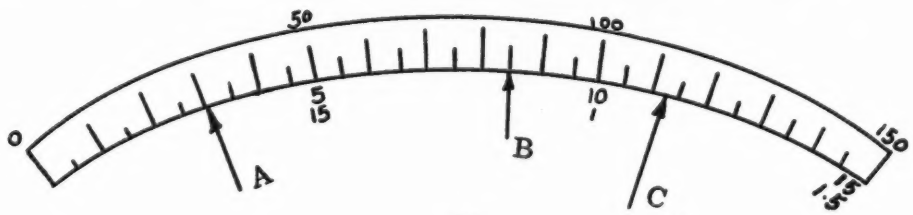
1. Read the reference (s) assigned below.
2. Study the questions and problems listed below and write your answers. Use complete sentences.
3. Be prepared to discuss these problems and questions in class.

References:

A. Buban, Peter and Schmitt, Marshall L., Understanding Electricity and Electronics, pp. 146-153, 237-247.
B. Marcus, Abraham, Basic Electricity, pp. 40-50, 77-91, 95-99.
C. Steinberg, William B. and Ford, Walter B., Electricity and Electronics - Basic, pp. 60-62, 65-66, 95-101, 242.

Questions and Problems:

1. What statement can be made about current flow in a series circuit? How many paths can the current take?
2. What general statement can be made about the total voltage in a series circuit with respect to the voltage drop across the individual components?
3. What is meant by the term voltage drop?
4. Make a general statement about the total resistance of a series circuit.
5. In a few sentences explain how a permanent magnet moving coil meter operates?
6. What should one do if the needle on a meter goes the wrong direction?
7. Why must an ammeter always be connected in series in a circuit?
8. How does a permanent magnet moving coil ammeter differ from a voltmeter with the same type of movement?
9. What does the word shunt mean? If you were to shunt a meter what would you do?
10. If one had a voltmeter in a circuit where the meter read 150 volts, what would be the potential difference between the two meter leads? Suggest a reason why a person should only touch one lead at a time.
11. List two things that should be done when a person is going to use an ohmmeter to measure the resistance of a device.
12. What type of meter does the abbreviation VOM identify? VTVM? How do the two meters differ?
13. What is the value of each division on each scale of the meter illustrated below?



What are the readings:

A. (15 volt scale) _____

B. (1.5 volt scale) _____

C. (150 volt scale) _____

What is the maximum voltage that should be impressed across this meter?

14. What statement can be made about the voltage across the branches of a parallel circuit?

15. What statement can be made about the total current in a parallel circuit?

16. Suggest a reason why the total resistance in a parallel circuit must be less than the smallest resistance in the circuit.

(The instructor may want to add some problems to be solved using series and parallel laws.)

APPLIED ELECTRICITY

Informational Assignment 3
Covering Units 13-18

Name _____
Due _____

ELECTRIC POWER

One of the basic values of electricity is its power potential. Since we use electricity to do work, we should understand the unit that expresses the rate at which work is done. The unit used to indicate electrical power is the watt. In the United States mechanical power is generally designated by a unit called horsepower. One should be able to convert from mechanical to electrical and from electrical to mechanical power.

As a consumer of electrical energy you should be familiar with the rate structure and cost of electric power.

In this unit you will become acquainted with Watt's law, conversion of power units, determination of efficiency, and the calculation of the cost of electric power.

Assignment:

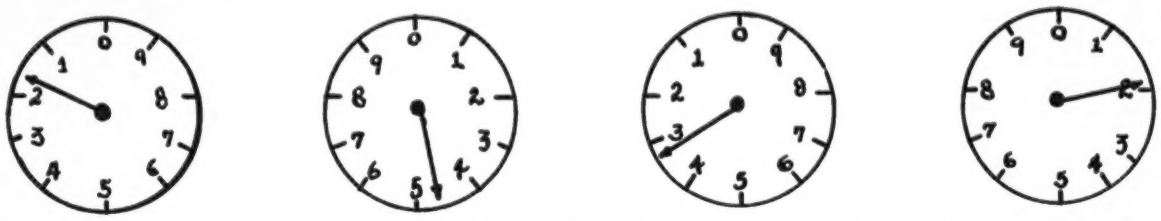
1. Read the reference (s) assigned below.
2. Study the problems and questions listed below and write your answers. Use complete sentences.
3. Be prepared to discuss these problems and questions in class.

References:

A. Buban, Peter and Schmitt, Marshall L., Understanding Electricity and Electronics, pp. 153-155, 252-255.
B. Marcus, Abraham, Basic Electricity, pp. 29-31, 92-95.
C. Steinberg, William B. and Ford, Walter B., Electricity and Electronics - Basic, pp. 89-94. Electrical rates from local power distributor.

Questions and Problems:

1. What is energy? What is electric power? What is the relationship between watts and watt-hours?
2. List the nine symbolic forms of the power formula.
3. Are any changes necessary in applying Watt's law to parallel circuits? Explain.
4. What is input power? Output power? What is the relationship of these two to electrical efficiency?
5. What is the horsepower equivalent of three kilowatts?
6. How much power will be dissipated when 120 volts are impressed across a circuit causing 10 amperes to flow?
7. Read the kilowatt-hour meter below.



8. Using the rates supplied by your instructor calculate the bill for the month of June from the following readings: June 1 7943 KWH, July 1 8219 KWH. (The instructor should use rates obtained from the local power distributor).
(The instructor may want to add some more problems dealing with variations of the power formula.)

APPLIED ELECTRICITY

Informational Assignment 4
Covering Units 19-27

Name _____
Due _____

OVERCURRENT PROTECTION AND SAFETY

There are certain safety precautions that must be observed with electricity to avoid danger to persons and property. If too much current is permitted to flow through a conductor, it can create enough heat to cause a fire.

For the above reason, among others, it is necessary to place in electrical circuits some device to control or limit the current to a safe level.

There are some simple safety precautions that must also be observed to avoid electrical shock which could cause death.

In this assignment you learn about the operation and applications of overcurrent protective devices, safe work habits with electricity, and first aid for electric shock.

Assignment:

1. Read the reference (s) assigned below.
2. Study the questions and problems listed below and write your answers. Use complete sentences.
3. Be prepared to discuss these problems and questions in class.

References:

A. Buban, Peter and Schmitt, Marshall L., Understanding Electricity and Electronics, pp. 33-41, 247-252.
B. Marcus, Abraham, Basic Electricity, pp. 261-264.
C. Steinberg, William B. and Ford, Walter B., Electricity and Electronics - Basic, pp. 127-130, 151.
Y. U. S. Department of Labor, Control of Electric Shock Hazards, Bulletin 216.

Questions and Problems:

1. What is the principle by which a fuse operates?
2. What two principles are used in operating circuit breakers?
3. What advantage does a dual element fuse have over an ordinary fuse?
4. Since January, 1961, the National Electrical Code has required that all plug fuses of 30 amperes or less shall be type S (Fusestats). Suggest some reasons why this regulation was enacted.
5. What procedures should be followed when a fuse has blown?
6. What types of cartridge fuses are available?
7. What design differences are there which prevent the substitution of improper size fuses?
8. What is an open circuit? A closed circuit?
9. What is meant by a grounded circuit? Is there more than one meaning to the term? Explain.
10. What types of fire extinguishers should be used on electrical fires?
11. If you were driving along a highway and came upon an accident where a car had rammed a power pole and one power cable was resting on the car, what would you do?
12. Approximately how much current is necessary to be fatal? Why is high voltage more dangerous than low voltage?
13. Why is there increased danger if one works on electrical circuits while standing on the ground or a concrete floor?
14. What procedure should be followed if you came upon a person who appears to have touched a "live" wire?

APPLIED ELECTRICITY

Informational Assignment 5
Covering Units 28-31

Name _____
Due _____

ELECTRICAL-ELECTRONIC SYMBOLS

As in many other areas of work, there have been developed certain symbols to be used when representing particular electrical devices. One may call it an electrical shorthand.

Most of these symbols have been standardized within the industry and are recognized by the American Standards Association. One should use these symbols when making a drawing which represents electrical circuits and devices.

It is necessary for any person working in electricity to be familiar with these symbols and to be able to recognize what they represent.

In this assignment you will be introduced to schematic diagrams and symbols as well as to some of the practices adopted in their use.

Assignment:

1. Read the reference(s) assigned below.
2. Study the questions and problems listed below and write your answers. Use complete sentences.
3. Be prepared to discuss these problems and questions in class.

References:

A. Buban, Peter and Schmitt, Marshall L., Understanding Electricity and Electronics, pp. 14-17, 20-26.
B. Marcus, Abraham, Basic Electricity, pp. inside back cover.
C. Steinberg, William B. and Ford, Walter B., Electricity and Electronics - Basic, p. 244.
K. Graham, Kennard C., Fundamentals of Electricity, pp. 275-284.
W. U. S. Defense Department, Graphical Symbols for Electrical and Electronic Diagrams, Part I.
X. U. S. Defense Department, Electrical Wiring Symbols for Architectural and Electrical Layout Drawings, Part III.

Questions and Problems:

1. What is the difference between a schematic and a pictorial drawing?
2. Draw the architectural symbols for the following:
   a. recessed ceiling lighting fixture
   b. clock outlet
   c. duplex convenience outlet grounding type
   d. range outlet
   e. three way switch
   f. push button
   g. door chime
   h. telephone
3. Draw the following schematic symbols:
   a. motor
   b. antenna
   c. potentiometer
   d. coil with an iron core
   e. ground
   f. alternating current power source
4. Draw a simple circuit including a battery power source, a fuse, switch, ammeter, and a voltmeter connected across a resistor load. Indicate polarity of the power source.
5. Do schematic diagrams show the physical location of components in a circuit?

APPLIED ELECTRICITY

Informational Assignment 6
Covering Units 32-33

Name _____
Due _____

POTENTIOMETERS AND RHEOSTATS

There are two ways in which variable resistors are frequently used in electrical-electronic circuits. One application is for dividing voltage, and the other is for limiting current.

For voltage dividing a potentiometer is used. An example of this process is the volume control of a radio or television receiver.

For current limiting a rheostat is used. An example of the application of this device is the dash-light dimming in an automobile.

It is important that one be familiar with the principles involved in each process as they have many applications.

In this assignment you will learn of current limiting and voltage dividing principles.

Assignment:

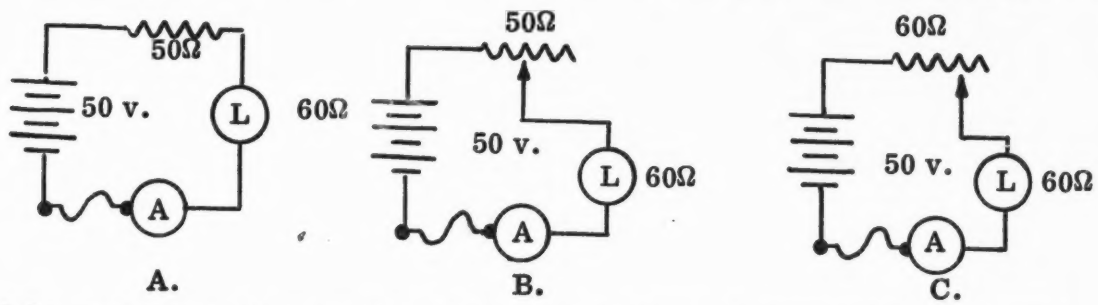
1. Read the reference(s) assigned below.
2. Study the questions and problems listed below and write your answers. Use complete sentences.
3. Be prepared to discuss these problems and questions in class.

References:

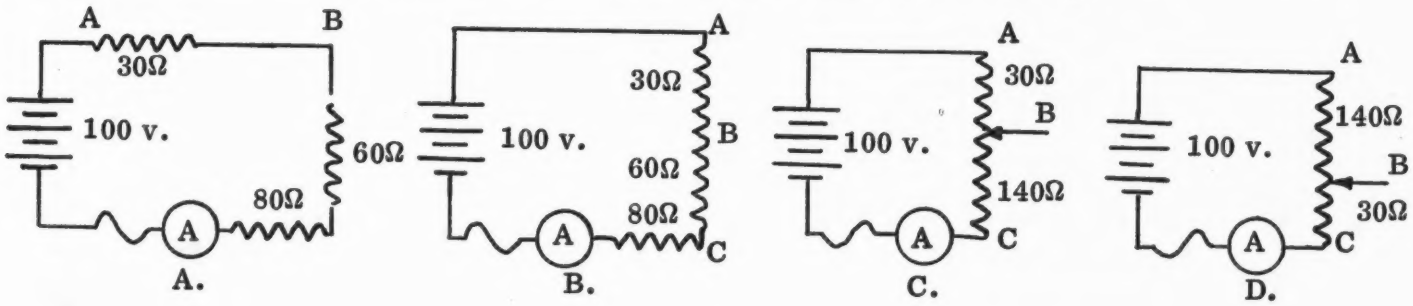
A. Buban, Peter and Schmitt, Marshall L., Understanding Electricity and Electronics, pp. 133-134, 250.
B. Marcus, Abraham, Basic Electricity, pp. 27-28.
C. Steinberg, William B. and Ford, Walter B., Electricity and Electronics - Basic, pp. 72-75.
T. Turner, Rufus P., Basic Electricity, pp. 40-41, 44-45, 58-60.

Questions and Problems:

1. What will be the total current flowing in the following circuits? Through the lamp?



2. If the resistance of one resistor in a series circuit is increased, what will happen to the current flow? If the size of this resistor is decreased?
3. How many terminals are required for a rheostat?
4. Draw the schematic diagram for a rheostat. Identify the rotor and stator terminals.
5. What will be the voltage between terminals A and B in each of the drawings?



6. Draw the schematic diagram for a potentiometer. Identify the rotor and stator terminals.

7. How many terminals are required for a potentiometer? May a potentiometer be used as a rheostat? If so, which terminals would be used?

8. How can one determine the power rating for a potentiometer or rheostat to be used in a particular circuit?

APPLIED ELECTRICITY

Informational Assignment 7
Covering Units 34-38

Name _____
Due _____

MAGNETISM AND ELECTROMAGNETISM

Magnetism and electricity are closely related to each other. Although we do not know as much about this relationship as we would like, we do know that we can produce electrical energy with a magnetic field. Also, we know that anytime there is an electrical current, it is surrounded by a magnetic field. This type of magnetism is called electromagnetism.

This inter-relationship of magnetism and electromagnetism is an interesting and important phase of electricity. Most electrically operated machines use magnetic principles.

In this assignment you are expected to develop some elementary concepts regarding the relationship of magnetism and electricity.

Assignment:

1. Read the reference(s) assigned below.
2. Study the questions and problems listed below and write your answers. Use complete sentences.
3. Be prepared to discuss these problems and questions in class.

References:

A. Buban, Peter and Schmitt, Marshall L., Understanding Electricity and Electronics, pp. 163-188.
B. Marcus, Abraham, Basic Electricity, pp. 55-72.
C. Steinberg, William B., and Ford, Walter B., Electricity and Electronics - Basic, pp. 16-31.
F. Crow, Leonard R., Learning Electricity Fundamentals, pp. 127-171.

Questions and Problems:

1. Why aren't natural magnets used very much?
2. What is the difference between a permanent and an electromagnet?
3. What is the law of magnetic attraction and repulsion?
4. Explain what is meant by magnetic induction.
5. List two ways to magnetize an object.
6. List three ways one may demagnetize an object.
7. List at least three uses for permanent magnets.
8. What is a solenoid?
9. What factors determine the strength of an electromagnet?
10. List at least four applications of electromagnets.
11. What is a relay? Explain how one operates. Give several examples of relays in common use.
12. Explain the operation of a door bell.

APPLIED ELECTRICITY

Informational Assignment 8
Covering Units 39-48

Name _____
Due _____

ELECTROCHEMISTRY

Early studies in electricity were done with single cells connected to form batteries. Electrochemistry is still an important source of electrical energy.

Batteries are used every day in automobiles, flashlights, missiles and portable radios. There currently is a considerable amount of research being done on the electro-chemical make up of the human body. As one can see this is an important area of electricity, an area that is expanding rapidly.

In this unit you will learn of several types of cells, how they may be inter-connected as well as other applications of electro-electricity.

Assignment:

1. Read the reference(s) assigned below.
2. Study the questions and problems listed below and write your answers. Use complete sentences.
3. Be prepared to discuss these problems and questions in class.

References:

A. Buban, Peter and Schmitt, Marshall L., Understanding Electricity and Electronics, pp. 203-218.
B. Marcus, Abraham, Basic Electricity, pp. 35-36, 216-240, 302-310.
C. Steinberg, William B. and Ford, Walter B., Electricity and Electronics - Basic, pp. 34-40, 67.

Questions and Problems:

1. What is meant by the term electrolysis? Electroplating?
2. List some materials that are refined or extracted through the use of electricity. Where are some of these plants located? Suggest reasons why they are located where they are? Example: Anaconda Copper at Great Falls, Montana, fertilizer plants in the Tennessee Valley.
3. Explain how electroplating is done. List some things that are electroplated. How would you classify the process of making electrotype?
4. Diagram the construction of a zinc-carbon cell.
5. May a wet cell be a primary cell? Explain.
6. What differences are there between a No. 6 cell and a penlight cell? What feature is the same?
7. Compare the voltages of a zinc-carbon cell, mercury cell, lead-acid cell, Edison (nickel-iron-alkali) cell, nickel-cadmium cell. What are the cathodes (negative terminals) in each? The anodes (positive terminals) in each? The electrolytes? List some advantages and disadvantages of each.
8. How may we test the condition of a zinc-carbon cell or battery? A lead-acid cell?
9. What is meant by "shelf life"? How may this problem be reduced?
10. What is meant by polarization?

APPLIED ELECTRICITY

Informational Assignment 9
Covering Units 49-54

GENERATORS

Name _____
Due _____

The most important and widespread source of electrical energy for commercial purposes is the generator. This is the source of power for your home, and it provides energy for your automobile electrical system while the motor is running.

Since the principles involved in electrical generators are basic to an understanding of electricity, it is important that the student of electricity gain knowledge of the characteristics of this source.

In this assignment you will explore the operation of an electrical generator, and the process of obtaining either alternating or direct current from them.

Assignment:

1. Read the reference(s) assigned below.
2. Study the questions and problems listed below and write your answers. Use complete sentences.
3. Be prepared to discuss these problems and questions in class.

References:

A. Buban, Peter and Schmitt, Marshall L., Understanding Electricity and Electronics, pp. 219-226.
B. Marcus, Abraham, Basic Electricity, pp. 101-126, 178-213.
C. Steinberg, William B. and Ford, Walter B., Electricity and Electronics - Basic, pp. 41-49, 108-111.

Questions and Problems:

1. Is a generator a machine? What is a machine?
2. What is the purpose of a generator?
3. What are the essentials of a generator?
4. What determines the direction of electron flow in a conductor passing through a magnetic field?
5. What determines the value of a voltage from conductors passing through a magnetic field.
6. What condition is necessary with respect to a conductor and a magnetic field to have an induced voltage?
7. What kind of voltage (and/or current) is generated in any armature rotating through a magnetic field?
8. How does a direct-current generator differ from an alternating current generator?
9. What sources of energy are used to drive generators?
10. How does a magneto differ from other types of generators?
11. What is the purpose of an exciter generator?
12. What is the stator of a machine? The rotor? The armature? Does an armature always rotate?
13. What determines the frequency of an alternating current?
14. Explain how three phase current differs from single phase current.
15. Take a field trip to an electric power generating station. Answer the following questions on the field trip:

    a. What was the speed of rotation of the rotor on the alternator?
    b. What excitation voltage and current were used?
    c. Where was the exciter generator located?
    d. What was the alternator output voltage?
    e. What was the alternator KVA or wattage?
    f. What protection is given (electrically) to the plant equipment for both lightning and overcurrent?
    g. How are the generators syncronized with the line when they are turned on?
    h. What voltages are distributed from the plant?
    i. How is the power leaving the plant metered?

APPLIED ELECTRICITY

Informational Assignment 10
Covering Units 55-60

Name _____
Due _____

TRANSFORMERS

Transformers are important electrical devices that have applications which range from ringing door bells to transmitting and varying power supplies over thousands of miles.

Because of the many uses of this efficient device and the basic electrical principles involved in its operations, it is important that it be included in any study of electricity.

In this assignment you will study the principles underlying the operation of a transformer as well as their application to power transmission and distribution.

Assignment:

1. Read the reference(s) assigned below.
2. Study the questions and problems listed below and write your answers. Use complete sentences.
3. Be prepared to discuss these problems and questions in class.
4. Take a field trip to a power generating station noting the generators and the manner in which power gets from the generator to the ultimate consumer.

References:

A. Buban, Peter and Schmitt, Marshall L., Understanding Electricity and Electronics, pp. 181-186.
B. Marcus, Abraham, Basic Electricity, pp. 327-344.
C. Steinberg, William B. and Ford, Walter B., Electricity and Electronics - Basic, pp. 111-120.

Questions and Problems:

1. Define induce with reference to electricity.
2. Define a step-down transformer. A step-up transformer.
3. Which winding is the primary winding of a transformer? The secondary winding?
4. What is meant by the term laminations?
5. What is necessary, with reference to the magnetic field (or the current causing it), to have a voltage and current induced in the secondary of a transformer?
6. May there be more than one secondary winding on a transformer?
7. Can a steady D.C. such as one obtains from a dry cell operate a transformer? Why?
8. What is the difference between self induction and mutal induction?
9. What is the unit of inductance?
10. Can a transformer be used with D.C.? Under what conditions? Suggest some applications.
11. List places where you have seen transformers used.
12. Make a diagram indicating the way power passes from the power plant to your home. Indicate the voltages used at various stages.
13. What is a power pool? What are its advantages? How many interconnections are there with your power distributor?
14. Why are high voltages used for transmitting power long distances?
15. What is the relationship between the number of turns and the voltage in a transformer? The number of turns and the current capacity?

APPLIED ELECTRICITY

Informational Assignment 11
Covering Units 61-65

Name _____
Due _____

ELECTRICITY FROM HEAT, LIGHT, FRICTION, PRESSURE AND NUCLEAR ENERGY

Practically all of our commercial electrical energy comes from mechanical generators, and much of the other electrical energy used comes from chemical sources. There are, however, other sources of electricity that are important today, and indications are that these may be more important in future years.

Since we can expect increasing use of these other sources of electrical energy it is essential that you have some understanding of sources other than mechanically generated and chemically produced electricity.

In this assignment you will become acquainted with heat, light, friction, pressure, and nuclear energy as sources of electricity.

Assignment:

1. Read the reference(s) assigned below.
2. Study the questions and problems listed below and write your answers. Use complete sentences.
3. Be prepared to discuss these problems and questions in class.

References:

A. Buban, Peter and Schmitt, Marshall L., Understanding Electricity and Electronics, pp. 228-232.
B. Marcus, Abraham, Basic Electricity, pp. 12-21, 240-252.
C. Steinberg, William B. and Ford, Walter B., Electricity and Electronics - Basic, pp. 50-57.
E. Cleveland Graphite Bronze Division, Clevite Corporation, 232 Forbes Road, Bedford, Ohio, Information on "Spark Pump," (a piezoelectric device).
H. Gannon, Robert, "Spark Pump Fires Engine," Popular Science, July, 1961, pp. 70-73.
K. Graham, Kennard C., Fundamentals of Electricity, pp. 5-11, 95-97.
N. Lightning Facts and Figures, Lightning Protection Institute.

Questions and Problems:

1. What term is used for electricity produced through light?
2. List some present applications of solar cells.
3. What is bio-electricity?
4. Suggest some applications of static electricity which benefit man.
5. List some places where static electricity is an undesirable problem.
6. What is a pyrometer?
7. Explain the operating principle of a thermocouple.
8. List some places where thermocouples are used.
9. What is piezoelectricity?
10. List some applications of piezoelectric effects.
11. Lightning is an example of what form of electricity?
12. List some safety precautions that should be followed during a lightning storm.
13. In what ways is nuclear energy being used to produce electrical energy? What are the present limitations for direct conversion of nuclear energy to electricity?

APPLIED ELECTRICITY

Informational Assignment 12
Covering Units 66-75

Name _____
Due _____

CONDUCTORS, INSULATORS, AND HEAT

One of the important applications of electricity is the production of heat. We find this application in small portable heaters, ranges, and in many places heating entire buildings. In some cases the heat produced is undesirable. All of these applications involve the principle that a current flowing through resistance creates heat.

There are certain things a person working with electricity should know about conductors, insulators, and the heating effects that result from their use.

In this assignment you will learn about the gaging, insulation used, and the composition of conductors. You will also be expected to learn some of the principles involved in the production and control of heat that is obtained from electricity.

Assignment:

1. Read the reference(s) assigned below.
2. Study the questions and problems listed below and write your answers. Use complete sentences.
3. Be prepared to discuss these problems and questions in class.

References:

A. Buban, Peter and Schmitt, Marshall L., Understanding Electricity and Electronics, pp. 43-52, 72-83, 95-104, 127-135, 188-192.
B. Marcus, Abraham, Basic Electricity, pp. 51-52, 254-274.
C. Steinberg, William B. and Ford, Walter B., Electricity and Electronics - Basic, pp. 77-85, 148-152.
Q. National Electrical Manufacturers Association, Manual for Electric House Heating.

Questions and Problems:

1. What gage system is used in the United States for non-ferrous metals? What is non-ferrous?
2. Which conductor has the larger diameter, a #12 wire or a #13?
3. What two methods may be used to determine the size of a conductor?
4. Explain the procedure for gaging a conductor with insulation.
5. Why is some wire stranded? How can one determine its gage?
6. List the three best conductors in order.
7. List at least five insulating materials and places where they are used.
8. What three types of tape are commonly used for electrical splices? How are they used?
9. What tools may be used for cutting wire?
10. What precautions must be observed when stripping wire?
11. What are the three basic types of electrical splices?
12. List some methods of terminating or joining wires.
13. What is "tinning"? What is a "cold" solder joint?
14. What causes a conductor to become hot? What factors determine the resistance of a given conductor?
15. How is the cross section area of a conductor often stated?
16. What is meant by safe current carrying capacity? What factors will influence this figure?
17. What is the safe current carrying capacity of ordinary lamp cord (rubber covered 18/2 code designated is SP-1)? What would be the maximum wattage of a lamp(s) used with such a cord? If this cord were 100 feet long what would be the voltage drop of the cord at maximum current and 120 volts (remember there are two conductors)?

18. What would be the power loss if the cord in question number 17 were changed to #16 conductors? Use the same current and voltage.

19. List the devices in your home that use electricity for heating. Suggest some industrial applications with which you are familiar.

20. What principles are used in electric arc welding?

21. What safety precautions must be observed around arc welding? What is the normal voltage across an arc used for standard arc welding?

22. What principle of heating is involved in an electronic oven?

23. List some applications of inductive and dielectric heating.

24. What types of units are available for heating in homes?

25. What special considerations should be given when contemplating the use of electricity for home heating?

26. List the advantages and the disadvantages of electric home heating.

APPLIED ELECTRICITY

Informational Assignment 13
Covering Units 76-83

Name _____
Due _____

LIGHT FROM ELECTRICITY

One of the primary uses of electricity is to provide light. There are many different types of lamps and lighting systems, each having certain unique characteristics and applications. Some of these lighting devices use an arc, some are gas discharge while others simply heat a conductor to incandescence. In the near future electroluminescence will probably find considerable use.

As a consumer you should have a knowledge of the operating principles and applications of this use of electricity.

In this assignment you will study the operating principles of the several types of lighting devices and some typical applications.

Assignment:

1. Read the reference(s) assigned below.
2. Study the questions and problems listed below and write your answers. Use complete sentences.
3. Be prepared to discuss these problems and questions in class.

References:

A. Buban, Peter and Schmitt, Marshall L., Understanding Electricity and Electronics, pp. 195-199.
B. Marcus, Abraham, Basic Electricity, pp. 276-294.
C. Steinberg, William B. and Ford, Walter B., Electricity and Electronics - Basic, pp. 142-146.
Z. Wellman, William R., Elementary Electricity, pp. 255-284.

Questions and Problems:

1. What is an incandescent lamp. Why are these lamps in an evacuated envelope (bulb)?
2. What types of bases are available on lamps? Give a typical application of each.
3. What sizes of screw bases are used? Give a typical application of each.
4. Make a diagram of a three-light lamp and explain how it operates.
5. Give some application of infrared lamps.
6. How does a photo flash lamp work?
7. What are the essentials in a circuit for a fluorescent lamp? Explain the purpose of each.
8. Explain how the fluorescent tube produces visible light.
9. Why have fluorescent lamps become so popular?
10. What types of fluorescent lamps are there? What color tubes are commonly used?
11. Explain the operation of a neon lamp. What color light does it produce?
12. List some applications of mercury lamps. What is "black light?"
13. What color light does a sodium vapor lamp produce?
14. What is electroluminescence?
15. What units of measurement are used when measuring light?
16. What factors should be considered when determining proper light for reading?
17. Where might one find arc lamps used?
18. What is L A S E R?
19. List some applications of photo-electric devices and explain how they operate.

APPLIED ELECTRICITY

Informational Assignment 14
Covering Units 84-100

Name _____
Due _____

HOME WIRING

One area of electricity that concerns and affects everyone is home wiring. We all use many electrical devices in our homes, and we need adequate power to operate them.

There are certain rules and regulations that govern the installation of electrical equipment with which you as a consumer should be aware.

This assignment is designed to acquaint you with some of the essentials of a good electrical installation with special consideration to safety and convenience.

Assignment:

1. Read the reference(s) assigned below.
2. Study the questions and problems listed below and write your answers. Use complete sentences.
3. Be prepared to discuss these problems and questions in class.

References:

A. Buban, Peter and Schmitt, Marshall L., Understanding Electricity and Electronics, pp. 261-277.
B. Marcus, Abraham, Basic Electricity, pp. 294-300.
C. Steinberg, William B. and Ford, Walter B., Electricity and Electronics - Basic, pp. 125-138.
S. Richter, H. P., Wiring Simplified, pp. 5-12, 19-79, 82-120.
T. Sears, Roebuck and Company, Simplified Electric Wiring Handbook, pp. 2-63.

Questions and Problems:

1. Is Underwriter's Laboratories a government agency? What is its purpose? Why should one look for the UL label on electrical goods? Who makes use of the services of the Underwriter's Laboratories?
2. Why must an electrical installation in most places be inspected by an electrical inspector?
3. Electrical codes have what primary purpose?
4. List some common electric wiring devices, and indicate where they would be used in an installation.
5. What methods are used to fasten cables in boxes?
6. What types of cable are commonly used for wiring homes? What restrictions are applied to the use of each?
7. How must conductors be protected from the armor on armored cable?
8. What is EMT? What advantages are there in a conduit system of wiring?
9. What are the main parts of a house wiring system?
10. What color wires are in a three conductor cable? What is the white conductor called? What is its voltage to ground?
11. What voltages are supplied to your house? Is it necessarily the exact voltage specified?
12. What equipment is generally considered the service entrance? What should its capacity be (in amperes) for your community in a new installation? What size is in your home?
13. What is the total current that may be drawn from each ungrounded conductor in a 100 ampere service? What is the total for the whole service then? How much current flows through the neutral conductor if the load is balanced on the two ungrounded conductors?
14. What is a load center? What advantages does it offer over having all brand circuits fused at the main panel?
15. What purpose does a ground on a service entrance serve? How is this ground connection made in a home served by a municipal water system? How is this done if there is no water system? How long should a ground rod be?

16. Where are grounding type outlets to be located? Which terminal on the receptacle is connected to ground? What is the purpose of using a grounding type receptacle?

17. How far apart should outlets be located along a living room wall?

18. What is the minimum size wire that may be used for wiring electrical circuits? What is the maximum current it can carry safely? Why do many authorities recommend the use of a #12 conductor for most circuits?

19. What special provisions are required for appliances in the kitchen? What size wire should be used?

20. What three general types of circuits are used in a home?

21. What considerations should be given in locating lighting fixtures? Where should a light fixture be located in a closet? What factors should be considered when selecting a fixture for a particular room?

22. How deep should conduit or cable be buried in the ground? What material may be used for underground wiring? What type of outlets should be used for outside wiring? List several reasons for locating outlets outside. What advantages are there to underground wiring as opposed to overhead wiring? What limitations can you suggest?

23. Suggest reasons why temporary wiring should be done in such a manner as it would be acceptable as permanent wiring. What should be the primary consideration in any temporary wiring?

24. Where should a light switch be located?

25. When should multiple point control be used?

26. If one does not use a center ceiling fixture in a room, what light switching arrangement should be used?

APPLIED ELECTRICITY

Informational Assignment 15
Covering Units 101-105

Name _____
Due _____

LOW VOLTAGE WIRING

There are several devices around the home that are ordinarily wired with low voltage - less than 50 volts. Wiring procedures are a bit different for these devices than for regular outlets. Items falling in this classification are door bells or chimes, thermostats and communication circuits.

Since most modern homes use most of these systems, one should have some knowledge of them.

In this assignment you will study some of the rules governing low voltage wiring and location of telephones and thermostats.

Assignment:

1. Read the reference(s) assigned below.
2. Study the questions and problems listed below and write your answers. Use complete sentences.
3. Be prepared to discuss these problems and questions in class.

References:

A. Buban, Peter and Schmitt, Marshall L., Understanding Electricity and Electronics, pp. 307-312.
C. Steinberg, William B. and Ford, Walter B., Electricity and Electronics - Basic, pp. 178-182.
F. Crow, Leonard R., Learning Electricity Fundamentals, pp. 335-367.

Questions and Problems:

1. List several advantages of low voltage wiring over the wiring that would be used for 120 volt devices.
2. What voltages are commonly used for door bell transformers? Where are the transformers usually located?
3. What type of staples should be used for attaching bell wiring?
4. What considerations should be given in locating door bells or chimes?
5. What considerations should be given in locating a thermostat for the heating system?
6. List some advantages of low voltage remote control wiring for switching lights.
7. What principle is involved in switching with low voltage remote control wiring?
8. How are the switches connected to each other in low voltage remote control wiring?
9. Explain the operation of a door bell.
10. Explain the operation of a door chime.
11. Explain the operating principle of the receiver in a telephone.
12. What happens electrically in a telephone system when you dial a number? What happens at the exchange?
13. Explain the operation of a telephone transmitter.
14. At what voltage do telephones operate?
15. What considerations should be given in locating telephones? Why might one wish to locate telephone outlets on a plan before the building is built?
16. What are annunciators? Where might they be used?
17. Devise a signal system you might use from a house to a garage or barn. Make a diagram of your proposal and explain how it would work.

APPLIED ELECTRICITY

Informational Assignment 16
Covering Units 106-118

Name _____
Due _____

ELECTRIC MOTORS

One of the most widespread uses of electrical energy is to supply the power to produce mechanical energy. We do this with a motor. The basic principle of an electric motor is relatively simple the attraction and repulsion of magnetic fields. This is done in several different ways with different types of motors. Each have their advantages and limitations.

There are many applications of electric motors both in the home and industry; therefore, you as a student of electricity should have some knowledge of these applications and the principles involved.

In this assignment you will learn of the operating principles of several types of electric motors, the procedures involved in reversing their direction of rotation and their common applications.

Assignment:

1. Read the reference(s) assigned below.
2. Study the questions and problems listed below and write your answers. Use complete sentences.
3. Be prepared to discuss these problems and questions in class.

References:

A. Buban, Peter and Schmitt, Marshall L., Understanding Electricity and Electronics, pp. 274-281.
B. Marcus, Abraham, Basic Electricity, pp. 346-391.
C. Steinberg, William B. and Ford, Walter B., Electricity and Electronics - Basic, pp. 157-163.
F. Crow, Leonard W., Learning Electricity Fundamentals, pp. 280-283, 294-333.

Questions and Problems:

1. What is the "field" of a motor? The "armature?"
2. How is the field connected to the armature in a universal motor? What type of D.C. motor is it?
3. Are D.C. motors still used in industry? Why?
4. Explain how a series motor operates.
5. How can one reverse a series motor?
6. What are some advantages of a universal motor? Where are they used?
7. What is meant by the term inductor?
8. Is there an electrical connection between the rotor and stator of an induction motor?
9. Describe the construction of the rotor in an induction motor.
10. Describe how an induction motor operates. How long are the starter windings used? What would happen if they were not turned off? How are they turned off?
11. What advantages does a capacitor start induction run motor have over a regular split-phase induction motor? List some typical applications of each type.
12. How does one reverse a split-phase induction motor?
13. Does a repulsion start-induction run motor have a wound armature?
14. Is there any electrical connection between the rotor windings and the stator windings on a repulsion start-induction run motor? On what principle does this type of motor operate?
15. In a repulsion start-induction run motor, what electrical difference exists in the rotor after it reaches rated speed? Explain. What advantages does this type of motor offer over a regular induction motor? What are some disadvantages?
16. How does one reverse a repulsion start-induction run motor?

17. What type of rotor does a shaded pole motor have? Where might one find this type of motor used?

18. If one has 120 and 240 volts available and wants to operate a motor with a name plate voltage of 120/240 which voltage should be used? How can the operating voltage of the motor be changed?

19. Three phase induction motors are commonly used where this type of power is available. What construction similarities are there between this type motor and a split-phase induction motor? What differences? What advantages does a three phase motor offer?

20. The frame of an electric motor should always be grounded. Why?

21. What type of guards should be used around motors and the equipment they are operating? Why?

22. Why are many motors equipped with "thermoguards," and similar circuit breakers or fuses? What do they protect? If a motor stops operating because of a thermal overload, what do you do?

23. Controllers are used in many motor installations. List several reasons for using these devices. Where have you seen them used? Suggest reasons why they were used in these particular situations.

24. What are the common speeds for induction motors?

25. What methods may one use to change the operating speed of a device driven by a motor?

26. List several types of drive mechanisms that may be used. List some examples of the application of drive mechanisms.

27. What information does one find on the name plate of a motor?

28. What routine maintenance should one perform on a motor?

29. List some advantages of magnetic starters when compared with manual starters.

APPLIED ELECTRICITY

Informational Assignment 17
Covering Units 132-138

Name _____
Due _____

ELECTRICAL CONTROL SYSTEMS

Electricity is used to regulate a variety of mechanical processes and to control the flow of certain liquid and gases. In the home these control devices are usually associated with the heating and cooling system. In industry they are used in all types of industrial processes from relatively simple machine operations to complex computer programed processes.

This is a rapidly expanding area of electricity with which you should become familiar.

In this assignment you will gain some knowledge of the principles underlying the operation of these controls and a few of their typical applications.

Assignment:

1. Read the reference(s) assigned below.
2. Study the questions and problems listed below and write your answers. Use complete sentences.
3. Be prepared to discuss these problems and questions in class.

References:

B. Marcus, Abraham, Basic Electricity, pp. 322-327.
M. Graham, Kennard C., Fundamentals of Electricity, pp. 260-268.
L. Graham, Kennard C., Interior Electric Wiring - Part I - Residential, pp. 190-199.

Questions and Problems:

1. List some applications of thermocouples used to control mechanical devices.
2. List some places where photoelectric devices are used to control operations or devices.
3. What principles are involved in humidity controls?
4. Why do many control devices incorporate relay arrangements?
5. What is a selsyn?
6. What does the term transducer mean?
7. Furnace controls provide examples of several types of controls. List the various controls that are on your furnace at home. Explain the purpose of each.
8. What is the purpose of a limit control?
9. Suggest some applications of time controls.

APPLIED ELECTRICITY

Informational Assignment 18
Covering Units 139-154

Name _____
Due _____

ELECTRICAL APPLIANCES

An important use of electricity in the home is for the operation of appliances. These appliances take many forms. Some are used for heating, some for cooling, and others are designed to provide rotary power.

Often appliances operate for many years with little attention other than periodic cleaning and lubrication; however, there are occasions when an appliance needs repair.

There are certain minor repairs of appliances that the homeowner can undertake and others which only trained personnel should handle; of course, in some cases replacement rather than repair is the answer. As a consumer of appliances you should have some famiarity with the operation of appliances and some understanding of the common problems, their cause and correction.

In this unit you learn of the principles of operation of the several types of appliances and typical troubles that can easily be repaired.

Assignment:

1. Read the reference(s) assigned below.
2. Study the questions and problems listed below and write your answers. Use complete sentences.
3. Be prepared to discuss these problems and questions in class.

References:

A. Buban, Peter and Schmitt, Marshall L., Understanding Electricity and Electronics, pp. 282-292.
B. Marcus, Abraham, Basic Electricity, pp. 255-261.
C. Steinberg, William B. and Ford, Walter B., Electricity and Electronics - Basic, pp. 148-152.
G. Gabbert, William L., Electrical Appliance Service Manual.

Questions and Problems:

1. What principle is used for heat control (thermostat) on most heating appliances?
2. What are the principle parts of a toaster?
3. If a toaster does not operate, what parts of it should be checked? What preventative maintenance should be observed with a toaster?
4. How are thermostats connected in the heating circuit with relation to the heating element?
5. What are the principle parts of an electric clothes iron?
6. What types of cords must be used on heating appliances?
7. The downtown sections of many of our larger cities in the United States still use D.C. Most automatic irons are designed for use on A.C. only. What will happen if one of these automatic irons is used on D.C.?
8. Why should one only use distilled water in a steam iron?
9. How are the different degrees of heat obtained on an electric range? (application of series and parallel circuits) What voltages are used in electric ranges?
10. What precaution should be observed before working on any electrical appliance?
11. Most modern electric ranges have convenience receptacles on them which are fused in the range. Where are these fuses usually located? If you have one of this type at home, find it.
12. Why must the frame of an electric range be grounded?
13. How does an electric water heater operate?

14. Why shouldn't an electric coffee maker be immersed in water? Why shouldn't an electric coffee maker be operated without water in it?

15. Why should any washing machine be grounded by a separate conductor used only for grounding?

16. What type of motor is usually used on a conventional washing machine.

17. Why shouldn't the water level in the tub be permitted to get above the height of the agitator?

18. Why should the wringer rolls be washed off after each laundry? Why should the pressure on the wringer rolls be released when not in use?

19. What are probable causes of trouble in an automatic washer?

20. What is the principle of operation of refrigerants as used in refrigerators and air conditioners?

21. What parts of a refrigerator are operated electrically? What purpose does each serve?

22. What differences are there between refrigerators and air conditioners?

23. If a particular air conditioner is rated as being a 3/4 Ton unit, what does it mean?

24. What protective maintenance should be performed on a refrigerator? A freezer? An air conditioner?

25. What type motor is normally used on household vacuum cleaners?

26. What things would you check if a vacuum cleaner did not operate?

27. If a fan operates with more than a reasonable amount of noise, what might you expect is wrong?

28. What factors should be considered in determining if an appliance should be repaired or discarded?

29. What factors should be considered in selecting an appliance for purchase?

30. Are grounded and short circuits necessarily the same? Explain.

31. What is meant by checking a device for continuity? What pieces of equipment might be used for this? What are the voltage considerations with each of these testing devices?

32. The National Electrical Code requires that current carrying metal parts of portable equipment must be grounded. Why was this regulation enacted? How can it be carried out?

33. What limitations are there in the use of extension cords? Where can parallel rubber lamp cord (SP-1) be used? Are there places where it may not? List some. Types S, SJ, and SO cords can be used for hard usage. How does the construction of these cords differ from type SP?

34. What types of caps (plugs) and cord ends may be used on extension cords? Where may they be used?

35. Most manufacturers of electric dryers recommend that their dryers be vented. How is this normally done?

APPLIED ELECTRICITY

Informational Assignment 19
Covering Units 155-160

Name _____
Due _____

AUTOMOTIVE ELECTRICITY

The modern automobile contains nearly every application of electricity. In it we use electricity for heat (igniting the fuel), light, mechanical motion (there are many electric motors in the modern car), chemical effects (battery) and mechanical generation. There are several electrical principles involved in the distribution of the electrical energy too.

Since the automobile is familiar to everyone and contains so many electrical devices, it makes a good machine to see many of the applications of electrical energy.

In this assignment you will study some of the electrical devices that permit the modern automobile to operate as it does.

Assignment:

1. Read the reference(s) assigned below.
2. Study the questions and problems listed below and write your answers. Use complete sentences.
3. Be prepared to discuss these problems and questions in class.

References:

A. Buban, Peter and Schmitt, Marshall L., Understanding Electricity and Electronics, pp. 292-301.
B. Marcus, Abraham, Basic Electricity, pp. 209-213, 341-344.
C. Steinberg, William B. and Ford, Walter B., Electricity and Electronics - Basic, pp. 167-176.

Questions and Problems:

1. If you examine the wiring to most electrical devices in an automobile, you discover there is only one conductor going to the device. Where is the return conductor?
2. List the electric motors in your family car.
3. Why is a relay used on the starting motor?
4. What type motor is used for the starting motor?
5. Approximately how much current does a starting motor use?
6. What is the purpose of the voltage regulator?
7. How can an alternator be used as it is on some cars, to charge the battery?
8. What is the purpose of the cut out relay? The current regulator?
9. What electrical principle is used in the ignition coil? How does it work?
10. What causes the pulsating voltage in the coil primary?
11. Make a diagram of the automobile ignition system and explain the purpose of each part.
12. Approximately what voltage is used at the spark plugs?
13. Why doesn't this high voltage kill a person?
14. What is the purpose of the capacitor across the points?
15. How are the two light intensities obtained in the automobile headlight?
16. How are automotive lighting circuits protected?
17. How do the directional signal lights operate?
18. Is there danger of fire with the low voltages used in the automobile? Explain.
19. How can battery terminals be kept clean? Why should they?
20. What gas is given off when a battery is being charged?

21. Why must one turn off a battery charger before disconnecting it from the battery?
22. Why should one use distilled water when adding water to the battery?
23. How does a horn operate?
24. What safety features are incorporated in the design of the sizes of fuses?
25. How do most fuel and temperature gages in automobiles operate?

APPLIED ELECTRICITY

Informational Assignment 20
Covering Units 161-176

Name _____
Due _____

ELECTRONICS

One of the most rapidly growing aspects of the electrical industry are those areas that make use of vacuum and gas tubes and semi-conductor devices. We generally refer to this phase of the industry as electronics.

These devices have many applications for communications systems such as telephone, radio, TV and telegraph and for a variety of industrial applications where communication is not involved. This later classification would include automatic controls for machines (automation), dielectric heating, photo-electric devices, computers, and many others.

In this unit you will become acquainted with some of the fundamental concepts of these electronic circuits and some of the safety precautions that should be observed in their use.

Assignment:

1. Read the reference(s) assigned below.
2. Study the questions and problems listed below and write your answers. Use complete sentences.
3. Be prepared to discuss these problems and questions in class.

References:

A. Buban, Peter and Schmitt, Marshall L., Understanding Electricity and Electronics, pp. 312-358.
B. Marcus, Abraham, Basic Electricity, pp. 394-464.
C. Steinberg, William B. and Ford, Walter B., Electricity and Electronics - Basic, pp. 185-201, 206-212, 214-221, 222-228, 232-239.

Questions and Problems:

1. What property of selenium, germanium and silicon is used in electronics?
2. How does a vacuum tube diode work?
3. What is the difference between a half wave and a full wave rectifier?
4. What is the principle of operation of a triode vacuum tube?
5. What things about a tube can be tested with a tube tester? Does a tube tester necessarily test all aspects of a particular tube's operation? Is the statement "the best test for a tube is the circuit in which it is to operate" valid? Why?
6. What is a semi-conductor? How does a transistor differ from a diode?
7. What advantages do transistors have when compared to vacuum tubes? What precautions must be observed with transistors?
8. What are the operating principles of transistors?
9. What are the basic parts of a crystal set? What function does each serve?
10. Make a block diagram of a superhetrodyne radio receiver. Explain the purpose of each part.
11. How does a radio speaker operate?
12. Make a block diagram of a stereo hi-fi including a tape input, radio input, turntable input, pre-amplifier, power amplifier, two speaker enclosures. Explain the purpose of each.
13. Make a block diagram of a public address system.
14. What precautions should be observed when working with microphones? What procedure should be followed if a microphone cable is going to be longer than 50 feet? (use low impedance microphones and cables)
15. What is feed back? What should be done if feed back occurs? Why should a microphone be located behind the speakers?

16. Make a block diagram of a television receiver and briefly describe the purpose of each section.

17. What is an implosion? Why does this hazard exist with a TV set?

18. What shock hazard exists with most table model radios and TV sets? How can this hazard be reduced?

19. What voltages are used in TV set circuits?

20. How does a TV picture tube function?

21. What is the basic difference between A.M. and F.M.?

22. What methods of modulation are used in TV?

23. What are some of the advantages of F.M. as compared with A.M.?

24. Who licenses and allocates frequencies to radio stations in the United States?

25. What precautions must be observed in grounding antenna systems? What size grounding conductor should be used for the mast? Why shouldn't one run an antenna over a power line? How far must antennas and lead-ins be from power lines? What is the purpose and how does a lightning arrester work?

26. What is a capacitor? What effect does a capacitor have in a D.C. circuit? What effect does it have in an A.C. circuit?

27. What are ultra-sonics? What are some applications of the principles of ultra-sonics?

28. What are some hobbies that can develop from an interest in electronics?

29. List some things that may cause interference in a radio or TV. How may these be eliminated or reduced?

30. What are the requirements for a Citizen's Bond license? What are the limitations in the use of these frequencies?

31. What are the classes of license for amateur radio? How long are the licenses valid for each class? What limitations are placed on each?

APPLIED ELECTRICITY

Informational Assignment 21
Covering Unit 177

Name _____
Due _____

OCCUPATIONS IN THE ELECTRICAL INDUSTRIES

The electrical industries provide many opportunities for employment in a wide range of jobs. The jobs vary greatly in their requirements, duties, qualifications, training required, and wages paid. These jobs vary from unskilled, requiring a few hours of training, to engineering and other professional levels that may require five or more years training at a college or university. People with a knowledge of electricity are needed in such diverse areas as: medicine, technical writing, servicing occupations, construction, teaching, data processing, sales, refrigeration, electrochemistry, power and light utilities, maintenance, telephone, radio and TV, research, product design and others.

To illustrate the demand, it is estimated that by 1970 the United States will be short two and a quarter million electronic technicians (1963 data). The electrical field is so broad that there are few areas of employment that are not influenced by electricity.

The purpose of this assignment is to acquaint you with some of these career opportunities and the training necessary to enter and progress within them. Information of this type will help you in the process of selecting and preparing for your occupational future.

Assignment:

1. Read the reference(s) assigned below.
2. Select an occupation in a field of electricity that interests you and answer the questions listed below concerning that occupation. (The teacher may wish to use this as a written report or as an oral report to the class.)

References:

A. Buban, Peter and Schmitt, Marshall L., Understanding Electricity and Electronics, pp. 360-388.
B. Steinberg, William B. and Ford, Walter B., Electricity and Electronics - Basic, pp. 1-15.
R. Panel of Consultants on Vocational Education, Education for A Changing World of Work, U. S. Department of Labor, Occupational Outlook Handbook.

People in the occupations in the community.
College and technical school bulletins and catalogs.

Questions:

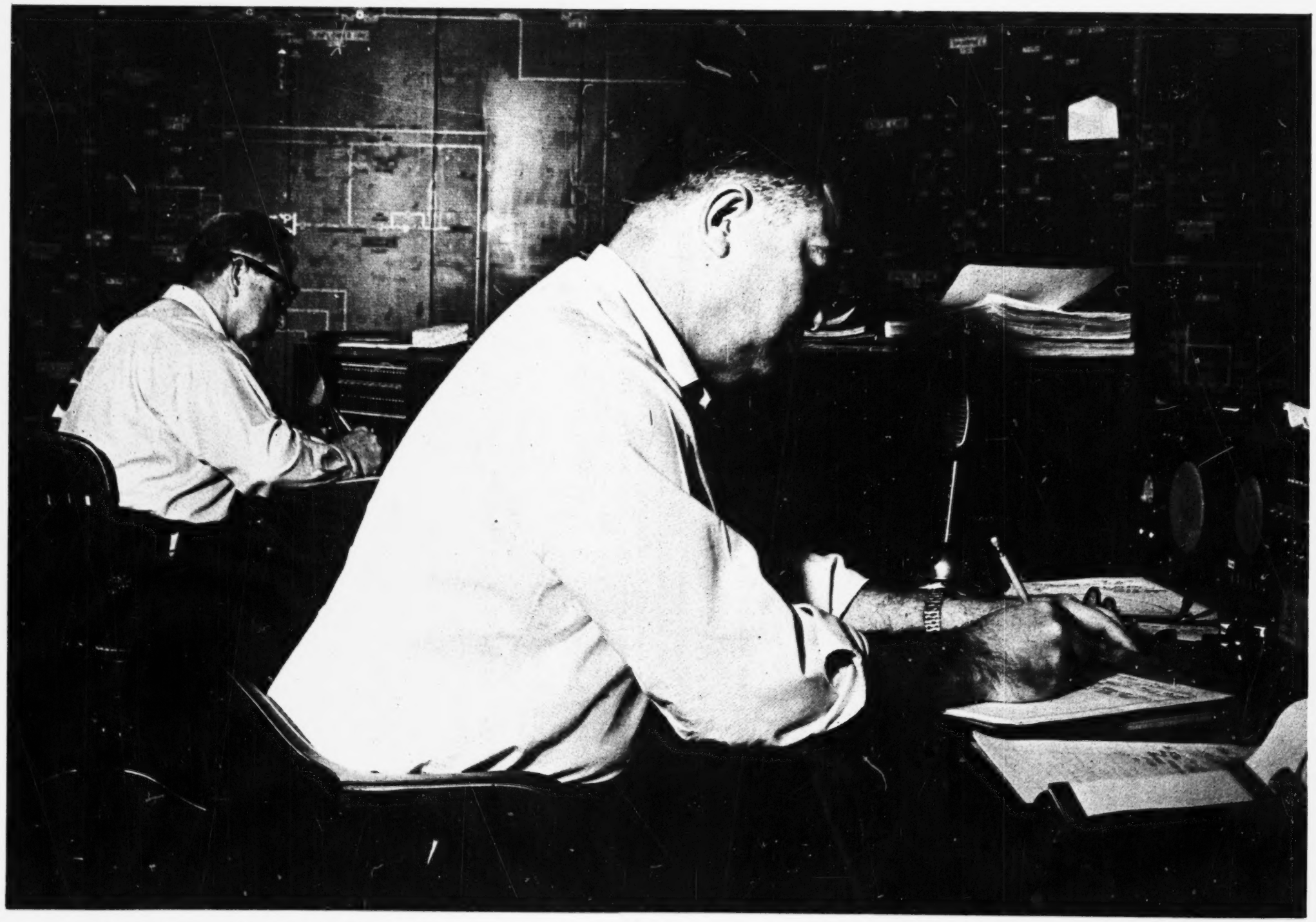
1. Training required to enter the occupation:
   a. What type of training is required? Any other entrance requirements?
   b. Where might this training be obtained?
   c. How long does this training take?
   d. What financial resources are needed to undertake the training?
2. Job opportunities:
   a. Approximately how many people are employed in this field?
   b. Where might one in this field be employed?
   c. What is the nature of opportunities for advancement?
   d. What are the trends in employment in this field?
3. Working Conditions:
   a. What is the nature of the work required in this occupation?
   b. Where is the work generally located? Inside? Outside? Seasonal? Traveling required? Particular parts of the country? May the job require moving?
   c. Are there any special physical requirements for a worker?
   d. What are the job hazards?
   e. Are any special personal-social traits desirable?
   f. What are the normal working hours?
   g. What are the normal starting salaries? After 5 years?
   h. Is union or other organizational membership required or desirable?
   i. Does the occupation offer an opportunity to perform a desirable service to your fellow citizens?

j. List the advantages of this occupation.
k. List the disadvantages of this occupation.

Optional Addition:

4. Consult the want-ad sections of several metropolitan newspapers and list job opportunities of the type you are interested in.

5. Compose a dummy letter of application (the teacher may want to do this in cooperation with the English Department).



System Dispatchers in the Kansas City central dispatching room, Kansas City Power & Light Company. In the background is a mock-up of the distribution network. (Courtesy of Kansas City Power and Light Company.)

ORGANIZING TESTING AND EVALUATION MATERIALS

Achievement in teaching is tested for several reasons and by several methods. Testing can be used to diagnose learning difficulties, motivate learning, evaluate teaching, evaluate learning or ascertain progress, establish a basis for marks, guide in teaching, and as a comparison between schools, classes, and students.

There has been some confusion in the past between evaluation and measurement. Evaluation involves value judgements while measurement is a more objective means of assessing the magnitude of a property. They are different processes, but there is no conflict between the two as both are essential in ascertaining student growth. In teaching industrial subjects, it becomes necessary to measure skill and the speed with which that skill can be performed, to measure factual information learned by the student, to evaluate attitude and work habits of students, interest, problem solving ability, progress of achievement, consumer knowledge, and the appreciation of design as well as other related aesthetic values. As indicated, these topics are either objective, qualitative or a combination of both.

In any type of testing it is imperative that we have an aim or goal to be reached. In the case of teaching, those ultimate goals are the objectives. These objectives provide standards by which the measurement can be made and thus evaluated. In the case of measuring skill, we are interested in observing the performance and examining the finished product. Speed, accuracy, and efficiency can also be checked, thus enabling the teacher to give helpful suggestions to the student for improving performance. The most common type of measurement is the testing for mastery of informational content or factual knowledge. This is usually done by written or oral examinations carefully prepared in advance. Progress is usually measured by the day-to-day advancement of student achievement and from the student's constructional efforts in the shop. Effort, attitude, and personality traits are impossible to measure and are usually evaluated through observation.

Test Construction (See Appendix for sample unit test and sample final exam).

Teachers of industrial subjects may use one or more of the many types of evaluative, checking, and testing devices very effectively. Observation, in and out of class, examination of the finished product or job plan, and oral test, performance test, procedure test, vocabulary test, progress chart, self evaluation, and rating scales (for interest, aptitude, etc.) are some of the most common types of testing devices. Some of the more common types of test items that lend themselves well to industrial education subjects are: (1) true-false, (2) listing or inventory, (3) multiple-choice, (4) completion, (5) best answer, (6) matching, (7) identification, (8) procedure, (9) problem solving, and (10) essay.

What constitutes a good test? Listed below are questions that should be answered in determining the quality of a test.

1. Validity -- does the test measure what it purports to measure?
2. Reliability -- does it measure with any degree of consistency?
3. Objectivity -- can the test be scored without bias so that two or more persons scoring the same test will arrive at the same score?
4. Discriminating -- does it differentiate between those students who know the material and those who do not?
5. Comprehensive -- does the test have sufficient breadth in sampling to cover the course or area thoroughly and fairly uniformily?
6. Administration -- is the test easily administered and scored?
7. Variety -- are the questions and total composition of the test arranged in a manner that will decrease boredom and fatigue?
8. Ambiguity -- is the test free from trick questions and statements that are not clear?

If these items are checked and satisfactorily considered, the result will be a test that is well constructed and one which can be of much use to the teacher, as well as a learning device for the student.

The method or procedure for the construction of good tests is relatively simple, providing certain steps are followed in its construction. Itemized below are the steps found to be helpful in building good tests.

1. List the major objectives for which an appraisal is desired.

2. Examine the course content for additional objectives.
3. Analyze and define each objective in terms of expected student outcomes.
4. Establish a table of specifications or format for the various type of questions.
5. Construct one or more test items of the various types of questions for each objective listed.
6. Assemble the items for the test, keeping in mind the format for easy scoring.
7. Write clear and concise directions for each type of question.
8. Study every aspect of the assembled test for the following:
   a. Does each item really measure the student's attainment of the objective?
   b. If not, how could it be revised to do so?
   c. Is each set of instructions clear? Do they apply to every item in the group, or do some items require specific directions?
   d. Is there plenty of space to write the responses to the questions?
9. Construct the key.
10. Have other instructors criticize, and if possible, take the test.
11. Make any necessary revision.
12. After the test has been administered to one or two groups of students, analyze, revise, and improve it.
13. Continually revise the tests to keep them current with latest developments in the field. The construction of a good test is never completed.

The following information deals with the wording of directions for various types of common test questions. It should be considered only as a guide and may be changed by the individual instructors to better meet their needs.

TRUE-FALSE

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The total resistance in a series circuit is equal to the sum of component resistances.

COMPLETION

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. An ammeter is connected in _____ with the device being meausred.

MULTIPLE-CHOICE

Directions: In the space at the left of each statement write the letter of the item which will make the statement both complete and true.

_____ 1. Resistance wires used in electrical heating devices are made from (A) silver; (B) copper; (C) aluminum; (D) nichrome.

LISTING

Directions: List the items called for in each of the following. Select your answers carefully.

1. List the three most commonly used splices:

(A) _____ (C) _____

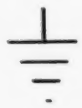
(B) _____

MATCHING

Directions: In the left hand column is a list of electrical devices. The right hand column contains symbols used to represent these devices. Match the symbols to the terms by placing the letter of the symbol in the blank at the left of the appropriate device.

_____ 1. Antenna

_____ 2. Fuse

A. 

B.

C.

PROCEDURE

Directions: List in order of sequence, the operation of a glow switch start fluorescent lamp.

_____ 1. A. Ionization of neon gas

_____ 2. B. Ionization of mercury vapor

_____ 3. C. High induced voltage from ballast

_____ 4. D. Heating of bimetalic strip

_____ 5. E. Cooling of bimetalic strip

BEST ANSWER

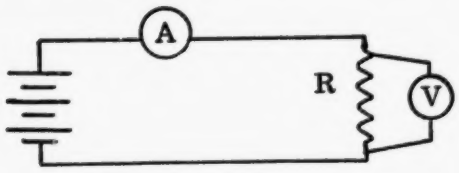
Directions: Each of the statements listed below is followed by several possible answers. Choose the answer that best completes the statement and place the letter in the space provided at the left.

_____ 1. The recommended gage for wiring a home duplex receptacle would be (A) #16; (B) #14; (C) #12; (D) #10.

PROBLEM

Directions: Read the problems carefully and work each one carefully showing all work performed to arrive at your answer. Label each answer.

1. How much current will flow in the circuit below?



100 volts

R = 50 ohms

ESSAY

Essay questions can be worded to suit the objective to be measured. It should be kept in mind, however, that the question should require the student to compare, explain why, describe, or tell how certain things occur. Care should be taken to avoid asking the student to list or enumerate in this type of question.

No attempt has been made here to discuss the standardized tests that are available or the method of marking, scoring, or tabulating scores on the different types of tests.

PROGRESS CHARTS

Methods for posting or keeping records of the students' progress can be done by means of progress charts. These charts are designed to be used for both broad and general tabulation or observation and are not constructed to be highly objective. Progress charts usually are of two types, those for manipulative content and those for informational content. This type of chart is designed to quickly indicate which instruction units have been experienced by the student. Some variations of the progress chart have been made so that different degrees of performance can be entered and thus serve an evaluative function. The chart itself, however, is a qualitative device and can be used only for arriving at generalizations of the student's ability.

Analysis - Progress Chart

Course - Subject

Grade

Qr. - Sem. - Year

School

Teacher

Operations:
Names:
Jobs:

Operations-Names-Jobs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
1.																													
2.																													
3.																													
4.																													
5.																													
6.																													
7.																													
8.																													
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11.																													
12.																													
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14.																													
15.																													
16.																													
17.																													
18.																													

BOOKLETS, PAMPHLETS, CHARTS, MAGAZINES, ETC.

There are many materials other than books that can be used to advantage as reference material in presenting information. Some of these are listed below. Those with an asterisk should be obtained as the information in them is of definite value to this course. Most instructors will also want to obtain many of the other materials. New material of this nature is being produced at irregular intervals and it is recommended that the instructor watch for announcements of new material in current issues of Industrial Arts and Vocational Education, School Shop, and The Industrial Arts Teacher.

American Radio Relay League, West Hartford, Connecticut,
How to Become a Radio Amateur $ .50
Learning the Radio Telegraph Code .50
Radio Amateur's License Manual .50
Available from Allied Radio and many other distributors.

*American Standard Requirements for Residential Wiring, National Wiring Bureau, 155 East 44th Street, New York 17, N. Y., $ .25 each (10-99 $ .10 each).

*The Challenge of Electronics, The Institute of Electrical and Electronic Engineers (IEEE), Box A., Lennox Hill Station, New York 21, N. Y., no charge.

Delco-Remy - This organization has prepared a fine series of training charts and manuals, some of which are suitable for this course. Write to: Technical Literature Department, Delco-Remy, Division of General Motors Corporation, Anderson, Indiana. Ask for a price list.

*Electronics - Your Chance to Shape the Future, Electronics Industries Association, 1721 D. Rale Street, N. W., Washington 6, D. C., 10 for $1.00.

*Electronic Instrument Company (EICO), 330 Northern Blvd., Long Island City 1, New York, Wall Chart of electronic symbols and information on amateur radio.

Kline, R. L., and Friauf, J. B., Electric Shock - Its Causes and Its Prevention, U. S. Government Printing Office, Washington 25, D. C., 1954, $ .20, NAVSHIPS 250-660-42.

Partridge, Gordon R., (Editor), A Dictionary of Electronic Terms, Allied Radio Corporation, 100 North Western Avenue, Chicago 80, Illinois, $ .50.

Rural Electrification Administration, Electric House Heating, U. S. Government Printing Office, Washington 25, D. C., 1960, $ .20.

U. S. Department of Defense (Navy), How to Keep Electricity from Killing You, U. S. Government Printing Office, Washington 25, D. C., 1961, $ .35 NAVSHIP 250-660-78.

U. S. Department of Labor, Job Guide for Young Workers, U. S. Government Printing Office, Washington 25, D. C., 1963, $ .45.

*Your Future in the Air Conditioning and Refrigeration Industry, The Air Conditioning and Refrigeration Institute, 1346 Connecticut Avenue, N. W., Washington 6, D. C., no charge.

Weston Electrical Instrument Corporation, 614 Frelinghurpen Avenue, Newark 5, New Jersey, Charts on meter movements.

In addition to the professional magazines mentioned above, either the shop or the school library should subscribe to a few of the magazines that carry articles dealing with this area. Some of these are:

Radio-Electronics, Gernsback Publications, Inc., 154 West 14th Street, New York 11, N. Y., $5 per year.

Electric Appliance Servicing News, 505 N. LaSalle St., Chicago 10, Ill., $2 per year.

E/E Teaching News, Buck Engineering Co., Inc., Box 710, Freehold, New Jersey, no cost.

Popular Electronics, $4 per year Zeff-Davis Publishing Co.,
Electronics World, $5 per year 434 S. Wabash Ave., Chicago 5, Ill.,

QST, American Radio Relay League, West Hartford, Connecticut, $5 per year.

CQ

Popular Science, Popular Science Monthly, 353 4th Avenue, New York 10, New York, $8 per year.

Popular Mechanics, 575 Lexington Avenue, New York 22, N. Y., $4 per year.

Hi Fi News

FILMS

There are many 16mm motion picture films and 35mm slide films available which deal with the area of electricity. Many of these are quite valuable in presenting electrical concepts to the student. Those of this catagory known to us at the time of writing were included.

The abbreviations used are:

MU - University of Missouri, Audio-Visual Department, Whittier Hall, Columbia, Missouri.

USOE - U. S. Office of Education sponsored films that were available from the International Film Bureau. These may only be available from rental agencies now.

EBF - Encyclopedia Britannica Films, Inc., 1150 Wilmette Avenue, Wilmette, Illinois.

Westinghouse - Westinghouse Electric Corp. These films are not available from Westinghouse for use in secondary schools. However, they may be available from rental agencies.

Jam Handy - Jam Handy Organization.

SVE - Society for Visual Education, Inc., 1345 Diversey Parkway, Chicago 14, Illinois.

Modern Talking Pictures - Swank Motion Pictures, Inc., 621 N. Skinker Blvd., St. Louis 30, Missouri, or 3718 Broadway, Kansas City 11, Missouri.

Association Films, Inc., 561 Hillgrove Avenue, La Grange, Illinois.

U. of Minn. - University of Minnesota, Audio-Visual Extension Service, 115 T.S.M.A., Minneapolis 14, Minnesota.

International Film Bureau, Inc., 332 South Michigan Avenue, Chicago 4, Illinois.

Coronet Films, Coronet Building, Chicago 1, Illinois.

Some films of value may be available from local armed forces recruiting offices.

Fundamentals of Electricity

Current and Electromotive Force, 16mm, sd, b & w, 11 min., U.S. Navy, 1945
Current Electricity, 35mm, slide film, #3 Jam Handy, $4.95
Electric Circuits, 16mm, sd, b & w, 10 min., M.U., $1.00
Electric Meters, 35mm, slide film, #10 Jam Handy, $4.95
Electrical Circuits, 35mm, slide film, 57 frames, #482-6, S.V.E., $6.00
Electrical Safety in the Home, 16mm, sd, color, 14 min., U. of Minn.
Electricity, 35mm, slide film, 48 frames, #427-2, S.V.E., $3.00
Electrons at Work, 16mm, sd, color, 14 min., EBF #1888 color, $150, b & w, $75
The Electron, An Introduction, 16mm, sd, b & w, 16 min. USOE
Elements of Electric Circuits, 16mm, sd, b & w, 10 min., M.U., $1.00
How to do Rescue Breathing, 16mm, sd, b & w, 5 min., M.U., $1.00
Keep 'Em Protected, 16mm, sd, color, 15 min., Westinghouse
Ohm's Law, 16mm, sd, color, 30 min., EBF Introductory Physics Series,
Parallel Circuits, 16mm, sd, color, 30 min., EBF Introductory Physics Series
Parallel Resistances, 16mm, sd, color, 30 min., EBF Introductory Physics Series
Principles of Electricity, 16mm, sd, b & w, 20 min., M.U., $1.00
Series Circuits, 16mm, sd, color, 30 min., EBF Introductory Physics Series
Series and Parallel Circuits, 16mm, sd, b & w, 10 min. M.U., $1.00
What is Electricity?, 16mm, sd, b & w, 20 min., (West), M.U., $1.00
What is Electricity?, 16mm, sd, b & w, 13 min., (EBF), M.U., $2.50
What is Electric Current?, 16mm, sd, color, 13½ min., EBF #1880 color, $150, b & w, $75

Magnetism and Electromagnetism

Electric Magnets, 35mm, slide film, 47 frames, #427-1, SVE, $3.00
Electromagnetism, 35mm, slide film, #6 Jam Handy, $4.95
Magnetic Fields, 16mm, sd, color, 30 min., EBF Introductory Physics Series
Magnetism, 16mm, sd, color, 30 min., EBF Introductory Physics Series
Magnetism, 16mm, sd, b & w, 10 min., (Coronet), M.U., $1.00
Magnetism, 16mm, sd, b & w, 10 min., (McGraw-Hill) M.U., $1.00
Magnetism, 35mm, slide film, #1 Jam Handy
Permanent Magnets, 35mm, slide film, 47 frames, #427-4 SVE, $3.00

Sources and Distribution of Electrical Energy

Alternating Current Theory, 16mm, sd, color, 30 min., EBF Introductory Physics Series
Alternating Current, 35mm, slide film, #8 Jam Handy, $4.95
Atomic Power at Shipping Port, 16mm, sd, color, 26 min., (Westinghouse)
Bell Solar Battery, 16mm, sd, color, 15 min., Bell Telephone Affiliates--Swank Motion Pictures, Inc., Modern Talking Pictures
The Electric Cell, 35mm, slide film, #4 Jam Handy, $4.95
Electrical Proving Ground, 16mm, sd, color, 26 min., (Westinghouse)
Electricity and the Storage Battery, 35mm, slide film 2 parts, #1, 2 Set D, Jam Handy, $3.50 each
Electrochemistry, 16mm, sd, b & w, 10 min., M.U., $1.00
Electrodynamics, 16mm, sd, b & w, 10 min., M.U., $1.00
Electrostatics, 16mm, sd, b & w, 10 min., M.U., $1.00
Energy Unlimited, 35mm, slide film, 36 frames, #S-7 SVE, $5.50
The Generator, 35mm, slide film, #7 Jam Handy, $4.95
How to Produce Electric Current with Magnets, 16mm, sd, 11 min., EBF $120 color, $60 b & w
Induced Electric Currents, 16mm, sd, color, 30 min., EBF Introductory Physics Series
It's CSP for Me, 16mm, sd, color, 10 min., (Westinghouse)
Magnetic Induction, 16mm, sd, color, 30 min., EBF Introductory Physics Series
Maintenance of Storage Batteries, 35mm, slide film, #15 Jam Handy, $3.50
Making Electricity, 16mm, sd, b & w, 11 min., M.U., $1.00
My Pop's a Lineman, 16mm, sd, color, 16 min., U. of Minn.
Power for Plum Street, 16mm, sd, color, 10 min., (Westinghouse)
Power on the Line, 16mm, sd, color, 30 min., (Westinghouse)
The Primary Cell, 16mm, sd, b & w, 10 min., M.U., $1.00
The Principles of Electric Motors and Generators, 35mm, slide film, 68 frames, #482-7 SVE, $6.00
Single-phase and Polyphase Circuits, 16mm, sd, b & w, 17 min., USOE, 1945, $26.36
Static Electricity, 16mm, sd, b & w, 10 min., M.U., $1.00
Static Electricity, 35mm, slide film, #2 Jam Handy, $4.95
Static Electricity, 35mm, slide film, 65 frames, #482-5 SVE, $6.00
The Storage Cell, 35mm, slide film, #5 Jam Handy, $4.95
Transformers, 16mm, sd, color, 30 min., EBF Introductory Physics Series
Transformers (lab), 16mm, sd, color, 30 min., EBF Introductory Physics Series
Voltaic Cell, Dry Cell, and Storage Battery, 16mm, sd, b & w, 18 min., Castle Films

Electrical Conductors and Heat

Wire Size and Voltage Drop, 16mm, sd, b & w, 13 min., USOE, 1945, $21.24

Electric Motors

Electric Motors, 35mm, slide film, #9 Jam Handy, $4.95
How Electric Motors Start and Run, 16mm, sd, b & w, Southern Assoc. of Ag. Eng. and Voc. Ag., Athens, Georgia
Principles of Electric Motors, 16mm, sd, b & w, M.U. Voc. Ag. Dept.
Repulsion Motor Principles, 16mm, sd, b & w, 18 min., USOE, 1945, $36.01
The Principles of Electric Motors and Generators, 35mm slide film, 68 frames #482-7 SVE, $6.00
Life Line Starters, 16mm, sd, color, 10 min., Westinghouse
Lubrication Ain't No Problem, 16mm, sd, b & w, 10 min., Westinghouse
The Starting Motor, 35mm, slide film, #5 Jam Handy, $3.50

Wiring

Conversation Crossroads, 16mm, sd, color, 18 min., Bell Telephone Affiliates or Modern Talking Pictures
Easy Does It, 16mm, sd, color, 24 min., Modern Talking Pictures #1084
The Electrician, 16mm, sd, b & w, 10 min., M.U., $1.00
The Electrical Worker, 16mm, sd, b & w, 29 min., Modern Talking Pictures #1667

Electrical Appliances

Home Electric Appliances, 16mm, sd, b & w, 10 min., M.U., $1.00

Automotive Electricity

The Ignition System (How it Works), 35mm, slide film, #6 Jam Handy, $3.50
The Ignition System (Care and Repair), 35mm, slide film, #2 Jam Handy, $3.50

Electronics

Calling Your Neighbor, 35mm, slide film, 36 frames, SVE #5-8, $5.50
The Electronics Technician, 16mm, sd, b & w, 29 min., Modern Talking Pictures #1664
Receiving Radio Messages, 16mm, sd, b & w, 11 min., EBF, 1943, $ .60
Sending Radio Messages, 16mm, sd, b & w, 11 min., M.U., $1.00, 1943
The Story of Television, 16mm, sd, b & w, 22 min., M.U., $1.00
Television: How it Works, 16mm, sd, color, Coronet Films
Vacuum Tubes, 16mm, sd, b & w, 11 min., EBF #216, $60.00

ORGANIZING INSTRUCTIONAL AIDS FOR APPLIED ELECTRICITY*

Introduction

Educators have long agreed that the best type of learning experiences are the direct, purposeful experiences which students encounter in their daily living. It is not always possible in the classroom to provide situations which let the pupils have this type of experience. It becomes necessary to develop what is called a contrived experience which will explain the principles involved in a manner that can be easily understood. Some of the most common contrived experiences or instructional aids are working models, cut-away models, mock-ups, scaled miniatures, demonstrations, chalk-board drawings, charts and nomographs, field trips, still pictures, motion pictures, television, tape recordings, specimens, and objects.

A good instructional aid is the result of an attempt to vitalize the instruction by broadening the sensory experience of the learner. Good instructional aids can be characterized as being: 1. large enough to be seen by the whole class, 2. readily stored, 3. durable, 4. made to scale, 5. in keeping with recognized technical standards, 6. designed for a specific purpose, 7. designed to emphasize important parts and only include essentials. For the most effective use, the material should be unobtrusive and ready to go at class time. Everyone should be able to see the material, the room should be at a comfortable temperature and well ventilated. Due to the uniqueness of these different types of experiences some lend themselves best to specific situations. The following paragraphs explain the advantages of each of the common contrived experiences and indicate how each can be used most effectively in classroom instruction.

Models

Next to direct contact with the actual object, a model is probably the next best thing, and in some cases, a model may serve as a better instructional aid than the real thing. It is usually made of wood, metal or plastic and is a different size than the actual object. Though it may or may not be workable, the model is similar to or identical with the original in every respect except size. Due to this fact, models are used in instances where the object being studied is too large to study in detail or is not readily accessible to the class. There are several types of models, each with a specific purpose. The cut-away model is very good for seeing the actual working parts of an apparatus with sections or portions removed for clarity. For example, the walls of a steam turbine can be removed to show the inner workings of the turbine blades or other components, without completely separating the original piece.

Mock-Up

A mock-up is slightly different from the model in that it is used mainly to show only a portion of the entire object. A good example of a mock-up is the cooling system of an automobile or section of an electrical circuit which has been laid out on a "bread board" for purposes of studying connections or circuit arrangements. Fuel systems, hydraulic systems or other parts of the whole object can be studied in detail when the mock-up is enlarged or rearranged so that every part is placed on the board. You can produce a different mock-up of the same machine by making only a few parts of it workable while ignoring other parts for the time being. The essential difference, then, between a model and a mock-up, is that a model is a recognizable imitation of the original (whether workable or not), whereas a mock-up alters the essential elements that are being studied in the original and concentrates on specific sections or elements.

Size, time, physical inaccessibility, and processes can be shown with the use of models or mock-ups in a relatively satisfactory manner. Another help in using models or mock-ups is color-coding or cross-hatching certain items of interest for definition. Every model or mock-up is, in a figure of speech, a simile or metaphor of the real thing; hence, the ever-present need for directing attention from the model to the reality for which it stands is a necessity. The differences as well as the likenesses should be pointed out when using contrived experiences in teaching.

Specimens and Objects

It is not possible for students to take a tour of the world, but we can bring fragments of the physical world into the classroom in the form of objects carefully presented in their realistic backgrounds. Such specimens are by no means an ideal solution, but since we cannot possibly experience the direct reality, they are good substitutes. Specimens enable us to learn many things that would

*Adapted from Drafting and Design Technology, published jointly by the Missouri Department of Education and the University of Missouri.

otherwise be unobtainable. The advantages and limitations are true of objects--pieces of leather, asbestos, porcelain, plastic, glass, copper, minerals, metals and alloys--that become necessary in teaching. These fragments are useful because they are the "real things" but they are limited by being torn from their context. Objects and specimens enable us to build generalizations that would otherwise cost prohibitive amounts of time and effort. The largest task of the teacher is choosing the proper aid for specific situations and this becomes an individual problem. Never show or substitute the sign for the real thing, if it is possible to show the real thing.

Demonstrations

In teaching, the term demonstration is used in its broad meaning to include the teaching of ideas, skills, attitudes, processes and other intangibles. We are interested here in the demonstration method and its possibilities. There are several facts about demonstrations that should be considered. We are not limited to material objects or to ideas immediately connected with them. In teaching a skill, a demonstration through guided performance is virtually indispensable. An effective demonstration requires more than a demonstrator and an audience. It requires materials with which to demonstrate and a knowledge of how to use the materials effectively. Films and television constitute an excellent media for demonstration in that the demonstrator can stop and ask if the step has been clearly understood before proceeding to the next step. This direct communication between the teacher and the student is a vital part of the demonstration as are answering student questions at the close of the performance.

Preparing a demonstration by the individual teacher is as arduous a task as performing it. A demonstration is a dramatic performance and as such needs practice and planning. The steps in preparing a demonstration are planning, rehearsing, execution, and timing. It should be kept in mind that the instructor should have decided in advance what the students are to learn, what they already know, how they can be motivated to learn more, and what experiences are likely to develop such learning. For clarification and understanding, certain steps should be followed in giving a demonstration. The teacher should establish rapport with the students, he should know the subject thoroughly, point out the key points and discuss them as the demonstration progresses, and evaluate at the completion of the demonstration. The teacher should also keep the demonstration as simple as possible, and should see that questions and discussions during the demonstration do not digress from the main ideas. He should constantly check to see that the demonstration is being understood and care should be taken not to hurry the presentation or to make it too lengthy. Any materials that are to be handed out to the students should be given to them at the end of the presentation to prevent the students from reading it during the demonstration. In evaluating the demonstration you will want to know what the students have learned and gage your success in using the demonstration method.

The same principles as discussed above about the demonstration are used in chalkboard drawing. The chief advantage of the chalkboard is its availability and ease of use. Care should be taken, however, to be neat and not to block the students' line of vision to the example you are drawing. Charts and graphs can be used as variations of the chalkboard but cannot be altered as easily, and in time certain information may become outdated. The flannel board is another derivation of the chalkboard demonstration and is in wide use in schools and businesses. The chief advantage of the flannel board is its capability of being changed and the absence of messy chalk dust during use. Storage of materials, however, becomes a problem if the flannel board is used to any great degree.

Field Trips

The field trip is classed as an observation of a direct purposeful experience. You can discover what it means by seeing it in operation. A field trip differs from a demonstration in that it is usually not followed by participation or activity by the students. The richer the experience with the ideas presented in observation, the more meaningful that situation will be. The more meaning we bring into our experience, the more meaning we can get out of it. Field trips offer experiences rich with meaning. It becomes necessary to teach the students to be critical and selective in their observations, and to look for specific items or situations that may be overlooked in casual observation. The field trip is especially rich in providing a total experience. It can influence one's ideas, emotions, and values. The field trip promotes school and community relations and problems of the community or industry can be brought back to the classroom.

The over-all procedure for planning a field trip is fairly simple. Advance decisions relating to the purposes of the trip, the responsibility for planning or pointing out what to look for, the frequency of taking field trips, and the evaluation of experiences gained on the trip are essential. Because the field trip takes considerable class time, it must always be justified in terms of educational gains. Planning for field trips involves a direct relationship with the goals or objectives of the school, objectives of the subject area, and the organization of experience with which one is working. One basic technique of the

field trip is to make each student directly responsible for specific information that can be gained by observation on the trip. This advanced planning gives the student direction and makes him responsible for his own learning.

After the instructor is convinced that a field trip is warranted, he should make a preliminary survey and prepare a list of situations, points of interest, and other information about the place to be visited. To obtain consent from the school administration for the trip, to obtain parental consent where necessary, and to make an estimate of the length of time involved, and the round trip schedule should be included in the over-all planning. It should be decided whether or not the entire class or just a selected group will make the trip. Final arrangements with the authorities at the destination point and with school authorities should then be conducted. The last step is then to plan the transportation route in detail and arrange financing.

Having discussed the administrative arrangements, the teacher should make the following preperations with the students prior to the excursion:

1. Arouse student interest in the trip (class discussion, photographs, bulletin board, and other similar material).
2. Discuss with the students the problems that the trip can help solve.
3. Make clear to students the purpose of the trip.
4. Develop background by consulting reference materials.
5. Work out with the students the specific points to observe during the trip or questions that the trip will answer.
6. Establish with the students the standards for safety and behavior.
7. Prepare and distribute to students any materials that can be used profitably in the course.

The pleasure and much of the value of a field trip depends on the quality of the teacher-student preparation. The evaluation of the field trip should be a joint enterprise between student and teacher. Such questions as the following should be asked:

1. Did the trip serve our purpose?
2. What factors accounted for its success?
3. Was there sufficient time?
4. Were the route and means of transportation satisfactory?
5. If we took the trip again, what changes would we make?

In evaluating the results of the trip in line with the growth of the students, the following questions might be asked:

1. Did the class see what they wanted to see?
2. What things did they like best?
3. What things did they like least?
4. Were any students disappointed? If so, why?
5. Were attention and interest consistently maintained?
6. Were the guide services adequate or deficient?
7. Were there discipline problems that need to be considered?
8. Did the trip accomplish what it was supposed to in the light of the preparation of the students and the objectives of the trip?

An objective test covering specific details of the trip should be developed and administered. Also an attempt should be made to measure the concepts and generalizations that were developed or changed as a result of the trip.

Motion Pictures

Through basic motion-picture techniques, such as direct photography, changing speed photography, photomicrography, and animation, great areas of desirable, but heretofore inaccessible, in-

structional experiences and visualized explanations can now be brought into any classroom. Two broad types of sound motion-picture films are being used in classroom work: the direct teaching film and the supplementary teaching film. The latter, which is produced for purposes other than teaching, is often useful in instructional situations.

The classroom use of teaching films has been found to: increase pupil interest in the subject, increase learning, increase retention as well as to stimulate greater interest in reading.

The teacher who uses films in the classroom must accept new and increased responsibility if they are to be used with greatest effectiveness.

It is the teacher's responsibility to choose wisely from large numbers of teaching films those which will make the greatest contribution to the instructional program. In selecting, he must consider such characteristics as authenticity, grade level, curriculum purpose, quality of photography and sound, organization, and study helps.

The greatest responsibility is incurred when the teacher actually prepares to use the film in the classroom. The film should never be accepted as a mechanical substitute for good teaching. Rather, a carefully selected teaching film is a tool of instruction which, wisely used, can bring results in terms of interest, learning, and pupil activity far beyond those previously accomplished with traditional learning materials.

Other teacher responsibilities for using films in the classroom include awakening pupil interest and stimulating the desire to learn, conducting vocabulary study before the film is shown, clarifying with pupils the purpose in viewing the film, providing good classroom conditions for film viewing, providing for individual and group evaluation as well as appropriate follow-up activities. In the hands of an intelligent, well-trained, and understanding teacher, the teaching film can be a vivid, interesting, dynamic and socially useful instrument of instruction.

The following items are offered as a more direct guide to the use of motion pictures in the classroom:

1. Select the film on the basis of the purposes, needs and interests of the class in question.
2. Plan the lesson so as to make maximum use of the material contained in the film.
3. Make use of other materials such as reference reading, objects, reports, and similar items, dealing with the general area covered by the film.
4. Tell the class about the film, such as the film title, the running time, where the picture takes place, characters--if any, the vocabulary involved and its general context.
5. Discuss the film before showing to the class to prepare them on what to look for, problems arising, new concepts brought out, and for other intangibles.
6. Show the film (twice if technical and rather complicated and you feel that the material will be more easily learned).
7. Discuss the film after showing, answering questions raised by the pupils, discussing the content of the film as it relates to the present classroom situation and the new learnings that the students should have obtained.
8. Engage in follow-up activities by continuing study in related readings, written reports, field trips, other films, and by giving tests over the information covered.

Television

The use of television in the classroom is still not too widely accepted because of the expense involved and the experimental nature of much of its use. It is, however, one of the many good ways of improving demonstrations and probably will find increasing use as better techniques are developed. If the equipment is available you may want to consult: Barnard, David P., "Audio-Visuals," Industrial Arts and Vocational Education, 52:10, 12, 44, January 1963; and Diamond, Robert, "Single Room Television," Audio Visual Instruction Magazine, pp. 526-527, December, 1961.

Overhead Projectors

Transparency projectors offer a practical method of presenting certain material, now that rather low cost reproduction methods are available. This system has several advantages, existing drawings

and diagrams may be reproduced or the teacher may prepare his own and they may be reproduced on transparent film. These transparencies are then projected on a screen which may be viewed with the room fully lighted. The teacher may also mark and sketch directly on the transparent film to provide emphasis.

Opaque projectors can be used effectively in projecting pictures, diagrams, and other illustrations directly from the printed page. However, with this type of projector a reasonably dark room is needed.

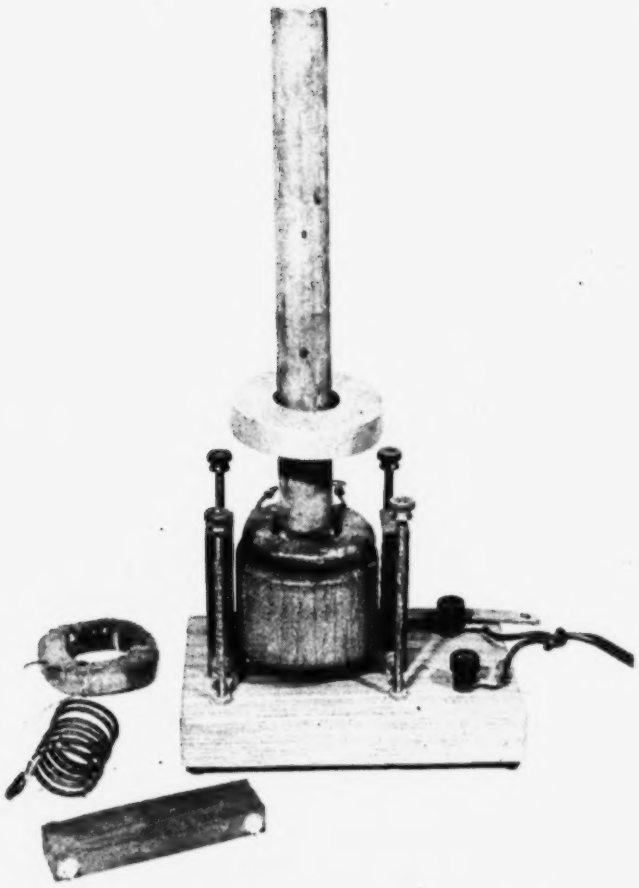
Slides and Film Strips

Slides and film strips are very effective when used following the procedure as outlined for motion pictures. Many commercially available film strips may be purchased or borrowed, some of which may have a record or tape narration to accompany them. Slides may be borrowed, purchased or made by the teacher to suit his own purposes in improving the presentation.

Bulletin Boards and Displays

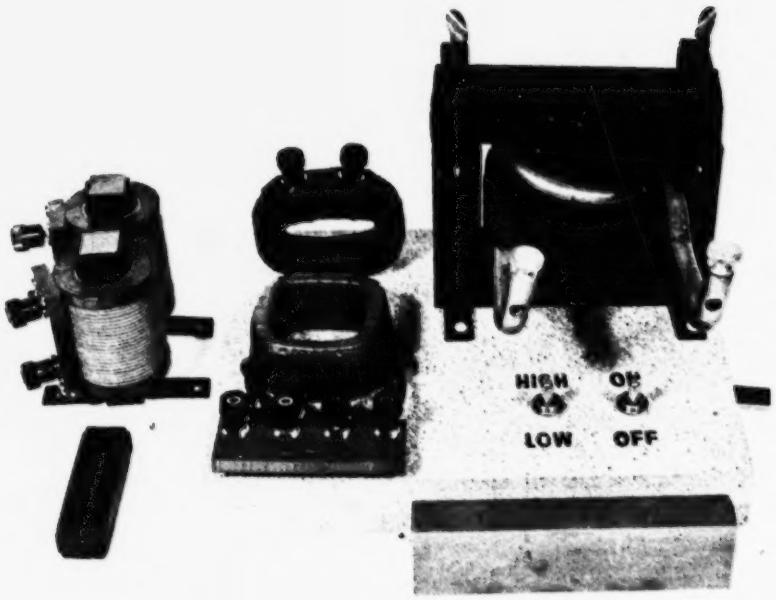
An effective method of constantly keeping materials in front of the students is to plan for effective and well-arranged bulletin boards and displays. The teacher should use care in planning to see that a central theme is carried through and, of course, the material should be frequently changed.

Three-Dimensional Instructional Aids



Jumping ring demonstration with teacher made transformer

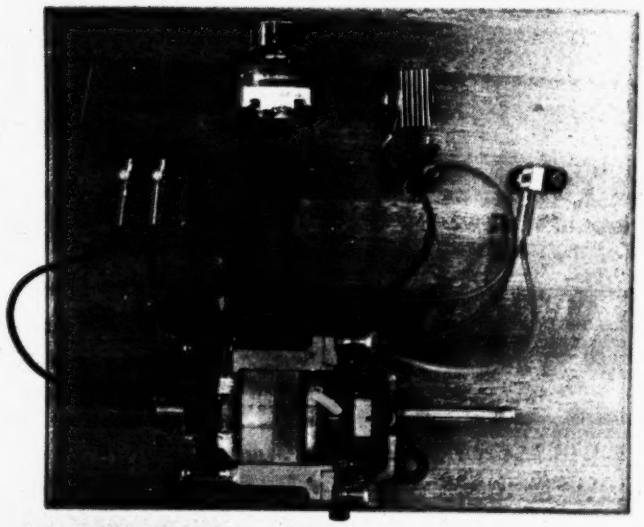
Teacher made power supplies



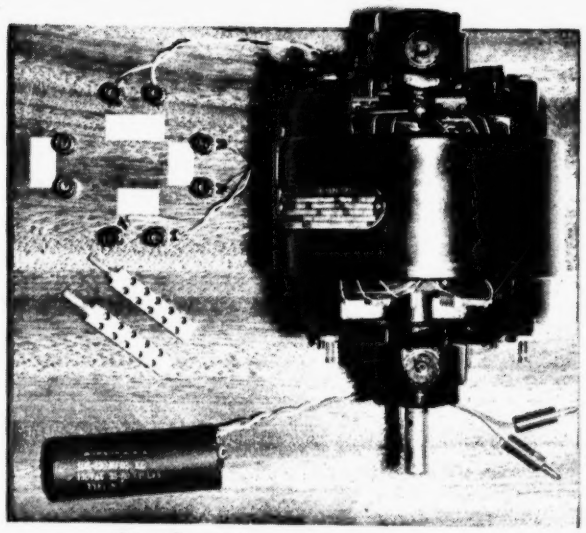
Commercial magnetic demonstration equipment

EXAMPLES OF TEACHER MADE DEMONSTRATION MATERIALS

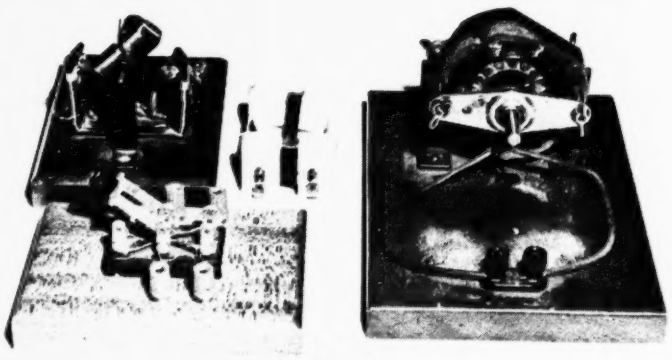
Cutaways of batteries, solenoids, circuit breaker, motor, meter movement



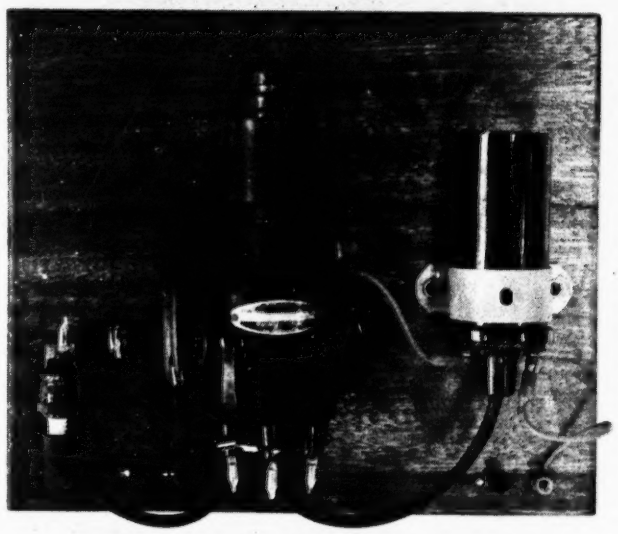
Operating cut away of series motor



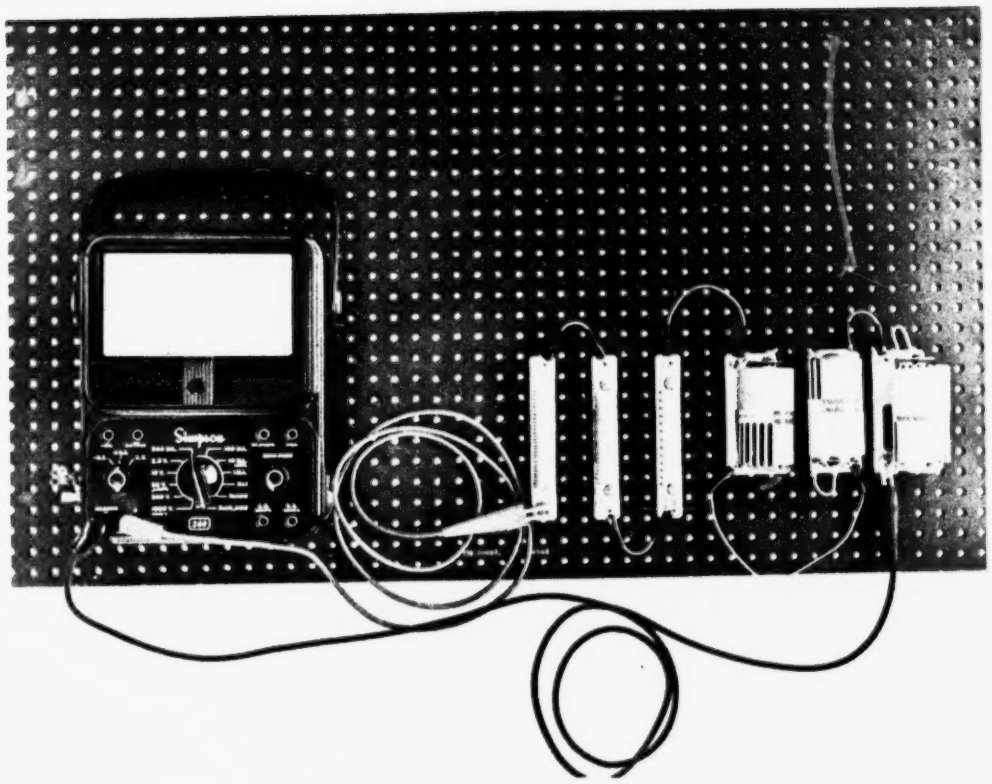
Student built motor, reversing switch, compass used as galvanometer, cut-away motor



Operating cut away of split-phase/capacitor induction motor

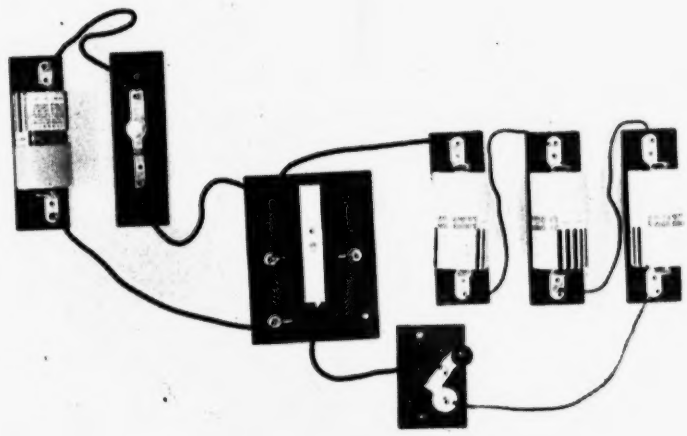


Automobile ignition system

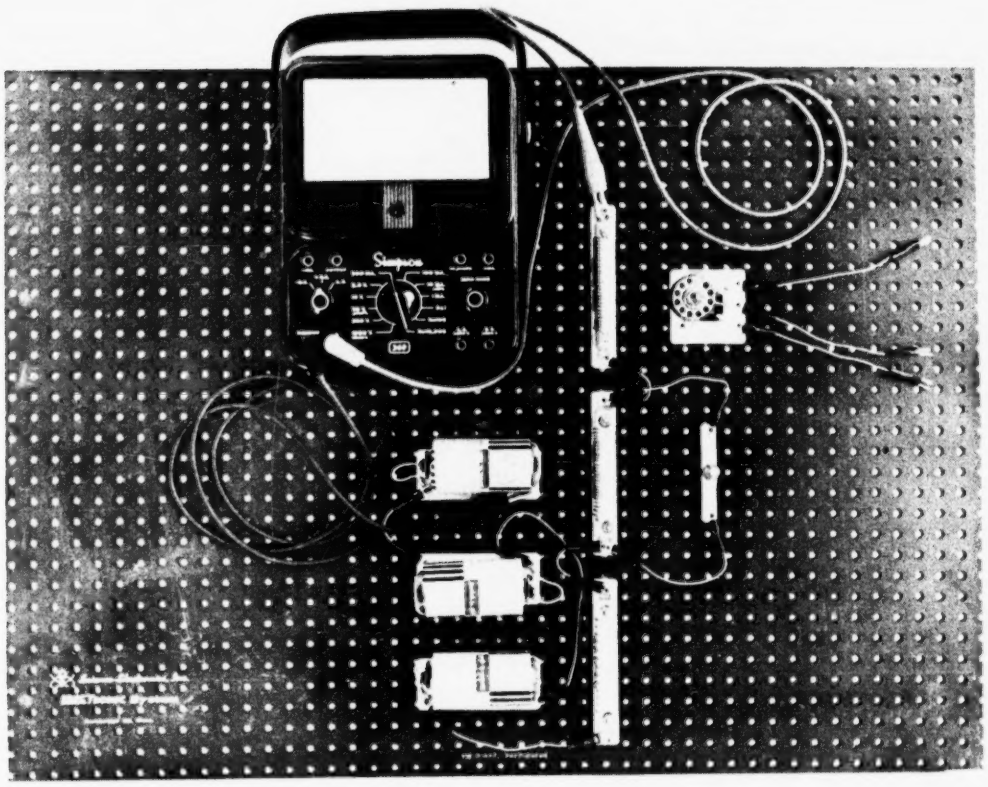


EXPERIMENTS WITH SEVERAL TYPES OF EQUIPMENT

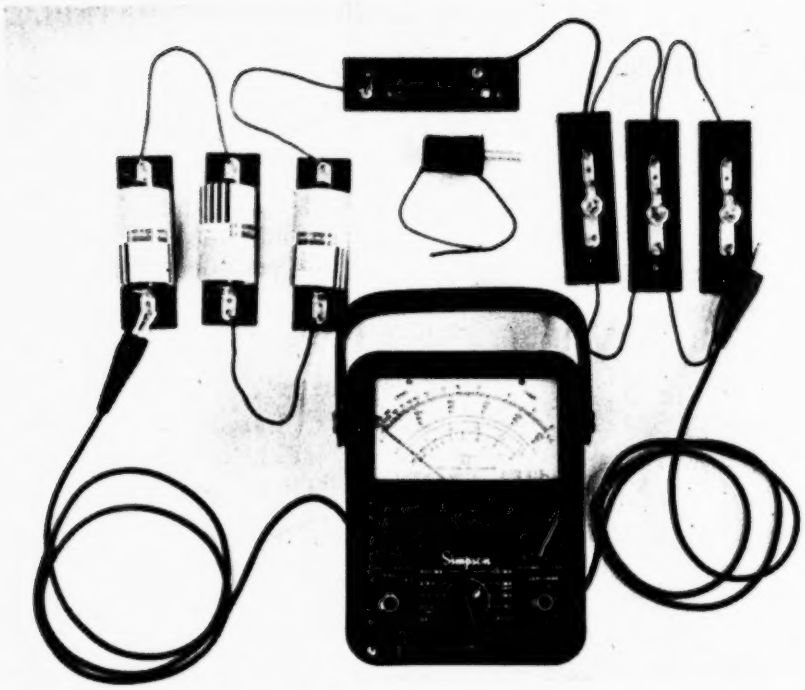
Above, series experiment



Right, relay experiment



Left, understanding the principle of a potentiometer



Circuit breaker experiment

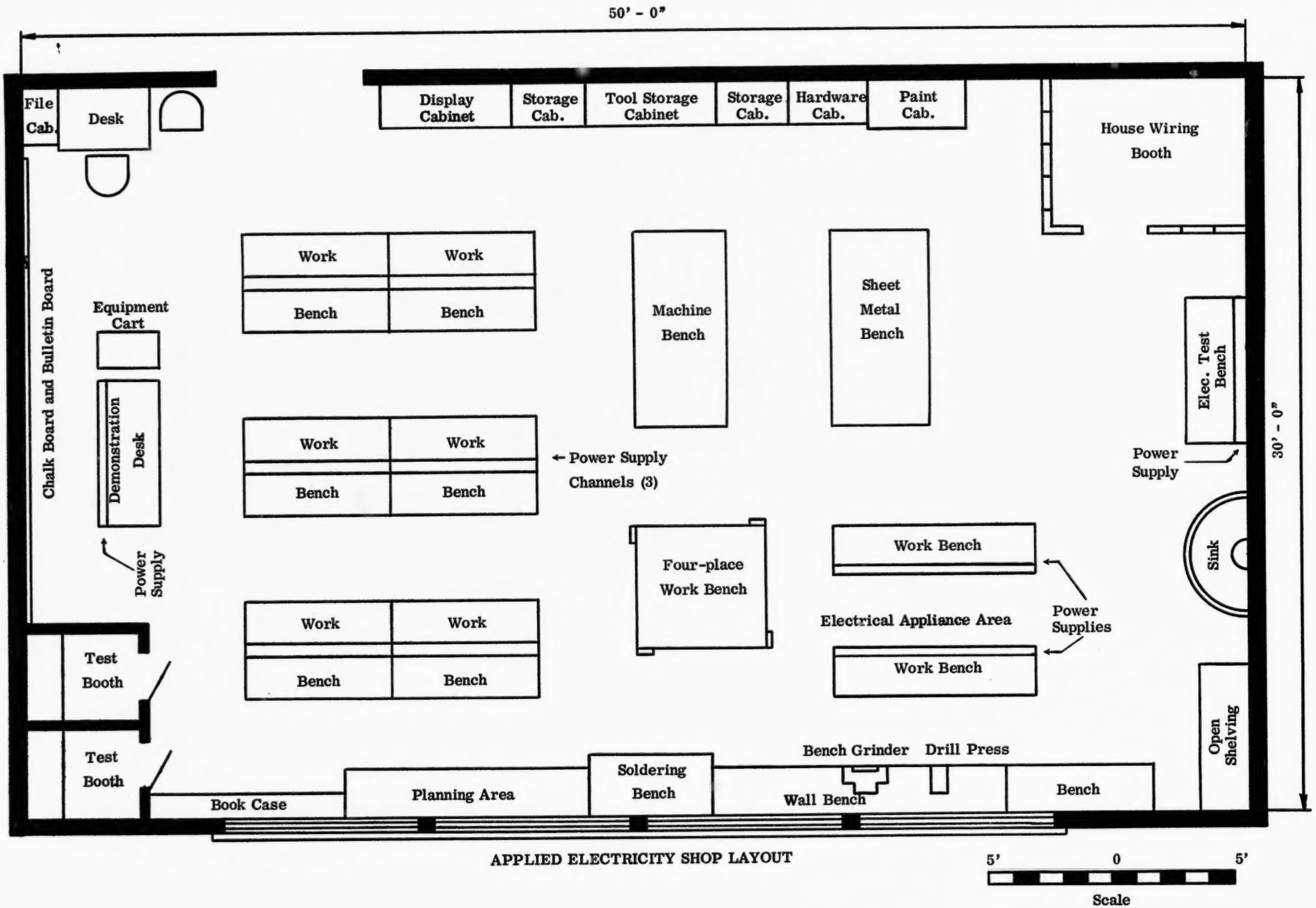
Photoelectric experiment

FREE AND INEXPENSIVE INSTRUCTIONAL MATERIALS*

Items	Sources
1. Air Force Occupational Manual	Airman Information Dept. ME 09 Box 7608 Washington 4, D. C.
2. Charts on the construction and operation of dry cell batteries	Burgess Battery Co. Freeport, Illinois
3. Information on transistors	C.B.S. Hytron Semiconductor Operation Lovell, Mass.
4. Books on electrical fundamentals, magnetism and electricity	Chrysler Corp. Educational Serv., Public Relations Dept. P.O. Box 1919, Detroit, Mich.
5. Course of study and student achievement record	Crow Electri-Craft Corp. 1102 Shelby Street Vincennes, Indiana
6. Information on automotive electrical system	Delco-Remy Div. General Motors Corp. Anderson, Indiana
7. Career Guidance Manual	DeVry Technical Institute 4141 Belmont Avenue Chicago 41, Ill.
8. Wall chart on electrical symbols, color codes, etc.	Eico 33-00 Northern Blvd. Long Island City 1, N. Y.
9. Operation manual on magnetic pickups	Electro Products Lab., Inc. 4501 N. Ravenswood Ave. Chicago, Ill.
10. Wall chart on storage cell. Descriptive literature on Edison battery	Electric Storage Battery Co. P.O. Box 8109 Philadelphia 1, Penn.
11. Instructors Guide for radio and TV courses	Electronics Industries Assoc. 1721 De Sales Street, N.W. Washington 6, D. C.
12. Description of motors and generators with theories of operations	Fairbanks-Morse and Co. Fairbanks-Morse Bldg. Chicago 5, Ill.
13. Outline of Industrial Electricity Training Program	Ford Motor Co. American Road Dearborn, Michigan
14. List of free technical publications. Educational comic books	General Electric Co. Nela Park Cleveland 12, Ohio
15. Booklet on motors, generators, etc. Training aids list	General Motors Corp. Ed. Services Dept. of Public Relations Detroit 2, Michigan
16. Price list of training aid	General Motors Research Labs. Warren, Mich.
17. Catalog on Training Courses Occupational Information	Grantham School of Electronics 821 19th Street, N.W. Washington 6, D. C.

*Adapted from A Guide For Teaching Electricity in Industrial Arts in Indiana, Department of Public Instruction, Indianapolis, Indiana.

18.	General information on hobbies. Radio electronics catalog and short wave information	Hallicrafters Dept. 21 Chicago 11, Ill.
19.	Descriptive literature on circuit breakers	Heinemann Electric Co. Trenton 2, N. J.
20.	1960 Vocational guidance manual	International Correspondence Schs. Box 36574H Cranton 15, Penn.
21.	Periodic table wall chart	International Rectifier Corp. El Segundo, California
22.	Equipment bulletins and ABC's of Capacitors	Line Materials Industries Milwaukee 1, Wis.
23.	Mercury battery wall chart	P. R. Mallory & Co., Inc. 3029 E. Washington St. Indianapolis 6, Ind.
24.	1960 Textbook Catalog	McGraw-Hill Book Co. Chicago 30, Ill.
25.	Power tube ignotron bulletins. Good general information	National Electronics, Inc. North Street Plant Geneva, Illinois
26.	List of textbooks Radio and TV training manuals	National Radio Institute Washington 16, D. C.
27.	Literature on meters and instruments	Phaostron Instrument & Elec. Co. 151 Pasadena Ave. South Pasadena, Calif.
28.	Electronic training program catalog	Philco Technical Rep. Div. P.O. Box 4730 Philadelphia 34, Penn.
29.	Tests on: "Alternating Current Fundamentals"; "Direct Current Fundamentals"	Prentice-Hall, Inc. Englewood, New Jersey
30.	Training manual and price lists and catalog of electronic kits	Progressive "EDU-KITS", Inc. 1186 Broadway, Dept. 528 AE Hewlett, N. Y.
31.	Kit catalog and sample lesson	Kitway Electronics 14125 S. McKinley Avenue Los Angeles 59, Calif.
32.	List of electronic textbooks Bobbs-Merrill text list	Howard W. Sams Co., Inc. 2201 East 46th Street Indianapolis 5, Indiana
33.	Training manual	Science Electronic, Inc. 195 Massachusett Ave. Cambridge 39, Mass.
34.	2-service entrance calculator 3-service and wiring manuals	Sears Roebuck and Co. Chicago, Illinois
35.	Occupational Information and Training program description	Sprayberry Academy of Radio-TV Dept. 120-K 1512 W. Jarvis Ave. Chicago 26, Ill.
36.	Laboratory Layouts and equipment catalog	Standard Electric Time Co. 89 Logan Street Springfield, Mass.
37.	Panel instrument catalog	Triplett Electrical Instr. Co. 286 Harmon Rd. Bluffton, Ohio
38.	Alternating current catalog Electrical Testing catalog	Wagner electric Corp. 6400 Plymouth Ave. St. Louis 14, Missouri



APPLIED ELECTRICITY SHOP LAYOUT

SUGGESTED EQUIPMENT, TOOLS AND SUPPLIES FOR APPLIED ELECTRICITY

Listed in this section are the items of physical equipment and tools as well as expendable supplies which are essential to providing the student experience outlined in this course of study. In addition to providing the essentials for Applied Electricity, these items will be basic to advanced work in electricity and electronics when advanced courses are added to the program.

It is strongly urged that test equipment be purchased pre-wired rather than in kit form. The instructor will not have time to adequately supervise the construction of kits as a new program is being organized.

It is assumed that the maximum class size will be 24 students. Adjustments in quantity of equipment and supplies should be made if variation from this maximum is anticipated. The equipment is planned so that experiments will be performed by students working in pairs.

Immediately following many of the items in the list will be found suggested manufacturers and model numbers that will indicate the appropriate quality and cost. This list of manufacturers is intended to be suggestive not exhaustive. If the equipment is purchased on a bid basis, lower prices may be obtained. A statement indicating that the material will be used for educational purposes should accompany all requisitions in order to receive educational discounts.

12	Volt-Ohm-Milliammeter (20,000 ohms/volt D.C./5,000 ohms/volt A.C.) $50 each (B&K Model 360, $58.75; Triplett #630 or #630PL, $49.50; Eico #555, $34.95; Weston #980, $53.50; Precision #120, $44.05; Simpson #260, $48.95; Paco #M-40W, $37.50) One meter for each work station	$ 600.00
1	Vacuum Tube Voltmeter (11 megohm input) (RCA #WV-77E, $43.95; Triplett #631, $69.50; Eico #222, $42.95; #221, $39.95; #232, $49.95; Knight, $39.95; Simpson #311, $69.95; Heathkit #1MW-11, $46.75; Paco #V-70, $47.50; Precision #68, $54.50)	50.00
1	Oscilloscope, 5 inch (Eico #460, $129.50; Precision #ES-150, $146.95; Simpson #466, $149.95; Paco #5-55W, $139.50)	140.00
1	Tube Tester (It is recommended the tube checker include more than just emission tests. The checker should include mutual or transconductance. Emission testers are available at less cost, but they are not as satisfactory. Since one checker is all that will be purchased in the foreseeable future the slight additional cost is more than justified. It is further recommended that a transistor testing attachment be purchased if not part of the instrument.) (Precision #10-40, $149.50; B&K #700, $166.55; Hickok #800, $179.50; Seco #107A, $149.50)	180.00
1	Voltage Regulated Power Supply (0-400 volts D.C.) (Kit) (Heathkit #PS-4, $56.95; Paco #B-12, $69.95)	70.00
5	A.C. Ammeter (0-25 amperes) (Simpson #370, $22.95)	115.00
10	D.C. Ammeter (0-1.5 amperes) panel type, mount in cases (often suitable meters are available in surplus material, see appendix to make them usable)	150.00
1	Volt-ammeter (dry cell type) (Sterling #35)	3.75
1	Battery Tester (Eico #584, $12.95; RCA #WV-37B, $24.95; Simpson #379, $29.95)	30.00
1	Audio Generator (Eico #377, $49.95; (kit) $31.95; Heathkit (kit) #AG-9A, $39.95)	50.00

1	Wattmeter (Simpson #390, $48.95; #391, $43.95; Triplett #660, $40.00)	45.00
1	Resistance-Capacitance Substitution Box (Eico #1140, $19.95)	20.00
1	A.C. Ammeter (clamp-on style) (Pyramid-Amprobe #RS-3, $52.50; Weston #749, $51.50)	50.00
1	Tachometer (direct reading style)	13.00
1	Transformer, Variable 7.5 ampere (Powerstat #116, $24.00; Ohmite #VT8FC, $26.50)	25.00
1	Megger (for measuring insulation resistance of motors)	75.00
1	Growler	40.00
1	Capacitor substitution (for electric motors)	30.00
1	Radio Frequency Signal Generator (Eico #320, $29.95; Paco #G-30, $39.95; Knight #516, $29.95)	40.00
1	Grid-dip meter (Eico #710, $49.95)	50.00
12	Headphones, single	13.00
1	Battery Eliminator, 6 and 12 volt (Eico #1060, $47.95; Paco #B-10, $39.50)	50.00
1	Capacity Checker (Eico #955, $39.95; Paco #C-20W, $31.50; Precision #1C-60, $32.95; C-D #BF-90, $40.91; Knight #503, $29.95)	40.00
1	Signal Tracer (Paco #Z-80W, $42.50; Eico #147, $39.95)	40.00
1	Cell Tester (Load testing Voltmeter for lead-acid cells)	5.50
1	Hydrometer	1.80

Equipment will be needed for student experiments and demonstrations. There are many commercially developed systems available which provide the instructor with a ready-to-use instructional system. Some of the systems that have been developed and would be suitable for the course are listed below. (Sources: B - Brodhead-Garrett; P - Paxton Equipment and Supply; N - Noname, Inc.)

Source	Description	
B	SE Kit series (10 kits)	$ 104.00
B, N	Science Electronics (Electronic System) I A 300 Package	395.00
P	Electronic Aids, Inc. Construction Skill Kits (each)	39.95
	Electronic Aids, Inc. Block System	152.00
B, P	Electronic Kits Supply, KS Series of Demonstration Boards, set of 20 -	375.00
	Electromatic System (May be purchased as complete layout for $5250.00. Includes many of the tools, test Equipment and other items included other places on this list.)	721.00
	Helio Productions, Series of Panels	133.55
	Universal Scientific Co. Crow Model 30 Series	762.00
	Universal Scientific Co. Crow Model 100G & 110G Demonstrations	560.00
B	Brodhead-Garrett Model 1000 Demonstrations	260.00

It should be remembered that some of this equipment is for demonstration purposes and would provide only one work station.

To provide the student with experiences outlined in this course, it is recommended that a system similar to the Brodhead-Garrett, SE series be obtained. One complete set for demonstration and certain kits in the series for those experiments that the students will perform should be obtained.

1	Series SE kits including 1 complete set 10 additional SE-1 10 additional SE-2 10 additional SE-4 10 additional SE-5	462.00

It might be desirable to have additional demonstration equipment such as provided by the:

1	Electronic IA-300 or similar package and/or	395.00
1	Brodhead-Garrett Model 1000 (Similar to Crow Models 100G & 110G)	260.00
	Total Major Items	$6,549.55

Minimum Tools and Machines:

12	Needle or Long Nose Pliers, 6"	30.00
12	Diagonal Cutting Pliers, 5 "	26.00
6	Side Cutting Pliers, 6" or 7"	17.00
6	Slip-Joint Pliers 6"	5.00
1	Slip-Joint Pliers (channel-lock type) 10"	3.00
1	Wire Stripper, #10-#22 Wire (G C model 766A or equal)	6.00
12	Pocket Knives, Electrical	18.00
6	Soldering Coppers, Electric 100 watt	48.00
12	Soldering Aids (GC #9088)	12.00
6	Soldering Guns, 100 watt	30.00
1	Soldering Pencil (Ungar complete with #113 Chisel tip or equal)	4.00
1	Nut Driver Set (Xcelite #127 or equal)	7.00
12	Screwdriver, straight brade 1/8 x 4"	5.00
6	Screwdriver, straight blade 3/16 x 4"	5.00
2	Screwdriver, straight blade 3/32 x 2"	.54
1	Screwdriver, straignt blade 1/4 x 6"	.85
1	Screwdriver, straight blade stubby	.50
1	Screwdriver, straight blade 5/16 x 8"	1.20
1	Screwdriver, Phillips #1 x 3"	.70
1	Screwdriver, Phillips #2 x 4"	.90
1	Screwdriver, Phillips #1 stubby	.60
1	Screwdriver, Phillips offset	.50
1	Screwdriver, Straight blade offset	.50
1 set	Hex or Allen Wrench set	.90
6	Rules, Steel 8ths, 16ths, 32nds, 64ths (B&S #300, Starrett #604R, or equal)	11.00
1	Gage, American Wire (B&S)	6.50
1	Micrometer Calipers 1"	15.00
2	Awls (Stanley #6A or equal)	2.00
1	Fuse Puller	.80

2	Bench Rules (Lufkin or Stanley #34 or equal)	3.00
1	Rule, Circumference 36"	7.00
2	Dividers, 6"	7.00
2	Square, combination 12"	4.00
1	Marking gage (Stanley #90G or equal)	1.75
1	Gage, Fractional Drill	6.50
12	Brushes, Bench 8"	16.80
1 set	Drills, twist fractional sizes 1/16 - 1/2 by 64ths, High Speed Steel	29.00
1 set	Taps and Dies (Ace #614 or equal)	25.00
1	Reamer, Center 3/8 x 1/2	2.00
1	Reamer, Burring 1 1/4" pipe capacity	5.00
1	Reamer, Hand Held (Hansen #120 or equal)	1.20
1 set	Wood bits, 3/8" to 1" by 16ths (power type)	4.00
1	Hand drill 1/4" capacity	4.00
1 set	Chisels and Punches, 2 chisels, pin, solid and center (Stanley #486K or equal)	3.50
1 set	Chisels, wood (1/4, 1/2, 3/4, 1")	5.50
1	Tin snips, aviation type	3.75
1	Scissors 5"	1.80
1	Nibbling tool (Adel)	3.80
1 doz.	Handles, file 3-6" (Disston #1 or equal)	1.80
1 doz.	Handles, file 6-10" (Disston #2 or equal)	2.20
1	Saw, Back 12"	5.60
1	Saw, Coping	.75
2	Hacksaw frame, 10" and 12" blades	6.00
1	First Aid Kit	8.00
1	Fire Extinguisher, Dry Chemical Type 10 lb.	40.00
1	Furnace, Gas	25.00
1	Spark lighter and extra flints	.90
1 pr.	Soldering Coppers (2 lb. pair)	2.75
1	Tube Pin Straightener, 7 & 9 pin (G C #8655)	1.50
1	Vise, Drill Press	10.00
2	Vises, Machinist 3"	48.00
2	Hammers, Ball pein	5.00
2	Hammers, Claw 13 oz.	6.00
2	Mallets, Soft Face 8 oz. Medium tips	5.50
6	C-Clamps 3"	6.00
1	Combination Oilstone	2.50
1	Wrench, 6" adjustable	2.30
1	Wrench, 8" adjustable	2.65
1	Wrench, 10" adjustable	3.40
1	Grinding Wheel Dresser	1.50

1 pr. for each student	Glasses, Safety It is recommended that an eye protection program be practiced whereby all students wear eye protection when working in the shop.	50.00
1	Vise-grip Pliers	1.70
1	End Nippers	4.50
1	Handy Seamer	5.25
1	Framing Square	4.50
1	Brace, Hand 10"	12.00
1 set	Auger Bits #4-16	32.00
1	Expansion bit (to 3")	3.00
1	Bit Extension 18"	4.00
1	Hold-it type Screwdriver	1.00
1	Forcepts ("Seizer")	4.25
1	Tweezers 6-1/2"	.75
1 set	Screwdriver, Jewlers	2.90
1	Stock Cart 30"	25.00
1	EMT Bender 1/2" (with handle)	5.00
1	Hole Saw	20.00
1	Jack Plane	8.00
1	Block Plane	4.00
1	Drill Grinding Attachment	34.00
1	Inspection Mirror (G C #5090)	.50
1	Flashlight with Magnifier	5.00
5	Flashlights	6.00
1 set	Chassis Punches, round (including 5/8, 3/4, 7/8, 1, 1-1/8, 1-5/32, 1-1/4 inches)	26.00
1	Nut Driver, Hollow shaft type (Xcelite HS 14)	1.00
1	Nut Driver, Hollow shaft type (Xcelite HS 16)	1.00
1	Nut Driver, Hollow shaft type (Xcelite HS 18)	1.20
1	Nut Driver, Hollow shaft type (Xcelite HS 20)	1.25
1	Bench Grinder 7"	180.00
1	Bench Drillpress 15" incl. motor	230.00
1	Electric Drill 1/4"	17.00

The following items would be needed if they are not available in other areas of the industrial arts department.

1	Squaring Shear, 24" (Di-Acro, $440.00; Pexto #132, $376.00)	376.00
1	Box and Pan Brake 24" (Di-Acro, $297.00; Pexto #PX24, $297.00; Berkroy B-90, $293.00)	297.00
1	Arbor Press, 1 ton	35.00

1	Shop Vacuum Cleaner	50.00
1	Dymo Labeling Machine M22 with tape	45.00
1 set	Number and Letter Stamps 1/8"	7.00
1	"Pop" Rivet set	25.00
1	Square Stake and Plate	40.00
	Tools and machines total	$2146.24

Supplies:

The following are typical of the type items that should be purchased to support the activities planned for Applied Electricity.

10 lb.	Solder, 50/50 rosin core, .0625 dia. 1 lb. spools	12.00
5 cans	Soldering Paste	.75
2 dz.	Coping Saw Blades	.75
20	Hacksaw Blades, 24 teeth/inch, 10"	2.90
1 dz.	Mill Files, Bastard cut, 10"	9.00
1/2 dz.	Half Round Files, Bastard Cut, 10"	9.00
1/2 dz.	Round File, Bastard Cut, 10"	6.00
2	Combination File Card and brushes	2.50
1500 ft.	Lamp Cord, SP-1 18/2, Black or Brown	30.00
250 ft.	Non-Metalic Sheathed Cable, 14/2	6.50
250 ft.	Cord, type S 16/3	25.00
1000 ft.	Cord, type S 14/2	84.00
15	Feed-through Switches	4.00
25	Caps (Eagle #912 or equivalent type)	2.00
20	Caps, Grounding type (Eagle #203 or equal)	9.00
25	Socket, key with pendant bushing	10.00
15	Cord ends	4.50
15	Cord ends, grounding type (Eagle #222 or equal)	13.50
5	2 wire to 3 wire adapter (Eagle #832 or equal)	1.25
1	Magnetic Motor Control, 1 phase with a start-stop station, size 0	7.50
1	Time clock switch with dim circuit (Paragon #41005-0 or similar style)	12.00
20	Crystal diodes 1N34 or similar type for crystal sets	2.00
20	Capacitors, variable, 365 picofarads	14.00
1	Coil winding calculator	.50
12	Doorbell transformers	24.00
24	Push buttons, doorbell type	24.00
12	Bell-buzzer combinations	24.00
12	3 lite bases	48.00
12	3 lamp cluster switches	12.00
24	Remote control switches	12.00
12	Remote control relays	24.00

1	Remote control transformer 24 volt	4.00
1	Lead Acid Battery	17.00
5	Cube Taps	.75
5	Bases (Eagle #6-B or equal)	.35
500 ft.	Wire, Building #14 TW	6.00
100 ft.	Hook-up wire	1.00
24	Dry Cells #6	23.00
6	Motors for troubleshooting and reversing (Motors in need of repair can often be obtained from local repair shops for $2-3 each)	18.00
3 lb.	#24 nichrome wire	15.00
10 lb.	#24 heavy Formvar	2.00
100	Terminal strip, 1 terminal	2.00
20	Duplex convenience outlets grounding type	10.00
20	Switches, 3-way	8.80
10	Switches, 4-way	6.00
20	Cleat Receptacles, medium base	4.00
20	Cleat Receptacles, miniature base	2.80
30	Switch boxes	7.50
15	Switch, SPST toggle, bat handle	15.30
20	Compasses, 25 mm	5.00
20 pr.	Bar magnets	10.00
18	Magnets, horseshoe, 1"	11.85
1 lb.	Iron filings	2.00
15	500 ohm, 2 watt potentiometer	13.95
20	1 megohm, 1/2 watt, fixed resistor 20%	1.80
20	Lampholder sockets for fluorescent lamp	6.80
20	Lampholder and starter socket for fluorescent lamp	9.40
20	FS 2 starters	3.60
12	Ballast for 15 watt fluorescent lamp	3.00
15	Fluorescent lamps, 15 watt	10.00
12	Solar cells, B2M	18.00
5	918 or 930 photo tube	13.95
30	Pilot lamps, #41, 222 or 233 (or assortment)	3.00
	Assorted machine screws, wood screws, tape (plastic, friction, and rubber), spade lugs, metal and fiber washers, oil and oil cans, tacks, assorted types of wire (brass, aluminum, iron), and similar electrical hardware	

The following items can probably be picked up at little or no cost as they need not be in working condition.

1	Air Conditioner (to replace filter and clean condenser coils)
1	Generator, automobile, with extra brushes
1	Ignition coil
1	Distributor

Furnishings and Storage Facilities

1	Display Cabinet (Instrument Storage) (Brodhead-Garrett SC14 or equal)	375.00
2	Storage Cabinets 18" deep (small parts drawers)	123.00
1	Tool Storage Cabinet (Brodhead-Garrett TSE13 or equal, no tools)	510.00
1	Hardware Storage Cabinet (Brodhead-Garrett T34 or equal)	190.00
1	Paint Storage Cabinet (Brodhead Garrett T37 or equal)	103.00
6	Benches, Locker bases, including Power Channel (Brodhead-Garrett ET160 or equal)	1134.00
1	Instructor's Demonstration Desk (Brodhead-Garrett ET631)	420.00
1	Machinist Bench (Brodhead-Garrett W45 or equal)	300.00
1	Sheetmetal Bench with 1 stakeplate (Brodhead-Garrett SM99S or equal)	290.00
1	Electrical Test Bench (Brodhead-Garrett ET5C or equal)	330.00
1	Woodworking vise with 4 vises (Brodhead-Garrett L13 or equal)	215.00
1	File Cabinet with lock	40.00
1	Instructor's Desk	88.00
2	Chairs	40.00
1	Bookcase 7' long	120.00
1	Wall Bench (Brodhead-Garrett WC10 or equal)	228.00
1	Soldering Bench (Brodhead-Garrett 6122TR or equal)	79.00
1	Bench, wall Locker base (Brodhead-Garrett W12L	235.00
1	Bench 6' x 24" x $1\frac{1}{2}$" Drawer base and Cabinet base	95.00
26	Stools, 22"	145.00
	Furnishings Total	$5,749.50
	Grand Total	$14,445.29

SOURCES OF ELECTRICAL EQUIPMENT AND SUPPLIES

Most of the recommended equipment and supplies for this course can be obtained from local hardware, electrical, and electronic distributors. If there are electrical and/or electronic manufacturers in the area, one can often obtain some equipment and supplies from them at low cost. Do not overlook the possibility of obtaining some items from the state surplus property office.

In some cases, where the possibility of annoying back-orders exist, one might be better off ordering from some of the larger supply houses. Some of the better known are listed below:

Allied Radio Corp., 100 North Western Avenue, Chicago 80, Illinois - general electronic tools, equipment, and supplies, Knight kits.

Arrow Sales, Inc., 2534 South Michigan Avenue, Chicago, Illinois - electronic supplies, surplus equipment.

Barry Electronics, 512 Broadway, New York 12, New York - surplus equipment and supplies.

Brodhead-Garrett Company, 4560 East 71st Street, Cleveland 5, Ohio - general industrial arts equipment and supplies.

Buck Engineering Company, Inc., Box 151, Freehold, New Jersey - power panels.

Burstein-Applebee Company, 1012 McGee Street, Kansas City, Missouri - electronic equipment, tools, and supplies.

Central Scientific Company, 1700 Irving Park Road, Chicago 13, Illinois - magnetic supplies, scientific apparatus.

Electromatic Manufacturing Company, Inc., Box 183, McMinnville, Tennessee - demonstration equipment.

Electronic Instrument Company (EICO), 330 Northern Blvd., Long Island City 1, New York - test equipment wired and kit.

Electronic Kits Supply Company, 1727 Glendale Blvd., Los Angeles 26, California - demonstration equipment.

Electronic Teaching Laboratories, 5034 Wisconsin Avenue, N.W., Washington 16, D. C. - demonstration equipment.

Equipto, Aurora, Illinois - benches, storage cabinets.

Fair Radio Sales Company, 2133 Elida Road, Lima, Ohio - surplus equipment and supplies.

Fay-Bill Distributing Company, 79 White Street, Department C-21 New York 13, New York - surplus equipment and supplies.

Graybar Electric Company,
1644 Baltimore Avenue, Kansas City, Missouri
2642 Washington Street, St. Louis, Missouri
electrical tools, equipment and supplies.

H. A. Holden, Inc., 1208 Harmon Place, Minneapolis 3, Minnesota - electric motor supplies and parts.

Hampden Engineering Corporation, East Longmeadow, Massachusetts - power distribution equipment.

Heath Company, Benton Harbor 35, Michigan - test equipment wired and kit.

Helio Productions, 414 East 7th, Mt. Carmel, Illinois, Electronic training aid system.

Industrial Arts Supply Co., 3002 Hennepin Avenue, Minneapolis 8, Minnesota, Teaching Aids, Supplies, Instruct-a-Kits, St. Cloud, Minnesota - kits.

Lafayette Electronics, 111 Jericho Turnpike, Syosset, Long Island, New York - electronic supplies.

National Kits, Inc., 140 Tenth Avenue, New York 11, New York - electronic kits.

Newark Electronics, Inc., 223 West Madison Street, Chicago 6, Illinois - electronic tools, equipment and supplies.

Olson Electronics, Inc., 260 South Forge Street, Akron, Ohio - electronic supplies.

Parent Metal Products, 6801 State Road, Philadelphia 35, Pennsylvania - benches and storage cabinets.

Patterson Brothers, 45 Samworth Road, Clifton, New Jersey - equipment and supplies.

Paxton Equipment and Supply, 7401 South Pulaski Road, Chicago 29, Illinois - tools, equipment and supplies.

Philco Technological Center, P.O. Box 4730, Philadelphia 34, Pennsylvania - demonstration and laboratory equipment.

Precision Apparatus Company, Inc., 70-31 84th Street, Glendale 27, Long Island, New York - test equipment, PACO test equipment wired and kit.

Radio Corporation of America, Audio Products, Meadow Lands, Pennsylvania - demonstration and laboratory equipment. test instruments.

Science Electronics, Inc., 195 Massachusetts Avenue, Cambridge 39, Massachusetts - demonstration and lab equipment (Electronic system).

Shop-Bilt, Inc., 315 South First Street, Effingham, Illinois - benches, cabinets.

Standard Electric Time, 89 Logan Street, Springfield 2, Massachusetts - power distribution equipment.

Standard Pressed Steel Company, Jenkintown, Pennsylvania - benches, storage cabinets.

Systems Analyzer Corporation, Nokomis, Illinois - add-a-phase power conversion equipment.

The Tolerton Company, 265 N. Freedom Avenue, Alliance, Ohio - benches, storage cabinets.

Thornton Associates, Room 38, 680 Main Street, Waltham 54, Massachusetts - Mini-lab circuit system.

Universal Scientific Company, Inc., 1102 Shelby Street, Vincennes, Indiana - demonstration equipment.

Vector Electronic Company, Inc., 1100 Flower Street, Glendale 1, California - Vector circuit system.

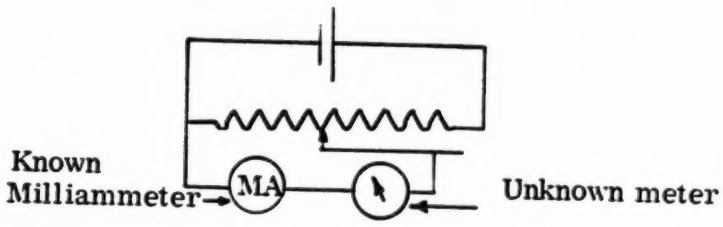
Appendix A

APPLIED ELECTRICITY

Utilization of Old and Surplus Meters
(Do not use as a student exercise)

Many good meters are available through the state surplus property office. These meters may have incorrect scales or have characteristics which make them unusable in their present condition. It is not very difficult to make new shunts or new multiplying resistors for these meters if the resistance of the meter movement and the full scale current are known. One method of determining this for a permanent magnet or Weston type movement is as follows:

1. Take the meter apart in as dust free atmosphere as possible.
2. Remove any shunts and external resistances from the meter.
3. Connect the meter in a circuit as below.



Caution: Make sure you start with the voltage divider at the low voltage end of the potentiometer or you could burn out the meter movement.

4. Adjust the slider (rotor) on the potentiometer slowly until full scale deflection is obtained on the unknown meter.
5. Record the current flow on the known meter. Since the two meters are in series with each other this will be the full scale current for the unknown meter.
6. Obtain a resistance decade box that will go down to 0 ohms in at least 1 ohm steps (Example: Eico Model 1171).
7. Place this resistance decade across the unknown meter in the circuit above with maximum resistance.
8. Remove the resistance in steps until $\frac{1}{2}$ scale deflection is obtained on the unknown meter, making sure that the current of step 5 is maintained on the known meter by adjusting the potentiometer.
9. The resistance on the decade box is the resistance of the meter. Theory: Current divides equally in the branches of two <u>equal</u> resistances - $\frac{1}{2}$ through meter, $\frac{1}{2}$ through the decade box.
10. If the meter is to be used as an ammeter (D.C.) the resistance of the shunt can be calculated by the following formula:

$$R\ shunt = \frac{I\ meter}{I\ shunt \times R\ meter}$$

Example: A meter has a full scale current of 1 ma and a resistance of 50 ohms. It is desired to have the meter calabrated for 1 ampere, full scale deflection. Since only 1 milliamp can flow through the meter movement the remaining 999 ma must flow through the shunt. Substituting: 1/999 X 50 = .05005 ohms for the shunt resistance. Resistances this small are difficult to measure in the shop so try to get it close and do final calabration with the meter in series with a known meter at the desired current. The wire used for the calabrating shunt should be a wire having a low (very small) temperature coefficient. Actually it should be slightly negative. Constantan wire can be used if regular meter shunt wire is not readily available. This wire can often be obtained surplus as one of the conductors in thermocouple wire.

11. Be sure the shunt wire is wound so that it can not short against itself or anything else. If there is room, put it inside the meter and close the meter. If not, put it externally and mount the meter in a cabinet.

12. If the meter is to be used as a voltmeter, it is necessary to connect a multiplier resistor in series with the meter movement. The total resistance of the meter and multiplier has to be such as to allow the full scale current to flow at the desired full scale voltage. Example: Using the 1 ma movement of the example above, it is desired to have a meter that will have a 500 volt range. The meter sensitivity for a 1 ma movement is 1000 ohms/volt (1 v/.001 a = 1000 ohms/volt). Therefore, the total resistance needed is 100 x 500 or 500,000 ohms. Since the meter resistance is 50 ohms the multiplier must be 499,950 ohms (500,000-50). This resistance is then added in series with the meter and it is enclosed in a case.

13. In the case of the voltmeter and the ammeter it probably will be necessary to remark the values for the scale on the meter, or make a new scale.

Appendix B

APPLIED ELECTRICITY

EXAM -- UNIT I
Fundamentals of Electricity

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The nucleus of the atom is made up of electrons and protons.

T F 2. An Ohmmeter contains a source of electrical energy.

T F 3. An open circuit is a circuit that has a complete electrical path.

T F 4. A rheostat can be used as a potentiometer.

T F 5. The rotor of a potentiometer is the center terminal of the three in this diagram.

T F 6. It is likely that the consumption of electrical energy will decrease in the next five years.

T F 7. A kilowatt is equal to 10,000 watts.

T F 8. The current flow is the same in any part of a series circuit.

T F 9. If a D.C. voltmeter reads in the wrong direction, reverse the two leads.

T F 10. The word shunt means series.

T F 11. A schematic diagram shows the actual physical location of components.

T F 12. Dry chemical type fire extinguishers are one of the best type for electrical fires.

T F 13. An ammeter is always connected in series in a circuit.

T F 14. The prefix milli means 1/1,000.

T F 15. Electrons have a positive electrical charge.

T F 16. Circuit breakers work on thermal principles, electro-magnetic principles or a combination of the two.

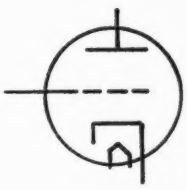
T F 17. The abbreviation VOM stands for Volt-Ohm-Milliammeter.

T F 18. The voltage across each of the components in a parallel circuit is the same.

Identification

Directions: Identify the following symbols by placing the name of the device in the blank beside the symbol.

19. _____

20.  _____

21. _____

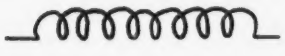
22. _____

23. _____

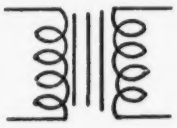
24. _____

25. _____

26. _____

27.  _____

28. _____

29.  _____

30. _____

31.

_____

32. _____

33. _____

34. _____

35.

_____

36.

_____

37. WP _____

38. S_3 _____

39. _____

Problems

Directions: Read each of the problems below carefully and solve. Show all work performed to arrive at your answer in the space provided. Label your solution (Ans.).

40. What is the voltage drop across a 250 ohm resistance with 2 amperes flowing through it?

41. How much current flows through a 15,000 ohm resistor connected across 150 volts?

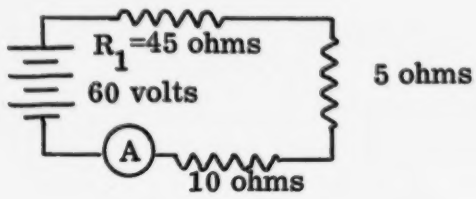
42. What is the resistance of an appliance operating on 120 volts and drawing 6 amperes?

43. What is the power rating of an appliance drawing 10 amperes on 240 volts?

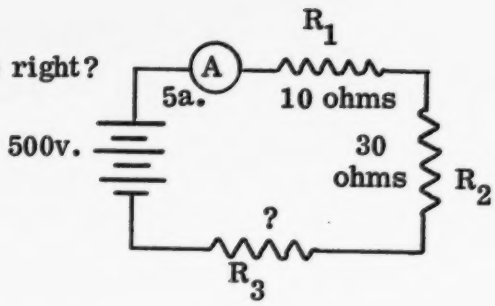
44. What voltage is impressed across a 1600 watt device drawing 8 amperes?

45. What is the maximum current flow through a 10,000 ohm, one watt resistor?

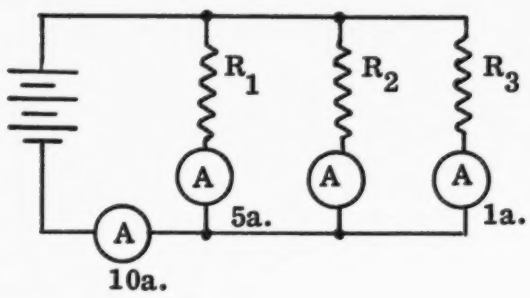
46. What is the voltage drop across R_1 in the circuit to the right?



47. What is the resistance of R_3 in the circuit at the right?

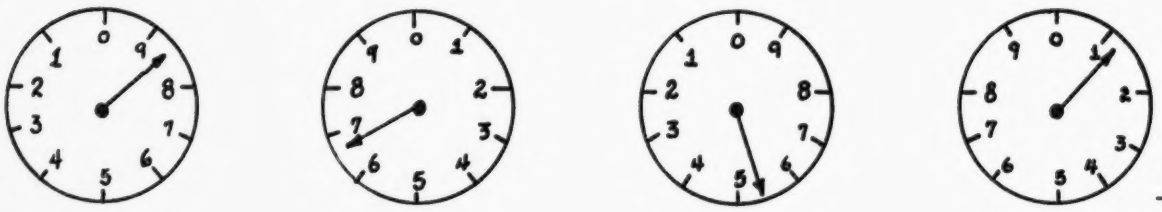


48. What is the current flow through R_2 in the circuit at the right?



49. What is the total resistance of the following three resistors in parallel? R_1 = 100 ohms, R_2 = 200 ohms, R_3 = 400 ohms.

50. What is the kilowatt-hour reading for the meter below?



_____ K.W.H.

51. Using the rates below, calculate the monthly bill for 261 KWH of electrical energy.
    4¢ per KWH for the first 50 KWH/mo.
    3.3¢ per KWH for the next 50 KWH/mo.
    3¢ per KWH for the next 50 KWH/mo.
    2.25¢ for any excess KWH/mo.
    60¢ service charge /mo.

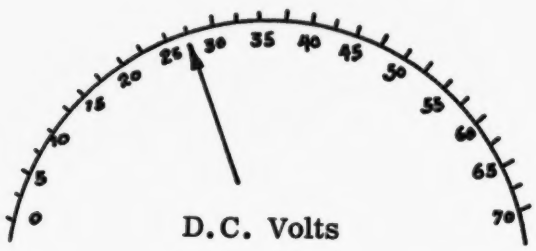
52. What should be the power rating of a 15,000 ohm resistor with .01 amperes flowing through it?

53. What is the rated efficiency of a device that consumes 2,200 watts and delivers 2,000 watts of power?

54. Assuming a $\frac{1}{2}$ horsepower motor were 100% efficient, what would be the power input in kilowatts?

55. What is the power consumption of a 100 ohm heating element connected across 120 volts?

56. What is the reading on the meter below?



_____ volts D.C.

APPLIED ELECTRICITY

Key for Exam — Unit I

Key to References:

A. Buban, Peter, and Schmitt, Marshall L., Understanding Electricity and Electronics
B. Marcus, Abraham, Basic Electricity

True-False

1. F - B-4
2. T - A-242
3. F - A-436
4. F - A-134
5. T - A-134
6. F - A-4-5
7. F - A-437
8. T - A-146
9. T - A-240-241
10. F - B-86
11. F - A-21
12. T - A-34
13. T - A-239
14. T - A-122
15. F - B-3
16. T - A-175, B-264, lecture notes
17. T - A-244
18. T - A-147

Identification

19. oscillator, alternating current source
20. vacuum tube
21. fuse
22. antenna, aerial
23. capacitor
24. ground
25. rectifier or diode
26. transistor
27. coil (inductor)
28. resistor
29. transformer
30. switch
31. T-V outlet
32. duplex outlet
33. special outlet
34. telephone
35. light, pull chain
36. range receptacle
37. weather proof duplex (outlet)
38. 3-way switch
39. doorbell, bell

All the symbols are inside the front and rear covers of Buban and Schmitt.

Problems

40. $E = I \times R = 2 \times 250 =$ 500 volts — A-144

41. $I = \frac{E}{R} = \frac{150}{15,000} =$ .01 amperes or 10 ma. — A-144

42. $R = \frac{E}{I} = \frac{120}{6} =$ 20 ohms — A-144

43. $P = I \times E = 10 \times 240 =$ 2400 watts — A-154

44. $E = \frac{P}{I} = \frac{1600}{8} =$ 200 volts — A-154

45. $I = \sqrt{\frac{P}{R}} = \sqrt{\frac{1}{10,000}} = \frac{1}{100} =$ .01 amperes or 10 ma. — A-154

46. $I = \frac{E}{R} = \frac{60}{60} = 1$ amp.

$E = I \times R = 1 \times 45 =$ 45 volts — A-147

47. $R_T = \frac{E}{I} = \frac{500}{5} = 100$

$R_3 = R_T - (R_1 + R_2) = 100 - (10 + 30) =$ <u>60 ohms</u> A-147

48. $I_3 = I_T - (I_1 + I_3) = 10 - (5 + 1) =$ <u>4 amperes</u> A-147

49. $\frac{1}{R_T} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}} = \frac{1}{\frac{1}{100} + \frac{1}{200} + \frac{1}{400}} = \frac{1}{\frac{4 + 2 + 1}{400}} = \frac{1}{\frac{7}{400}}$

$R_T =$ <u>57 ohms</u> A-149

50. <u>8651 K.W.H.</u> A-254

51.
$$\begin{aligned} 50 \times .04 &= \$2.00 \\ 50 \times .033 &= 1.65 \\ 50 \times .03 &= 1.50 \\ 111 \times .0225 &= 2.4975 \\ \text{fixed} &= .60 \\ \hline & \$8.2475 \text{ or } \underline{\$8.25} \end{aligned}$$
A-255

52. $P = I^2R = (.01)^2 \times 15,000 = .0001 \times 15,000 =$ <u>1.5 watts</u> A-154

53. $\text{eff} = \frac{\text{output}}{\text{input}} = \frac{2,000}{2,200} =$ <u>90.9%</u> B-391

54. $\frac{1}{2} \times .746 =$ <u>.373 KW</u> B-391

55. $P = \frac{E^2}{R} = \frac{120^2}{100} = \frac{14400}{100} =$ <u>144 watts</u> A-154

56. <u>27.5 volts D.C.</u> A-244

Appendix C

APPLIED ELECTRICITY
COMPREHENSIVE FINAL EXAMINATION

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Electrons go from minus to plus in the external circuit of a battery.

T F 2. A voltmeter is ordinarily connected in parallel with the device being measured.

T F 3. An ohmmeter should never be connected in a circuit with the power turned on.

T F 4. Permanent magnets should be stored with like poles together.

T F 5. The total resistance of a series circuit is equal to the sum of the individual resistances.

T F 6. Brass makes a good permanent magnet.

T F 7. The total voltage in a series circuit is the same as the sum of the voltage drops across the components.

T F 8. The magnetic north pole and the geographic north pole are at the same location.

T F 9. A fuse is a device that operates on the principle that current flowing through resistance creates heat.

T F 10. The total power in either a series or parallel circuit is equal to the sum of the component power consumptions.

Multiple-Choice

Directions: Select the best answer to complete each of the following statements and place the letter of it in the blank at the left.

_____11. A person went to the store to buy 50 feet of #14 AWG conductor. No wire gage was available. It was known the stock contained four sizes of wire--numbers 10, 12, 14, and 18. Which of the following diagrams represents the correct selection?

A. o B. O C. O D. O

_____12. While on an automobile trip, your car is forced off the road into a power pole which breaks. It appears a wire may be resting on the roof of the car. You and your passengers should:

A. Jump out of the car and get help.
B. Take a piece of wire or other metal and place it between the car and the ground and step out.
C. From the information given it should be safe to step out of the car.
D. Remain in the car until help from the power company arrives.

_____13. The visible light emitted by a flourescent lamp is obtained:

A. Directly from the ultra-violet rays within the lamp.
B. From the glow of the lamp filaments.
C. From the ultra-violet rays striking the phosphor coating.
D. From the chemical action as the neon lights up.

_____14. Which of the following are most permeable?

A. Air
B. Brass
C. Copper
D. Steel

_____15. The property of a device or circuit to store electricity is called:

A. Impedance
B. Reactance
C. Capacitance
D. Inductance

_____16. To control a ceiling light from two places one should use:

A. Two three-way switches.
B. Two four-way switches.
C. One three-way and one four-way switch
D. Two two-way switches.

_____17. Resistance wires used in electric heating devices are often made from:

A. Silver
B. Copper
C. Aluminum
D. Nichrome

_____18. Copper wire is measured by the:

A. American wire gage
B. Birmingham wire gage
C. United States standard gage
D. Music wire gage.

_____19. What type(s) of modulation is (are) used for television?

A. Amplitude modulation
B. Frequency modulation
C. Pulse modulation
D. Amplitude and frequency modulation

_____20. If coil "A" has 500 turns and .1 amperes flowing through it and coil "B" has 250 turns with .2 amperes flowing through it, the relative field strength of coil "A" will be:

A. Twice the strength of coil "B".
B. The same strength of coil "B".
C. One half the strength of coil "B".
D. Three tenths the strength of coil "B".

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

21. An ammeter is always connected in _____ with the device being measured.

22. As a result of the electrons and ions striking the electrodes in a neon lamp, with enough force to free electrons, the current strength is _____.

23. Conductance is measured in _____.

24. An example of a (an) _____ circuit would be a lamp with a broken filament.

25. The prefix _____ signifies the value 1/1000.

26. When transmitting power over long distances, high voltage is used to reduce _____ _____.

27. When a circuit is complete, it is called a _____ circuit.

28. If one shunts a device, he connects something in _____ with it.

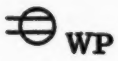
29. A VOM is a _____.

30. The total current in a _____ circuit is the sum of the individual currents.

Identification

Directions: Identify the following symbols by placing the name of the device in the blank beside the symbol.

31. _____

32.  _____

33. _____

34. S_3 _____

35. _____

36. _____

37. _____

38. S_4 _____

39. _____

40.

_____

Matching

Directions: The left column lists several electronic devices. The right column shows the schematic symbols for several electronic devices. Place the letter of the correct symbol in the blank beside the named device.

_____ 41. Transformer

_____ 42. Coil with air core

_____ 43. Capacitor, fixed

_____ 44. Capacitor, variable

_____ 45. Potentiometer

_____ 46. Resistor, fixed

_____ 47. Crystal diode

_____ 48. Voltmeter

_____ 49. Electron tube

_____ 50. Ballast

A.

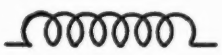
B.

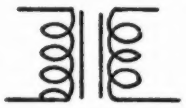
C.

D.

E.

F.

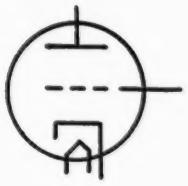
G. 

H. 

I.

J.

K.

L. 

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

Three sources of electrical energy are piezoelectricity, friction and direct nuclear conversion. List four other sources.

51. _____

52. _____

53. _____

54. _____

List the three most commonly used electrical splices.

55. _____

56. _____

57. _____

There are four essential parts to any radio receiver. One of these is a reproducer. What are the other three?

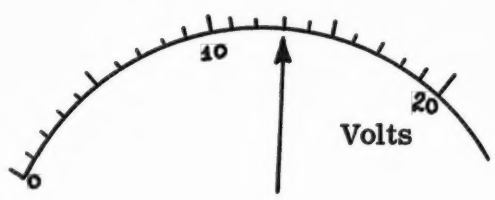
58. _____

59. _____

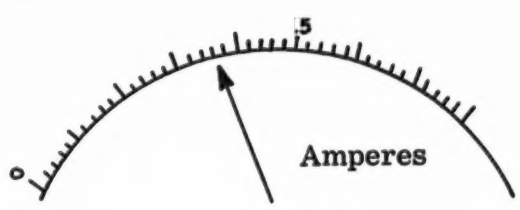
60. _____

Performance

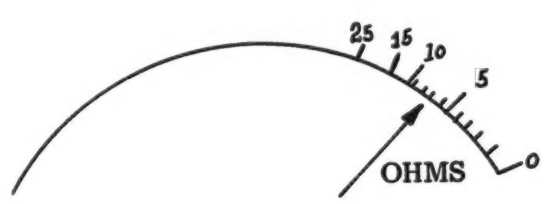
Directions: Read each of the following meter scales and record the value in the appropriate blank. Use the mark nearest the pointer.



61. _____ volts



62. _____ amperes



63. _____ ohms

A person complained of getting a shock from an electric motor. What would you suspect is the trouble

64. _____

What would you use to test your theory stated above?

65. _____

Procedure

Directions: List in order of sequence the operation of a glow switch start fluorescent lamp. Place the proper letter beside the number.

_____ 66.	(1)	A. Ionization of neon gas
_____ 67.	(2)	B. Ionization of mercury vapor
_____ 68.	(3)	C. High induced voltage from ballast
_____ 69.	(4)	D. Heating of bimetalic strip
_____ 70.	(5)	E. Cooling of bimetalic strip

Problems

Directions: Read each of the problems below carefully and solve. Show all work performed to arrive at your answer in the space provided. Label your solution (Ans.).

71. What is the resistance of a device that has a current flow of 5 amperes when connected across 120 volts?

72. What power is consumed by a device drawing 10 amperes when the e.m.f. is 50 volts?

73. What is the total resistance of three 90 ohm resistors connected in parallel?

74. How much current flows through a 5,000 ohm resistance connected across 100 volts?

75. What would be the voltage drop across a 600 ohm resistor connected in series with two other 600 ohm resistors? The total voltage is 30 volts.

APPLIED ELECTRICITY

Key for Comprehensive Final Examination

Key to References:

A. Buban, Peter, and Schmitt, Marshall L. Understanding Electricity and Electronics
B. Marcus, Abraham, Basic Electricity

True-False

1. T - A-122
2. T - A-241
3. T - A-243
4. F - A-164
5. T - A-147
6. F - A-165
7. T - A-146
8. F - A-167
9. T - A-37
10. T - A-148, 154

Multiple-Choice

11. B - A-Backcover
12. D - Film-"My Pop's a Lineman"
13. C - A-198
14. D - A-165
15. C - A-138
16. A - A-269
17. D - B-256
18. A - A-Inside back cover
19. D - A-351
20. B - B-69

Completion

21. series - A-239
22. increased - Turner-64
23. mhos - Turner-36
24. open - Turner-42
25. milli - A-122
26. power loss - A-363, Turner-42
27. closed - A-18, Turner-42
28. parallel - B-86
29. volt-ohm-milliammeter - A-244
30. parallel - A-148

Identification

31. duplex convenience outlet
32. weatherproof convenience outlet
33. range receptacle (outlet)
34. three-way switch
35. push button
36. buzzer
37. telephone
38. four-way switch
39. recessed fixture
40. clock receptacle (outlet)

All these symbols are given inside the back cover of Buban and Schmitt.

Matching

41. H
42. G
43. A
44. B (backward in Buban and Schmitt)
45. E
46. C
47. J
48. K
49. L
50. I - B-288

These symbols are given inside the front cover of Buban and Schmitt.

Listing

51. heat - A-231
52. light - A-228
53. chemical - A-208
54. mechanical - A-219

55. pigtail - A-81
56. tap - A-81
57. Western Union - A-81
58. antenna-ground - A-317-325
59. tuner - A-317-325
60. detector - A-317-325

Performance

61. 13 volts - A-242
62. .36 amperes - A-240
63. 7 ohms - A-244
64. winding shorted to frame } {Information sheet with
65. voltmeter, ohmmeter, or megger } {job assignment 22

Procedure

66. A
67. D
68. E
69. C
70. B B-289

Problems

71. $R = \frac{E}{I} = \frac{120}{5} =$ 24 ohms A-144

72. $P = I \times E = 10 \times 50 =$ 500 watts A-154

73. $R_T = \frac{R}{N} = \frac{90}{3} =$ 30 ohms A-148

74. $I = \frac{E}{R} = \frac{100}{5000} =$ .02 amperes or 20 ma. A-144

75. $\frac{1}{3} \times 30 =$ 10 volts A-147

Appendix D

APPLIED ELECTRICITY

Resistance of Soft Annealed Copper Wire (20 degrees C.)

B. & S. gage No.	Diameter in Mils d	Area in Circular mils d^2	Ohms per 1000 ft.	Pounds per 1000 ft.	Amperes for Rubber Covered Wire
				Bare	
0000	460.00	211,600	0.04893	640.5	195
000	409.64	167,810	0.06170	508.0	
00	364.80	133,080	0.07780	402.8	
0	324.86	105,530	0.09811	319.5	125
1	289.30	83,694	0.1237	253.3	110
2	257.63	66,373	0.1560	200.9	95
3	229.42	52,634	0.1967	159.3	
4	204.31	41,742	0.2480	126.4	70
5	181.94	33,102	0.3128	100.2	
6	162.02	26,250	0.3944	79.46	55
7	144.28	20,816	0.4973	63.02	
8	129.49	16,509	0.6271	49.98	40
9	114.43	13,094	0.7908	39.63	
10	101.89	10,381	0.9972	31.43	30
11	90.742	8,234.0	1.257	24.93	
12	80.808	6,529.9	1.586	19.77	20
13	71.961	5,178.4	1.999	15.68	
14	64.084	4,106.8	2.521	12.43	15
15	57.068	3,256.7	3.179	9.858	
16	50.820	2,582.9	4.009	7.818	10
17	45.257	2,048.2	5.055	6.200	7
18	40.303	1,624.3	6.374	4.917	5
19	35.890	1,288.1	8.038	3.899	
20	31.961	1,021.5	10.14	3.092	
21	28.462	810.10	12.78	2.452	
22	23.347	642.10	16.12	1.945	
23	22.571	509.45	20.32	1.542	
24	20.100	404.01	25.63	1.223	
25	17.900	320.40	32.31	0.9699	
26	15.940	254.10	40.75	0.7692	
27	14.195	201.50	51.38	0.6100	
28	12.641	159.79	64.79	0.4837	
29	11.257	126.72	81.70	0.3836	
30	10.025	100.50	103.0	0.3042	
31	8.928	79.70	129.9	0.2413	
32	7.950	63.21	163.8	0.1913	
33	7.080	50.15	206.6	0.1517	
34	6.305	39.75	260.5	0.1203	
35	5.615	51.52	328.4	0.0954	
36	5.000	25.00	414.2	0.0757	

Heavy Forvar Copper Wire Table (at 20 degrees C)

B & S Gage. No.	Nominal Diameter, inches	Pounds Per 1,000 feet	Ohms per pound	Feet per pound	Turns per square inch	Area in Circular mils
8	.1324	50.8	.01238	19.7		16,509
9	.1182	40.4	.01964	24.9		13,094
10	.1056	31.9	.03127	31.4		10,381
11	.0943	25.3	.04977	39.5		8,234
12	.0842	20.0	.07940	50.0		6,530
13	.0753	15.9	.1256	62.9		5,178
14	.0673	12.6	.2007	79.3		4,107
15	.0602	10.05	.3167	99.0		3,257
16	.0539	7.98	.5032	125.	340	2,583
17	.0483	6.34	.7986	158	425	2,048
18	.0432	5.02	1.272	199	530	1,624
19	.0387	4.00	2.013	250	660	1,288
20	.0346	3.17	3.201	315	800	1,022
21	.0310	2.51	5.099	398	990	810
22	.0277	1.99	8.110	503	1,200	642
23	.0249	1.58	12.89	633	1,500	510
24	.0224	1.26	20.37	794	1,820	404
25	.0201	.998	32.43	1,000	2,200	320
26	.0180	.793	51.46	1,260	2,700	254
27	.0161	.630	81.68	1,580	3,300	202
28	.0144	.501	129.5	2,000	4,000	160
29	.0130	.396	206.6	2,520	4,700	127
30	.0116	.316	326.6	3,160	5,500	101
31	.0105	.251	518.3	3,990	6,500	80
32	.0095	.198	829.7	5,050	7,700	63
33	.0085	.158	1,309.5	6,330	9,000	50
34	.0075	.126	2,070.5	7,940	10,500	40
35	.0067	.0996	3,303.2	10,050	12,500	32
36	.0060	.0791	5,243.9	12,650	14,900	25

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ED013339

MERCHANDISING GROUP INSTRUCTION

A Course of Study

Designed for

Students preparing for

or presently employed in Distributive Occupations

Issued by

Department of Industrial Education
College of Education
University of Missouri
Columbia, Missouri

In Cooperation with

Vocational Education Division
State Department of Education
Jefferson City, Missouri

VT002040

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MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
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(Address) 103 Industrial Education Bldg., Columbia, Missouri

DATE: July 10, 1967

RE: (Author, Title, Publisher, Date) Industrial Education Dept., MERCHANDISING, GROUP INSTRUCTION, cooperatively with Industrial Education Dept. and Missouri State Dept.of Education, (1966).

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Occupational Focus job cluster
Geographic Adaptability United States
Uses of Material Study Guide for related instruction
Users of Material students

(4) Requirements for Using Material:
Teacher Competency Qualified teacher of distributive education
Student Selection Criteria Junior in high school with exploratory course in general business and salesmanship
Time Allotment 180 hours

Supplemental Media --
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Desirable ____ (Check Which)

Describe Instructor's guide @ $.50 Answer Key?

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FOREWORD

This course of study contains an analysis of MERCHANDISING together with assignment sheets designed for group instruction covering the related information taught in preparatory distributive education programs.

The assignment sheets were prepared by Mr. Robert F. Johnson while a graduate student in Industrial Education. The original analysis along with the completed format and the compilation of materials were prepared by Mr. Roy P. Roberson, Research Assistant in Industrial Education, University of Missouri.

Credit is also due Mr. Lester B. Kesterson, Director of Cooperative Industrial and Distributive Education, State Department of Education, for guidance and assistance in preparing the distributive education series, of which this is a part.

We wish to acknowledge our indebtedness to Dr. H. H. London, Professor of Industrial Education at the University of Missouri, for the direction and administration of the Curriculum Materials Laboratory in which this material was prepared, and to Mr. James B. Karnes, Instructor in Industrial Education at the University of Missouri, who supervised the preparation of the material and edited the manuscript. Credit is due to Mr. B. W. Robinson, Assistant Commissioner of Education, Mr. Merton Wheeler, Director of Industrial Education, and to other staff members of the State Department of Education for their efforts in the development of the Industrial Education Curriculum Series of which this course of study is a part.

HUBERT WHEELER

Commissioner of Education

November, 1965
1,500

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Training Plan and Progress Record

INTRODUCTION

In preparing this course of study, it has been assumed that the attainment of occupational competency in any type of work involves three different, yet closely related, types of learning.

1. Mastery of the practical Job Skills and Procedures performed by the worker in the occupation.

2. Comprehension of the Technical and Related Information basic to an intelligent understanding and practice of the occupation.

3. Development of those Personal-Social Traits which are essential for the successful worker.

The first group of these "units for learning"--the job skills and procedures--has been arranged in the analysis section under the heading of "Job Training." The second group of learning units--the technical and related information--has been arranged under the heading of "Related Information." The third group--personal-social traits-- has been listed under "Personal Qualifications" in the introductory section addressed to the student.

In a cooperative educational program it is necessary for both cooperating agencies, the school and the employer, to understand clearly just what each is to be responsible for in the training of the student-worker. Experience has shown that most of the practical job skills and procedures of an occupation can best be learned through supervised work on the job. Experience has shown also that the school can best teach most of the technical and related occupational information needed by young student-workers. This division of responsibility has been made in the arrangement of the course of study; that is, it is expected that the student-worker should master the job skills and procedures through practical work on the job under the immediate supervision of the employer, and that he will receive instruction in related occupational information in the school under the direction of the coordinator.

The last section of this course of study contains three copies of a TRAINING PLAN and PROGRESS RECORD for RETAIL MERCHANDISING. One copy is market "Student" in the upper right corner. With this copy, in the space marked Time in Hours, the student will keep a tally of the hours he spends on his job performing operations in each of his training areas. The next copy marked "Employer" should be given to the employer for recording the student's job performance in each area. The third copy may be used by the coordinator for his record.

Skills and information related to the student's job can be taught through direct instruction. But personal-social traits are acquired only through practicing them during the process of acquiring skills and information and in one's daily conduct. Therefore, both the employer and the school, as well as the home, must assume responsibility

for developing in the student-worker those habits, attitudes and character traits which are essential for success in his occupation and in life. Both the employer and the school should be constantly on the alert to see that the student-worker places desirable interpretations on his experiences and that he does not practice habits and exhibit character traits detrimental to his success in life and on the job.

Since a coordinator's class is usually made up of fifteen or more students, each differing from the other significantly, and possibly studying a dozen or more occupations which differ markedly in their requirements, it follows that it will be impossible for a coordinator to teach, through the group method, the occupational information which relates to the specific job of each student-worker. In order to be effective, this type of instruction must be individualized. There is, of course, some related information, such as occupational health and safety, workman's compensation, wage-hour laws, fair labor standards, unemployment compensation, and the like, which is of common interest and concern to all student-workers, and may be effectively taught by the group method. However, if a coordinator is to make an optimum contribution to the in-service vocational education of his students, he must devote a large portion of his classroom instruction to content which deals specifically with the occupation of each boy and girl in his program.

Obviously, it is desirable to teach related information in school at the time it will be used most advantageously on the job. This means that the two phases of the student-worker's training should parallel each other in a progressive manner. The coordinator will find the assignment sheets in this study guide well adapted to this end. He can select from day to day the assignment which covers the informational units related to the work the student is doing on the job. With this arrangement, the coordinator will be able to serve, during a major portion of his classroom time, as a supervising study and helping teacher for a variety of occupations.

Your attention should be called to the fact that there are <u>two types of retail merchandising study guides available</u>. Both types cover the identical material, but each is designed for a different purpose. Although both types require the same reference materials, one is designed for individual study, while the other is designed for group discussion as their titles indicate. This study guide, <u>Merchandising Group Instruction</u>, has been developed with essay type questions which lend themselves well to group instruction. The other study guide, <u>Merchandising Individual Study</u>, utilizes objective type questions and is designed for guiding a student's study on an individual basis.

A coordinator who has students in distributive occupations, as well as trade, industrial, or service occupations represented in his class, might choose to utilize the study guide with objective type questions for directing the related study of D.E. students. In a class consisting solely of students in distributive occupations, a coordinator might elect to use the study guide with discussion type questions for group teaching purposes. EACH STUDY GUIDE HAS THE SAME CONTENT COVERING THE SAME READING ASSIGNMENTS DIFFERING ONLY IN THE DESIGN OF THE QUESTIONS AND THE PURPOSE FOR WHICH THEY ARE INTENDED.

Each of the two study guides contains certain record data such as; numbers and range of units covered by each assignment; introductory paragraphs designed to develop interest and explain the importance of the assignment, and to convey to the student what he is expected to learn; specific reference readings; activity assignments; and a series of questions designed to check student attainment. If a coordinator uses the discussion type study guide for his students, he will find that the study guide with objective questions serve as excellent objective type test material for the corresponding discussion material covered.

In selecting books for this course of study, an effort was made to restrict their number, yet adequately cover the subject of retail merchandising. Only those references with the most recent publication date were selected so that current information and practices can be consistently presented. Possibly, older copies of the references could be used. However, both the study guides are written for use with, and are keyed to, the particular editions listed on the reference page.

Keys for the study guide assignments are available in a separate manual. They have been prepared to enable the coordinator to score quickly the questions included in each assignment. The key gives the correct answers to the questions, as well as the reference and the page on which each answer can be found. The key manual is bound under cover separate from each study guide so the coordinator may keep it apart from student use.

TO THE STUDENT-WORKER

In past years many workers, especially youth, have entered the retail trades largely by chance. Few have chosen the vocation as a result of definite investigation and planning. Now, however, retail merchandising has progressed as a field of employment to the point where it is advantageous to make systematic preparation if one wishes to enter and advance in these occupations. By far, a greater number of employment opportunities are open to younger people in the various phases of retail business; therefore, to help them become more able to make a wise occupational choice, it is important that certain high school students have an opportunity to learn something while in school about the kind of work they would like to do.

The primary purpose of this course of study is to provide a guide for instruction through which students may gain certain basic knowledge and training in the field of retail merchandising. This material is designed to help the Distributive Education student acquire knowledge about retail merchandising that will help him, if properly applied to the job, get off to a good, solid, successful start in the field. Students who have had considerable work experience should also find this course interesting and helpful since it covers several phases of retail merchandising such as locating and purchasing merchandise, preparing goods for display, and selling to the consumer.

In just about any occupation it is impossible to do a good job unless one has the proper physical and mental tools needed and unless scientific methods are used in performing the tasks of that occupation or profession. Retailers, as well as people in the professions, have specific tools to be used and definite methods of using them to achieve a profitable store operation.

The attainment of occupational competency in any type of work involves three different, yet closely related, types of learning:

1. Mastery of the practical job-skills and procedures performed by the worker in the occupation.

2. Comprehension of the technical and related information basic to an intelligent understanding and practice of the occupation.

3. Development of those personal-social traits which are essential for successful workers.

Job-skills and procedures will mostly be taught by your employer on the job. Some of the fundamental principles and procedures of your occupation can be acquired from class instruction. Specific technical and related information required in your occupation will be taught both by group methods and individual study. The assignments

in this study guide are directed to the related information fundamental to successful performance of duties in retail merchandising. Therefore, this material is broad and basic to the particular field.

Personal-social traits may be developed as a result of your classroom instruction and your employer's teaching. Desirable personality traits are of extreme importance for success in life. They are the factors by which one primarily is judged when meeting people and when attempting to obtain a job. They are vitally important in holding a job. In fact, studies reveal that the chief cause of ninety per cent of the persons being discharged from their jobs is due to a lack of desirable personal-social traits, while only ten per cent of the discharges are the result of a lack of skills. It should be noted, however, that without job skills it is exceedingly difficult to find employment.

The following are some of the more important personal-social traits that a retail merchandising student should possess:

Personal Cleanliness. Dirty hands or clothing repel customers.

Good Health. Retail merchandise work requires abundant energy, and the ability to stand on one's feet for long hours. A student-worker must have no health problems that are offensive to customers.

Pleasing Personality. People employed in retail merchandising must be pleasant to meet, approachable, emotionally stable, and have a sense of humor.

Courtesy. The practice of being polite, considerate, and sympathetic to others will pay dividends in any business, especially in the field of retailing.

Attentiveness. The ability to pay close attention, to respond quickly and to concentrate on his work is essential to the student in retailing.

Cooperation. The ability and disposition to work harmoniously with others, to be helpful, and to do one's share are necessities.

Honesty. A salesman must give full value for every cent he receives from his customers--workers in all phases of retail activity must be accurate in giving merchandise information at all times.

Initiative. The ability to see things that need to be done and to keep busy doing them without constant supervision is one of the most marketable traits of a retail employee.

REFERENCES

A. Wingate, John W. and Weiner, J. Dana, Retail Merchandising, South-Western Publishing Company, 5101 Madison Road, Cincinnati 37, Ohio, Sixth Edition, 1963. $4.64* (11)**

B. Richert, Meyer, and Haines, Retailing Principles and Practices, Gregg Publishing Division, McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 34, New York, Fourth Edition, 1962, $5.76* (9)**

C. Wingate, John W. and Nolan, Carroll A., Fundamentals of Selling, South-Western Publishing Co., 5101 Madison Road, Cincinnati 37, Ohio, Eighth Edition, 1964, $4.12* (5)**

As indicated by the frequency of use numbers above(numbers in parentheses) all three references are important as reference material for use with this particular study guide. Reference A, Retail Merchandising, is the priority text to be used when working the assignments. Where B and C references are recommended, they are essential if a student is to be able to adequately cover the assigned material and answer the study guide questions. To prevent gaps in student progress through this study guide, use of all three texts is necessary.

Both reference B and C, same editions, are used with the Salesmanship Group Instruction and Salesmanship Individual Study Study Guides, other publications in the Preparatory Distributive Education Series published by the Department of Industrial Education at the University of Missouri.

* Subject to educational discount
** Frequency of use for assignments

ANALYSIS OF
MERCHANDISING

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What The Worker Should Know
Fundamentals of Retailing		
	1 1.	Competition in our economy
	1 2.	Elements of our private enterprise economy
	1 3.	Importance of the consumer
	1 4.	Consumer assistance through governmental and other organizations
	1 5.	Producer and manufacturer in our economy
	1 6.	Mass production in our way of life
	1 7.	Functions of wholesalers and retailers in the business world
	1 8.	Methods of retail selling
	1 9.	Reasons for retail business failures
	1 10.	Retailing in relation to changing times
	1 11.	Types of small-scale retail outlets
	1 12.	Types of retail businesses operated on a large-scale basis
	1 13.	Principles of supermarket operation
	1 14.	Factors essential to discount store operation
	1 15.	Principles of chain store operation
	1 16.	Advantages and disadvantages of individual proprietorship type businesses
	1 17.	Advantages and disadvantages of a partnership
	1 18.	Advantages and disadvantages of the corporate form of business ownership
	1 19.	Basic activities in carrying on a retail business
	1 20.	Latest merchandising techniques
	1 21.	Developments and trends in retail business

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What The Worker Should Know
Buying for Consumer Demand		
22. Identify regular customers	2	22. Benefits of having a regular clientele
23. Determine customer demand		
24. Conduct and analyze a customer survey		
25. Conduct a comparison shopping survey	2	25. Values of comparison shopping
26. Interpret market information	2	26. Sources of information available for studying markets
27. Identify the latest styles and fashions	2	27. Importance of styles and fashions to the sale of merchandise
28. Plan fashion assortments to stock	2	28. Various phases of the fashion cycle
29. Analyze customer fashion preferences	2	29. Where buyers get fashion information
30. Plans for buying staple goods	2	30. Factors affecting staple goods demand
31. Recommend needed private brands of merchandise	2	31. Advantages and disadvantages of stocking private branded merchandise
32. Plan specifications for manufacture of merchandise	2	32. Large chain organizations buy specification merchandise
33. Prepare a buying plan for a season	2	33. Buying plans are important instruments
34. Classify merchandise into types		
35. Determine demand for color, price, and size merchandise	2	35. Factors affecting color, price, and size merchandise assortment
36. Ascertain and evaluate new merchandise items		
Responsibilities of A Store Buyer		
37. Identify buying channels	3	37. Channels through which buyers make market contact
	3	38. Functions of a resident buying office
	3	39. Factors to consider in deciding where to buy
	3	40. Rules to follow in deciding what to buy
	3	41. Store requirements for selecting a new item

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What The Worker Should Know
42. Assist the buyer in making purchases	3	42. Fundamentals of buying
	3	43. Proper conduct for the buyer
44. Identify the specific function of the store buyer	3	44. Function of a store buyer
	3	45. Specific duties of a buyer
46. Estimate merchandise quantity to buy		
47. Make up a basic stock list	3	47. Values of a basic stock list
48. Determine prices to pay for merchandise	4	48. Current market prices
49. Bargain for prices		
50. Figure discounts on purchases	4	50. Discounts available from different supply sources
51. Figure credit terms from suppliers	4	51. Best credit and shipping terms available
52. Figure shipping costs	4	52. Best methods of shipment for merchandise
	4	53. Special buying arrangements and allowances
Handling Incoming Merchandise		
54. Determine suitable transportation for shipments	5	54. Methods of handling incoming merchandise
55. Check incoming merchandise	5	55. Methods of checking and inspecting incoming merchandise
56. Mark goods with prices	5	56. Store methods used to price goods
57. Interpret information found on store retail price tickets	5	57. Fundamentals of price ticket coding
58. Arrange, store and locate stock in the storage room	5	58. Conditions under which certain stock should be stored
59. Display forward store	5	59. Advantages of a good forward stock arrangement
60. Interpret an invoice	5	60. Various methods of invoice control
61. Route shipments of incoming merchandise	5	61. Importance of proper routing for shipments
62. Figure retail prices	5	62. Elements of store expense
63. Figure stock turn	5	63. Why a fast stock turn is desirable
64. Set up a unit and/or a dollar stock control	5	64. Advantages of good stock control
65. Interpret stock control information	5	65. Obtain stock control information

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What The Worker Should Know
Pricing for Profits		
66. Figure markdowns on retail prices	6	66. Causes of markdowns
67. Figure mark-ups on retail prices	6	67. Fundamentals of planning initial mark-up
68. Interpret consumer demand	6	68. Purposes of figuring the demand factor into pricing
69. Analyze business conditions and recommend mark-ups	6	69. Conditions justifying a high and a low mark-up
70. Analyze prices in relation to store overhead	6	70. Factors that determine the retail price of an article
71. Identify goods to be used as loss leaders and merchandise premiums	6	71. Methods of using loss leaders and premium merchandise
72. Coordinate the buying function with other store activities	6	72. Reasons why buying has to be coordinated with other store activities
73. Evaluate various price lines of merchandise	6	73. Determining the best price line to carry
74. Analyze and apply store price policies	6	74. Advantages of having price policies
Selling to Customers		
	7	75. Types and functions of non-personal selling
	7	76. Duties of the salesperson
77. Work as a salesperson in various departments	7	77. Steps involved in making a sale
78. Meet customer objections to buying merchandise		
79. Make sales and properly record them		
80. Identify various type customers	7	80. Psychological buying motives of customers
81. Suggest additional merchandise to fill customer needs	7	81. Utilizing suggestion selling
	7	82. Benefits of suggesting additional merchandise
83. Interpret the various buying stages a customer goes through	7	83. Buying decisions customers have to make
84. Record sales on a cash register		
85. Return change to customer		
86. Write up charge sales		
87. Utilize store wrapping service	8	87. Store objectives of a wrapping service

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What The Worker Should Know
88. Employ proper telephone sales manners and techniques	8	88. Telephone selling
89. Work as a member of the sales team	8	89. Importance of the sales force working as a team
90. Solve sales problems to the store's and customer's advantage	8	90. Problems that might arise on the selling floor
91. Identify the various steps involved in making a sale	8	91. Basic types of sales transactions
92. Check the cash register for proper change level	8	92. Check change in the cash register
93. Identify customers and have checks approved for cashing	8	93. Store policies on accepting checks
Advertising and Displaying Merchandise		
94. Interpret store advertising	9	94. Purposes of retail advertising
95. Plan store advertising		
96. Determine goods that should be advertised		
97. Choose appropriate advertising media		
98. Write advertising headlines and copy	9	98. Rules for writing headlines and copy
99. Build and tie in store displays with the overall store promotion theme	9	99. Objectives of store display
100. Build an appropriate window display	9	100. Principles of window display
101. Build interior displays	9	101. Factors involved in setting up interior displays
	9	102. Effective use of colors in display work
103. Analyze promotional advertising	9	103. Forms of promotional advertising
Keeping Records and Controlling Stock		
104. Analyze and utilize store records for the buying and merchandising process	10	104. Phases of retail record keeping
105. Assist in taking a full store inventory		
106. Analyze stock control methods	10	106. Advantages and disadvantages of various stock control methods

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What The Worker Should Know
107. Identify causes for stock shortages	10	107. Reasons for stock shortages
108. Interpret a balance sheet and a profit and loss statement	10	108. Uses of a balance sheet and a profit and loss statement
109. Forecast the needed type, style, and amount of stock	10	109. Importance of stock planning forecast and control
110. Compute stock turn for various departments		
111. Plan for greater stock turn results	10	111. Effect of stock turn on profits
112. Suggest needed price changes on merchandise		
113. Identify slow-moving stock	10	113. Methods of moving slow-selling merchandise
114. Draw a store organizational chart		
	10	115. Management uses of store capital
116. Interpret store financial information	10	116. Management's need and use for store financial information
117. Bill customers	10	117. Methods of billing customers
118. Interpret the various phases of bookkeeping	10	118. Requirements of a good bookkeeping system
Observing Government Regulations		
119. Identify imposed government regulations	11	119. Government regulations in the distribution of goods
	11	120. Reasons for increased government regulation
121. Interpret employee benefits derived from government regulations	11	121. Government regulations of working conditions
	11	122. Government regulations on prices
	11	123. Advantages and disadvantages of resale price maintenance laws
	11	124. Regulations on merchandising
	11	125. Regulations on advertising and selling
	11	126. Tax regulations for business

Assignment Sheet No. 1 | Covering Units 1-21

FUNDAMENTALS OF RETAILING

Retailing is the function of selling goods to the consumer profitably, of maintaining the most advantageous proportion between sales, stocks and profits, and of controlling the relations between purchases and estimated future sales. It is the last link in the process of distributing the producer's goods to the consumer and is one of the most important fields of work in the United States today. Retailing is the third largest industry in our country. One out of every seven persons gainfully employed works in some phase of retailing. In this important, vital field, there are unlimited opportunities for advancement and success for the person who desires to succeed and has a willingness to work and learn.

Wants and needs are much different today for Americans as compared to those of thirty to forty years ago. Modern retail stores reflect these changes and will continue to meet new needs with stocking new products, developing new merchandising techniques and providing the necessary customer services. Whether a store is large or small, retailing functions are basically similar. Retail businesses must effectively merchandise their goods if they are to meet customer demands and operate successfully.

In this assignment you will study the importance of retailing in the economy, types of retail stores, and the methods of selling used for different kinds of merchandise.

Assignment:

1. Read the references listed below.
2. List the nine types of small scale retail concerns and the five large scale retailing concerns given in your text, and select a local business in your community as an example of each.
3. Answer the questions below and turn in this assignment by _____.

References:

A. Wingate and Weiner, Retail Merchandising, Sixth Edition, 1963, pp. 2-66.
B. Richert, Meyer and Haines, Retailing Principles and Practices, Fourth Edition, 1962, pp. 7-14.

Questions:

1. What are the major differences between the consumer of today and the consumer of the past?

2. Discuss the different classes of customers the retailer must seek to please.

3. What are the different age groups of consumers that the retailer must consider?

4. Explain why even now consumers must continue to receive consumer education.

5. How is it possible for small retailers to hold their own in this increasingly mass production-mass distribution economy with increasingly selective consumers?

6. How has competition in retailing promoted a "profit squeeze"?

7. Compared to business today, what major changes are expected to come about in retailing within the next few decades?

8. Explain the three weapons that small retailers may use to combat their domination by large-scale retailers...
   a. specialization
   b. personal service
   c. convenience of location

9. Discuss how downtown department stores are attempting to maintain their portion of the buying public in the face of the suburban movement and the success of discount houses.

10. What are the advantages of mail-order type retailing?

11. What effect has self-service had on food stores and other retail establishments?

12. What are the two main types of shopping centers and why are they becoming more and more popular?

13. Which type of retailing is best, and what size store is most desirable?

14. What are the reasons for the rapid growth of discount houses in recent years?

15. In what fields do independent stores do the major share of business? Why?

16. What effect has the increase in mobility of our population had on the operation of retail stores?

17. How do consumer cooperatives distribute their earnings to their members?

18. It has been predicted that small retailers will eventually disappear. Do you believe this to be true? Defend your answer.

19. What are the features that have characterized the growth of the supermarket during the years since the great depression of the 30's?

20. What are the features of the discount store operation that have resulted in its phenomenal growth in the 1950's and 60's?

21. Discuss the advantages and disadvantages of an individual proprietorship in relation to: a partnership, a corporation.

22. Name the basic retailing activities and discuss the advantages of setting up a detailed organization of these activities in the case of a: a small scale retailer; large scale retailer.

23. In recent years many customers have become increasingly price conscious. Discuss what changes, if any, this has brought about in the operation of retail stores.

24. Nearly everyone is familiar with the two largest mail order houses--Sears, Roebuck & Co. and Montgomery Ward & Co. Discuss the extensive changes in the methods of operation these companies have undergone in the past 25 years.

25. Discuss the meaning of the following terms: (A) the specialty shop; (B) voluntary chain; (C) corporate chain; (D) consumer co-operative; (E) direct selling.

Assignment
Sheet No. 2

Covering
Units 22-36

BUYING FOR CONSUMER DEMAND

Many merchants have difficulty in buying correctly. There can be no such thing as an ideal stock because each one store has its own individual problems. A stock which in one store may be adequate to meet the varying demands of customers might be inadequate for another.

A careful study of market offerings, stock on hand, fashion desires of customers, and money available for purchases will provide the buyer with needed information for purchasing the adequate stock for his store.

This assignment presents many of the factors that a buyer must consider when purchases are to be made for his store.

Assignment:

1. Read the references listed below.
2. In a paper not exceeding three pages describe methods used to study customer demand and why it is important to consider customer demand in purchasing.
3. Answer the questions below and turn in this assignment by _____.

References:

A. Wingate and Weiner, Retail Merchandising, Sixth Edition, 1963, pp. 163-189.
B. Richert, Meyer and Haines, Retailing Principles and Practices, Fourth Edition, 1962, pp. 343-348.
C. Wingate and Nolan, Fundamentals of Selling, Eighth Edition, 1964, pp. 70-76.

Questions:

1. Briefly compare and contrast staple goods to fashion goods, convenience goods, and shopping goods.

2. Discuss the characteristics of staple goods and the factors a buyer should consider in drawing up a staple list.

3. What are the major advantages of having private brands?

4. What are the disadvantages of stocking private brands?

5. Discuss the problems that discount houses have in deciding whether to use private or national brands.

6. What are the sources of information a buyer might use when formulating a written buying plan?

7. Discuss why it is usually necessary to have an assortment of various prices within each classification of fashion goods.

8. What were the typical merchandise classifications given in your text?

9. How do chain stores such as J. C. Penny Co. and Sears, Roebuck and Co. go about setting up specifications for merchandise they buy?

10. Discuss the major ways to get information to determine what your customers want.

11. Name and discuss the ways different fashion cycles vary as to time.

12. Explain the different methods a retail buyer may use to determine the style preferences of his store's clientele.

13. Discuss how the model stock plan used in planning fashion assortments is organized.

14. Explain how a study of past sale records can aid in determining future customer demand.

15. Name and explain the different ways a retail store might conduct customer surveys.

16. What are the advantages to be gained by the study of trade papers and magazines?

17. How do substitution sales by the sales force affect the buyer's job?

18. Discuss how scientific developments and labor saving devices create new fashions.

Assignment
Sheet No. 3

Covering
Units 37-47

RESPONSIBILITIES OF A STORE BUYER

Basically, there are three main channels of purchasing open to buyers of retail stores. They are (1) display markets, (2) manufacture and wholesale salesmen, and (3) buying offices.

Due to economic conditions or to location of natural resources, various industries and markets have become centralized in different parts of the country. Many manufacturers and wholesalers display their goods in these centrally located display markets to which retail merchants can conveniently come to inspect and purchase goods. Some retailers find it most convenient to do a part of their purchasing from manufacturers who have a policy of dealing directly with the retailer through manufacture and wholesale salesmen. Large department stores do a large part of their purchasing through buying offices located in principal key cities. Smaller stores, to meet chain store competition, have been forced to associate themselves with such offices

The first step in profitable merchandising is wise buying. This assignment will explore the functions of the channels of purchasing available to the retail store.

Assignment:

1. Read the references listed below.
2. Select a type of retail store, then list the factors to consider in deciding on suitable suppliers of merchandise.
3. Answer the questions below and turn in this assignment by _____.

References:

A. Wingate and Weiner, Retail Merchandising, Sixth Edition, 1963, pp. 193-220.
B. Richert, Meyer and Haines, Retailing Principles and Practices, Fourth Edition, 1962, pp. 408-422.

Questions:

1. What factors determine the frequency of retail buying trips to a central market?

2. Discuss the various reasons a buyer might select certain sources of supply.

3. Give the factors a buyer should have in mind as he views a manufacturer's line of merchandise.

4. Give several of the major unethical practices a buyer should avoid.

5. The policy of group buying that is sometimes practiced by resident buying offices consists generally of what type procedure?

6. Discuss the following terms in relation to the aid that may be given a buyer in a retail store in making new market contacts: (a) trade papers, (b) trade directories, (c) comparison shopping, (d) trade shows, (e) market trips.

7. What are the advantages and the disadvantages of depending largely on traveling salesmen as the primary market contact?

8. Discuss the differences in the two distinct kinds of resident buying offices: (a) independent office, (b) store-owned office.

9. Since World War II, consumers have shown increasing interest in imported merchandise--discuss how a retail store buyer may use this to an advantage for his store.

10. Discuss the requirements a buyer should look for in considering a new item for his store.

11. Discuss the "don'ts" a buyer should avoid in selecting and purchasing goods for his store.

12. Name and explain the desirable qualifications of a retail buyer.

13. What are the factors a buyer must consider when buying in advance?

14. What is a merchandise plan?

15. What factors influence a merchandise plan?

16. Describe the aspects involved in controlling the merchandise plan.

17. Name and briefly describe the five items to be used as a guide in selecting merchandise.

18. Describe the services the buying office performs for a buyer in the market and his home store.

Assignment
Sheet No. 4

Covering
Units 48-53

NEGOTIATING FOR PRICE

When the buyer has decided that certain merchandise best fulfills his customers' needs, he must negotiate on a number of factors before a purchase agreement is made. A major element is the price of the merchandise. What the retailer actually pays for his merchandise, however, depends not only on the seller's list price but also upon the various discounts which may be secured.

The retailer is also interested in the period of time allowed for the taking of discounts and the date when the bill finally becomes payable, that is, the dating that may be obtained. These two elements-discounts and dating--are known as the "terms of sale".

Finally, negotiations may also take place over transportation charges. In this assignment we turn our attention to these various aspects of negotiations.

Assignment:

1. Read the reference listed below.
2. Answer the following, explain fully, and hand in by _____.
   a) Assume that merchandise shipped on May 15 was billed at $1,950 with terms of 2/10-30 extra, F.O.B. destination, and that the bill was paid on the day the cash discount expired. On what date was the bill paid and what was the amount of the check?
   b) Assuming the same terms and figures given in (a) above, plus the fact that anticipation was allowed, what amount should be remitted to the seller if the bill was paid on June 1?
3. Answer the questions below and turn in this assignment by _____.

Reference:

A. Wingate & Weiner, Retail Merchandising, sixth edition, pp. 225-252.

Questions:

1. Discuss why you think a capable buyer should or should not guess at prices; memorize prices; estimate prices.

2. List and discuss when, or over what points the buyer should bargain to gain price concession.

3. Discuss the advantages which may result from a group of stores banding together to place group orders.

4. There are basically four kinds of discounts available to the retailer. List these and explain the purpose of each.

5. Explain the protection given the small retailer by the Robinson-Patman Act.

6. Discuss the term E.O.M., explaining when and why it is used, and what the letters stand for.

7. Discuss the term R. O. G., explaining when and why it is used, and what the letters stand for.

8. List and discuss what is meant by the several variations of the F.O.B. shipping terms.

9. Discuss the meanings of the shipping methods called "piggyback" and "fishyback".

10. Give an example of extra dating. Give an example of post dating. Explain the meaning of each.

11. Discuss what is meant by purchasing on consignment terms.

12. Discuss and give your reasons why you think the cash discount is a reward for prompt payment, or a penalty for late payment.

13. Explain other forms of price adjustments that may be given a buyer that are not in the form of invoice discounts.

14. List and explain special buying arrangements that result in a reduced cost of merchandise to a retailer.

15. List and discuss all information that should be contained on a written purchase order.

Assignment
Sheet No. 5

Covering
Units 54-65

HANDLING INCOMING MERCHANDISE

A moment's reflection will readily reveal that after goods are purchased they must be delivered to the store and made available for inspection by customers. This process is necessary in stores of all kinds and sizes and involves the performance of several closely related activities including Receiving, Checking, Marking, Storing, and Arranging.

Receiving refers to the activities necessary in taking physical possession of merchandise at the store and its movement to the area where it is opened and checked. Checking includes a matching of the order against the invoice, the opening of containers, the removal and sorting of the goods, and a comparison of the quantity and quality of the goods with the specifications of the order. Marking consists of placing certain types of information on the merchandise or on price tickets attached to or placed near the goods. This aids the customer and the salesperson in making selections and provides information for certain aspects of control. Storing and Arranging refers to the activities involved in moving merchandise from the marking room to the stock room, if one is used, or otherwise to the sales floor.

In this assignment we will study Receiving, Checking, Marking, Storing and Arranging in detail, emphasizing the importance of the proper performance of each to the successful operation of a large or small retailing business.

Assignment:

1. Read the references listed below.
2. Using both the information in your text and visits to local retail stores, summarize the following:
   In what ways do the receiving, checking and marking activities of chain stores differ from those of single-unit retail establishments?
3. Answer the questions below and turn in this assignment by _____.

References:

A. Wingate and Weiner, Retail Merchandising, Sixth Edition, 1963, pp. 253-282.
B. Richert, Meyer and Haines, Retailing Principles and Practices, 1962, pp. 123-141.

Questions:

1. Describe the four major types of floor layouts used in receiving rooms giving the advantages and disadvantages of each.

2. In relation to checking the quantities of merchandise received, discuss and explain the following terms: direct check; apron; blind check; dummy invoice.

3. Discuss the advantages of the newer concepts in receiving goods.

4. Describe the plan of a receiving room that is equipped with stationary tables; with portable tables; with mechanical conveyors.

5. List and discuss what the checker may find wrong in a careful check on quality of incoming shipments.

6. List and discuss several kinds of price tickets used in marking goods. Give the advantages and disadvantages of each.

7. Describe the various methods used to code cost price on price tags. Which is best?

8. List each type of information commonly found on price tickets. Tell why it is important to include each.

9. Discuss the advantages of machine marking over hand marking.

10. Describe the advantages of the newest development in price tickets, that of using punched-card marking.

11. Discuss the procedures and the reasons for control systems set up for remarking merchandise.

12. How does the proper layout of reserve stock help the retailer obtain more volume?

13. What are the ways that supermarkets and discount stores attempt to reduce their reserve stock areas? What are the advantages of reduced reserve stock areas?

14. List types of merchandise that it is important to have where the customer can easily handle and inspect. Why is it necessary that this merchandise be so placed?

15. Why is arrangement of stock important to the salesperson and to the merchandise stock control people?

16. Trace the wholesaler's invoice as it travels through the retail store from the receiving point to the office for payment.

17. List and discuss the seven steps of invoice control.

18. What has mechanization done to the procedures at the points of: receiving; checking; marking; and storing the goods?

19. Trace the steps of the flow of goods from the time they are received at the retail store until they are delivered to the customer. Explain the process of each step.

20. What are the advantages of maintaining an adequate assortment of goods?

21. List and discuss the merchandising operations with which personnel assigned to receiving incoming goods should be familiar.

22. When should a store use and what are the advantages of: the open check; the blind check; the spot check?

23. In relation to the function of receiving merchandise, explain the meaning of the following terms: LCL shipment; log; receiving apron.

24. What information besides the retail price is often included on price tickets? Why is this information important?

25. What type of price ticket would you expect to use when marking: rayon hose; crew socks; men's belts; women's handbags; pajamas?

26. Explain the concept of stock turnover. Why is turnover important to the retail store?

27. What basic merchandise information might a retailer derive from using a dollar control and/or a unit control type of stock-control system?

28. What information is needed to make a dollar or unit control system function? Where can this information be obtained?

29. In what ways do retail stores benefit from a good stock control system?

30. List and discuss the ways a salesperson can assist the stock record department to increase the accuracy of the control system.

Assignment
Sheet No. 6

Covering
Units 66-74

PRICING FOR PROFITS

No retailer can stay in business very long unless his store yields a profit. Successful pricing is often put forth as the means of maximizing profits, actually it is only one of several steps the store must take to secure such profits. Yet pricing is an important step and needs to be given careful consideration.

"Retail markup" means the amount that is added to the merchandise cost price to determine the retail price. Since prices are constantly on trial, quite often it becomes desirable to alter those originally placed on various items. The changes usually represent decreases in prices and are referred to as "markdowns".

In this assignment we will study various retail policies on taking markups and markdowns. We will also take a look at the use of price leaders and the practice of offering premiums in relation to their effect on the profits of a retail store.

Assignment:

1. Read the references listed below.
2. Talk with three or four local retailers about their policies on taking markdowns. Analyze and write up each one's policy, noting any disagreement among them as to just when and how much markdown should be taken.
3. Answer the questions below and turn in this assignment by _____.

References:

A. Wingate & Weiner, Retail Merchandising, Sixth Edition, 1963, pp. 285-310.
B. Richert, Meyer & Haines, Retailing Principles and Practices, 1962, pp. 430-445.

Questions:

1. Discuss the ways to use markdown to further boast a store's sales promotion policies.

2. List and discuss the variations in markup according to the kind of merchandise and the type of store.

3. List and discuss the use of loss leaders and leaders. Point out why they have received much criticism.

4. What is bait advertising and how is it used by retailers of today?

5. Discuss the various methods used by chain-stores to purchase their merchandise and tell how they are different from the methods used by small retailers.

6. What are the duties and responsibilities of the merchandise manager?

7. Explain the attitude of the Better Business Bureau regarding the use of false leaders in retail advertising.

8. What are some of the actions a retailer may take when competition is threatening to reduce his profit on an item?

9. Define and explain the following terms: markup per cent, markon, initial markup, maintained markup, and markup formula.

10. List and discuss the formulas for finding: markup per cent, cost price, retail price, dollar markup.

11. What are the reasons for markups on the same or similar merchandise being different in different stores?

12. List and discuss conditions which may exist that will justify a high markup or a low markup.

13. What are the basic premium merchandising policies being used in retailing today and how do these affect initial markup?

14. Discuss merchants' attitudes and objections toward the use of premium devices.

15. Draw and discuss a typical organization chart for a merchandising division of a department store.

16. Explain how competition affects the final decision of the amount of profit margin a store will try to obtain.

17. Discuss the psychological affect that pricing in odd numbers has on customers.

18. When setting prices on merchandise, how would a merchant take into consideration the following: desirability of the article, habits and customs of the consumer, service policies, and depreciation.

19. How do minimum price laws in your state affect the practice of using loss leaders, promotional pricing in general, and manufacturer list prices.

20. List and discuss the usual operating expenses the average store in your community may encounter. In what way will tight control of these expenses affect pricing and markup?

Assignment
Sheet No. 7

Covering
Units 75-83

SELLING TO CUSTOMERS

One of the very important activities in our economy--one that differentiates the American way-of-life from a large part of the world --is salesmanship. It did not "just happen" that Americans are the best-fed, best-housed, and best-clothed people on earth. It is not an accident that we are making, exchanging, and consuming goods (and services) at a rate which is unique only to this country. American salesmen are the agents who have, in large measure, brought this favorable economic condition into being. Not only has salesmanship made substantial contributions to the American way-of-life, salesmanship is a way-of-life.

Salesmen are rewarded on the job in relation to the results they produce. High level earnings, economic security, recognition, and promotions are among the forms of compensation for successful salesmen. Salesmanship can be learned through study and practice--much the same as typing, sewing, or piano playing. Salesmen can become as proficient as doctors, engineers, or educators. There is much knowledge to be mastered. There are skills to be perfected.

In this assignment, we shall consider the techniques a successful salesman must develop if he is to make a contribution to his customers, his company, and to society.

Assignment:

1. Read the references listed below.
2. The next time you shop in a retail store for any type of merchandise make written notes on the following:
   a. The success qualities that the salesman exhibited.
   b. How he exhibited them.
   c. What success qualities were lacking.
   d. How you knew that they were lacking.
3. Answer the questions below and turn in this assignment by _____.

References:

A. Wingate and Weiner, Retail Merchandising, Sixth Edition, 1963, pp. 314-345.
B. Richert, Meyer and Haines, Retailing Principles and Practices, 1962, pp. 196-223.
C. Wingate and Nolan, Fundamentals of Selling, Eighth Edition, 1964, pp. 28-32.

Questions:

1. To what extent does non-personal selling assist personal selling? Discuss.

2. Discuss personal selling at the wholesale level and the retail level.

3. Contrast internal and external personal selling methods.

4. Name and discuss the methods of the different types of external non-personal selling retail stores engage in.

5. Explain how and to what extent informative labeling of merchandise can act as a non-personal selling media.

6. Discuss what you consider the future of the automatic vending machine. Give your reasons.

7. Name and discuss the meaning of the five points of the star salesman.

8. Explain the importances of stockkeeping as a duty of salespeople.

9. Discuss the important points for a salesperson to follow when giving directions to customers.

10. Discuss some of the ways a salesperson may help keep store expenses down and help prevent waste and losses.

11. Formulate several situations that normally may be points of customer complaints. Discuss how you would handle each.

12. Explain the points of a good pre-approach as the first step of a sale.

13. Name and discuss several objectionable traits a salesperson can exhibit that are irritating to the average customer.

14. Contrast and discuss the service greeting and the merchandise approach. When should each be used?

15. By what means might a salesperson determine a customer's wants?

16. A salesperson must have specialized knowledge to present effective selling conversation. Discuss these important points.

17. Explain why the salesperson must answer objections. Give a brief example of the four types of valid customer objections.

18. When is the "best time" for the salesperson to start to close a sale? Explain.

19. Discuss the activities performed during the mechanics of closing a sale.

20. Discuss what phrases may be employed by the salesperson as the customer departs that will build goodwill for the store.

21. Name and discuss the psychological wants of human beings as they relate to selling.

22. Discuss how a customer's buying motives may differ, and how the salesperson may utilize these motives in getting the customer to buy.

23. What type of open remarks would you use in using a merchandise approach if you suspect the customer is a shopper? Why?

24. What are the major reasons stores encourage salespersons to use the merchandise approach? Why?

25. Name and discuss the rules a salesperson should keep in mind when making suggestions to his customer for additional merchandise.

26. Name and discuss the four "keys" to use when "trading up." Give the reasons you believe these keys could be of help to a salesperson.

Assignment
Sheet No. 8

Covering
Units 84-93

PERSONAL AND NONPERSONAL SELLING

All retail stores, regardless of type or size, perform a number of activities related to the actual sale of merchandise to the customer, such as presenting the customer with a sales check or a cash register receipt, receiving and safeguarding money, and recording sales transactions. To insure proper performance, the procedures or routines must be planned carefully, carried out smoothly, and revised as business conditions change.

In addition to advertising and display, which will be studied in the next assignment, a variety of other nonpersonal methods of retail sales promotion is used by retailers. Nonpersonal selling methods that seem to be of greatest importance today are telephone and mail-order selling, packaging, and consumer premiums, including trading stamps.

This assignment presents an introduction to the broad fields of nonpersonal retailing such as selling by telephone and mail-order. This unit also covers sales recording, making change, packaging, and wrapping customer purchases. The student will find that this unit provides valuable tips and information on closing sales and handling money that could very well serve to help prevent him from making costly errors.

Assignment:

1. Read the references listed below.
2. Assume that you are the proprietor of a retail drug store. In a paper not to exceed two pages, tell how you would proceed, and what types of items you would feature in setting up a program of telephone selling in your drug store.
3. Answer the questions below and turn in this assignment by _____.

References:

A. Wingate and Weiner, Retail Merchandising, Sixth Edition, pp. 352-379.
B. Richert, Meyer and Haines, Retailing Principles and Practices, pp. 93-115.
C. Wingate and Nolan, Fundamentals of Selling, Eighth Edition, pp. 422-435.

Questions:

1. Name and explain the various types of devices used in retailing today for recording sales.

2. Discuss differences in the duties of a floor cashier and a check-out cashier.

3. What are the advantages of the tube system for recording sales?

4. List and explain the "musts" in making change.

5. Discuss the major types or methods of credit authorization.

6. Explain the system developed to handle and record sales called Uni-Tote.

7. List and discuss the retail objectives in wrapping customer packages.

8. What are the differences between wrapping and packing?

9. Discuss the advances that have taken place in recent years in preparing packages for delivery and mailing.

10. Is the use of telephone selling increasing or decreasing in retail stores? Why?

11. Discuss the problems a telephone salesperson will encounter that are different from those of selling on the sales floor.

12. List and discuss the special pointers a salesperson should observe when selling by telephone.

13. What are the duties that are associated with the job referred to as "order filler"?

14. What kinds of goods are best suited for telephone selling?

15. Discuss the system of team selling in small stores; in self-service stores; in departmentalized stores.

16. Briefly explain several factors that contribute to informal teams in store organizations and how they should be dealt with.

17. Explain the term "sales grabbing", and three major solutions for solving the problem.

18. Define the following terms: cash-take; cash-send; charge-take; charge-send; C.O.D.; and will-call or lay-away.

19. In what ways will accuracy in filling out the sales slip help in store operations and control?

20. Describe the procedure used in many stores as explained in your test, for exchanges, will-calls, and discounts of various kinds.

21. Describe the procedure outlined in your text concerning how to check your change fund.

22. List and discuss the eight steps or basic rules of how to make change.

23. Briefly explain the importance of the following parts of checks: date, payee, maker, amount, signature, and endorsement.

24. Explain and discuss the marked-bill trick and the split-bill trick often used by short-change artists.

25. Discuss the concepts of appropriateness, durability, appearance, economy, and speed, in the wrapping of packages.

Assignment
Sheet No. 9

Covering
Units 94-103

ADVERTISING AND DISPLAYING MERCHANDISE

The primary purposes of retail advertising are (1) to build a reputation for the store and (2) to increase the customer traffic and the sales volume of the store. The successful accomplishment of these two aims results in the achievement of the retailer's third purpose: (3) to increase the net profit of the store.

Since the very beginnings of trade merchants have recognized that they must show their wares under the most favorable conditions, if passers-by are to be enticed to purchase. From the rude display of the early merchant, with his commodities spread out on the street, have sprung the massive show windows of the modern retailer, with lavishly prepared displays, brilliantly lighted, all with the same purpose in mind--to interest passers-by and to induce them to purchase

In this assignment you will explore the psychology of advertising, study the methods of singling out which merchandise to promote, evaluate the media best to use, and learn the procedures in preparing an advertisement. In addition, this assignment is designed to acquaint you with some of the essentials necessary in the preparation of a good display which will bring forth the most satisfactory sales results.

Assignment:

1. Read the references listed below.
2. Make a newspaper advertisement layout, following the directions given in the job assignment sheet included with this assignment.
3. Answer the questions below and turn in this assignment by _____.

References:

A. Wingate and Weiner, Retail Merchandising, Sixth Edition, 1963, pp. 383-434.
B. Richert, Meyer and Haines, Retailing Principles and Practices, Fourth Edition, 1962, pp. 280-311.
C. Wingate and Nolan, Fundamentals of Selling, Eighth Edition, 1964, pp. 381-396.

Questions:

1. Discuss the major factors that various types of stores should study in deciding which goods to advertise.

2. What types of goods usually should not be advertised and why?

3. Explain the principle of timeliness in regard to window displays.

4. Discuss the use of backgrounds and lights to attract attention and accent a window display.

5. Explain the factors that determine how often window displays are changed.

6. How do signs and labels increase emphasis on open displays?

7. What are the advantages of direct-mail advertising?

8. What factors must be considered in selecting a newspaper in which to advertise?

9. Name several forms of outdoor advertising used by retail stores.

10. Name as many media of advertising as you can that are used by retail stores.

11. What three functions must a headline accomplish in an advertisement?

12. Explain the difference in factual appeal and emotional appeal in advertising copy writing.

13. Discuss the steps in the preparation of an advertisement.

14. All states now have "Printers' Ink" statutes. What purpose do these laws serve?

15. Where might a beginning retailer secure help with his advertising problems?

16. What are the objectives of merchandise displays?

17. Display has several advantages that advertising does not possess; what are they?

18. Name and explain the major purposes of retail advertising.

19. What are the major factors to consider in determining when to advertise?

20. Discuss the three major considerations related to selection of a medium of advertising.

21. Explain the five factors that determine the competitive strength of a layout.

22. Discuss the advantages and disadvantages of advertising.

23. Compare the three types of promotional advertising with each other.

24. Discuss the advantages of effective store display.

Assignment Sheet No. 10 | Covering Units 104-118

KEEPING RECORDS AND CONTROLLING STOCK

There are numberous important merchandising functions, and the performance of each in an efficient manner is as essential in a small store as in a large department store.

Advantageous turnover, or the carrying of stocks just sufficient to meet public demand, is the secret of success in retailing. Records of sales, stocks and purchases should be carefully analyzed. On the basis of previous experience and current business developments, the volume of future purchases that will give the turnover desired should be planned. The merchandise division should be able to analyze business barometers for the purpose of forecasting business conditions.

In this assignment, we will study merchandise records and control relative to their importance to effective business operation and future planning.

Assignment:

1. Read the references listed below.
2. Take your stand, pro or con, and prepare a debate outline on the following topics:
   a. The large retail department store has a greater need for using automatic data processing than small shopping district stores.
   b. A store's success is more dependent on outside general business conditions than it is on inside management abilities.

   Be prepared to orally defend your point of view.
3. Answer the questions below and turn in this assignment by _____.

References:

A. Wingate and Weiner, Retail Merchandising, Sixth Edition, 1963, pp. 446-504.
B. Richert, Meyer and Haines, Retailing Principles and Practices, 1962, pp. 448-474.

Questions:

1. What methods of keeping records for cash receipts seem best for a large retail business? A small retail business?

2. Under what conditions would it be wise for a store to establish a petty cash fund? Discuss the different expenses that should be paid from this fund.

3. List several expenses that most businesses incur regularly. Classify these expenses under fixed and variable.

4. Discuss the effects that a decrease in normal sales volume may have upon the five most important records in a retail business: cash, expenses, sales, purchases, and inventories.

5. Discuss the advantages and disadvantages of using automatic data processing methods in keeping business records.

6. Select a business in your community and discuss methods and procedures for taking a physical inventory for it.

7. Discuss the advantages and disadvantages of the perpetual inventory method of stock record control.

8. Discuss the use of a unit control system. Will the mechanization of unit control systems decrease the need for clerks to keep records? Explain.

9. Discuss why you do or do not agree with this statement: The chief value of the income statement is in showing how to increase net income.

10. Name the three main divisions of a balance sheet. Discuss what accounts would be placed under each. Why?

11. Discuss the pro and con of the following statement: A small retail store does not have as great a need for financial records as the large department store.

12. Discuss the pro and con of the following statement: Planning, forecasting, and control are of greater importance to the large retailer than the small retailer.

13. Name and discuss the four phases of merchandise planning.

14. Discuss the three stock turn equations. Which equation would probably be preferred by stores in your community?

15. Discuss the advantages of increasing a store's stock turn. How would increasing stock turn affect profits?

16. How does open-to-buy control affect a store's inventories and profit?

17. Name and discuss some of the better methods of moving slow-selling merchandise.

18. Discuss what you consider to be the duties and responsibilities of the controller.

19. What are sources of capital for starting and operating a business? How does the wise selection of these sources affect future profits?

20. Discuss the personal characteristics or traits a store owner should consider about a customer before granting him credit.

Assignment Sheet No. 11 | Covering Units 119-126

OBSERVING GOVERNMENT REGULATIONS

Since 1933 there has been a growing trend toward increased government regulation over business. The main reason for this trend is that the public has expressed a need for protection from unfair business prices and practices, the sale of harmful food, misrepresentation in advertising, and conspiracies among sellers.

One should have a clear understanding of the fact that business operates under laws that both aid and control, thus the American business enterprise must not be classed as a completely free enterprise system. It is important to learn some of the regulations under which business must operate.

The purpose of this assignment is to present to you the governmental regulations covering wages, hours of work, insurance, working conditions, competition, prices and retail credit.

Assignment:

1. Read the references listed below.
2. Write a paper listing some of the businesses in your area which are affected by the regulations presented in this assignment. State how these businesses are affected and whether they are aided or controlled.
3. Answer the questions below and turn in this assignment by _____.

References:

A. Wingate and Weiner, Retail Merchandising, Sixth Edition, 1963, pp. 507-532.
B. Wingate and Nolan, Fundamentals of Selling, Eighth Edition, 1964, pp. 477-494.

Questions:

1. If you publish a magazine in which false advertising is published, are you subject to any liability under the regulations of the Federal Trade Commission?

2. What is the role of better business bureaus in establishing ethical practices in advertising and selling?

3. What is the significance of the nonsigner clause of the fair-trade laws?

4. Name at least three different kinds of acts that are prohibited under the laws administered by the Federal Trade Commission.

5. What is the essence of the Robinson-Patman Act, and why is this act important?

6. Explain whether you think that it is legal under the Robinson-Patman Act for a firm to sell goods to an independent retailer for 50¢ a dozen in 10 dozen lots and sell the same item to a chain store for 30¢ a dozen in lots of 10,000 cases.

7. What are the basic reasons for most of the taxes imposed by the government on business firms?

8. What are the chief types of taxes and/or licenses that a business needs to consider in estimating expenses?

9. In what way does the government regulate or control monopolies?

10. Discuss the laws that regulate business selling methods.

11. Are retailers free to sell any type of product their customers are willing to buy? Give examples supporting your answer.

12. Is the trend for government regulation today toward or away from a laissez-faire attitude?

13. Develop a list of reasons why the trend today is toward increased government regulation of business.

14. Why have the reasons you developed in question 13 become more noticeable during the last quarter of this century than they were before?

15. Discuss the chief reasons for the increase in government regulation of working conditions that are designed to protect the welfare of employees during recession years.

16. What essential information should be found on an informative label? A descriptive label?

17. What are the chief requisites for labeling foods?

18. Summarize the section of the Federal Food, Drug, and Cosmetic Act that affects the labeling of drugs.

19. What are the chief rules set up by the Federal Trade Commission to enforce advertising standards of textiles?

20. The Federal Trade Commission has the power to take action against various unfair advertising practices. What are these practices?

TRAINING PLAN AND PROGRESS RECORD
FOR
MERCHANDISING

Employer's Copy

JOB TRAINING: What the Worker Should Be Able to Do	Proficiency Shown	RELATED INFORMATION: What the Worker Should Know
Fundamentals of Retailing		
	☒	History and organization of retail business; functions of the various phases of retailing; forms of business ownership; and, new trends in retailing
Buying For Consumer Demand		
Conduct customer and comparison shopping surveys; analyze consumer demand; draw up a buying plan; evaluate new merchandise Time in hours _____	☒	How to determine consumer demand; analyze surveys; the importance of the fashion cycle; how to classify merchandise
Responsibilities of a Store Buyer		
Identify best channels for merchandise supply; assist with buying; make a basic stock list; figure discounts; figure credit terms Time in hours _____	☒	Channels for making contact with buyers; factors to consider in buying merchandise; how to estimate quantity to buy; the best credit terms and method of shipment available
Handling Incoming Merchandise		
Check incoming merchandise; mark goods; store and/or display goods; route shipments from suppliers; figure stock turn; interpret stock control information Time in hours _____	☒	Methods of checking and inspecting incoming merchandise; methods of invoice control; how stock control information is obtained
Pricing for Profits		
Figure mark-ups and markdowns on prices; analyze prices relative to clientele and demand; identify goods to be used for promotional purposes Time in hours _____	☒	Why price changes are necessary; the effect of demand on pricing; factors that determine retail prices; methods of promoting merchandise

Selling to Customers

Work as a salesperson in various departments; record sales; write up charge sales; make telephone sales; check cash register for change level

Types and functions of non-personal selling; duties of salespeople; customer buyin motives; how to record sale telephone sales techniques

Time in hours _____

Advertising and Displaying Merchandise

Help organize and carry out store advertising and promotion; write advertising copy; build floor and window displays

Rules for writing advertising copy; effective methods of store promotion; methods of evaluating store promotion; techniques of display

Time in hours _____

Keeping Records and Controlling Stock

Analyze store records for buying purposes; identify stock shortages; identify levels of store organization; make stock forecasts; interpret store financial information

Phases of store record keeping; reasons for stock shortages; effects of stock turn; the overall store organization and levels of authority

Time in hours _____

Observing Government Regulations

Identify government regulations and their effects; make suggestions for complying with government regulations

Various government regulations and how they pertain to retail selling

Time in hours _____

Code for employer's use in marking student's progress:

Performed some operations in area

Performed most operations in area

Performed some operations with reasonable proficiency

Performed most operations satisfactorily

TRAINING PLAN AND PROGRESS RECORD
FOR
MERCHANDISING

Student's Copy

JOB TRAINING: What the Worker Should Be Able to Do	Proficiency Shown	RELATED INFORMATION: What The Worker Should Know
Fundamentals of Retailing		
	☒	History and organization of retail business; functions of the various phases of retailing; forms of business ownership; and, new trends in retailing
Buying For Consumer Demand		
Conduct customer and comparison shopping surveys; analyze consumer demand; draw up a buying plan; evaluate new merchandise	☒	How to determine consumer demand; analyze surveys; the importance of the fashion cycle; how to classify merchandise
Time in hours _____		
Responsibilities of a Store Buyer		
Identify best channels for merchandise supply; assist with buying; make a basic stock list; figure discounts; figure credit terms	☒	Channels for making contact with buyers; factors to consider in buying merchandise how to estimate quantity to buy; the best credit terms and method of shipment available
Time in hours _____		
Handling Incoming Merchandise		
Check incoming merchandise; mark goods; store and/or display goods; route shipments from suppliers; figure stock turn; interpret stock control information	☒	Methods of checking and inspecting incoming merchandise; methods of invoice control; how stock control information is obtained
Time in hours _____		
Pricing for Profits		
Figure mark-ups and markdowns on prices; analyze prices relative to clientele and demand; identify goods to be used for promotional purposes	☒	Why price changes are necessary; the effect of demand on pricing; factors that determine retail prices; methods of promoting merchandise
Time in hours _____		

Selling to Customers

Work as a salesperson in various departments; record sales; write up charge sales; make telephone sales; check cash register for change level

Types and functions of non-personal selling; duties of salespeople; customer buyin motives; how to record sale. telephone sales techniques

Time in hours _____

Advertising and Displaying Merchandise

Help organize and carry out store advertising and promotion; write advertising copy; build floor and window displays

Rules for writing advertising copy; effective methods of store promotion; methods of evaluating store promotion; techniques of display

Time in hours _____

Keeping Records and Controlling Stock

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Time in hours _____

Observing Government Regulations

Identify government regulations and their effects; make suggestions for complying with government regulations

Various government regulations and how they pertain to retail selling

Time in hours _____

Code for employer's use in marking student's progress:

Performed some operations in area

Performed most operations in area

Performed some operations with reasonable proficiency

Performed most operations satisfactorily

TRAINING PLAN AND PROGRESS RECORD
FOR
MERCHANDISING

JOB TRAINING: What the Worker Should Be Able to Do	Proficiency Shown	RELATED INFORMATION: What The Worker Should Know
Fundamentals of Retailing		
	☒	History and organization of retail business; functions of the various phases of retailing; forms of business ownership; and, new trends in retailing
Buying For Consumer Demand		
Conduct customer and comparison shopping surveys; analyze consumer demand; draw up a buying plan; evaluate new merchandise	☒	How to determine consumer demand; analyze surveys; the importance of the fashion cycle; how to classify merchandise
Time in hours _____		
Responsibilities of a Store Buyer		
Identify best channels for merchandise supply; assist with buying; make a basic stock list; figure discounts; figure credit terms	☒	Channels for making contact with buyers; factors to consider in buying merchandise how to estimate quantity to buy; the best credit terms and method of shipment available
Time in hours _____		
Handling Incoming Merchandise		
Check incoming merchandise; mark goods; store and/or display goods; route shipments from suppliers; figure stock turn; interpret stock control information	☒	Methods of checking and inspecting incoming merchandise; methods of invoice control; how stock control information is obtained
Time in hours _____		
Pricing for Profits		
Figure mark-ups and markdowns on prices; analyze prices relative to clientele and demand; identify goods to be used for promotional purposes	☒	Why price changes are necessary; the effect of demand on pricing; factors that determine retail prices; methods of promoting merchandise
Time in hours _____		

Selling to Customers

Work as a salesperson in various departments; record sales; write up charge sales; make telephone sales; check cash register for change level

Types and functions of non-personal selling; duties of salespeople; customer buyin motives; how to record sale telephone sales techniques

Time in hours _____

Advertising and Displaying Merchandise

Help organize and carry out store advertising and promotion; write advertising copy; build floor and window displays

Rules for writing advertising copy; effective methods of store promotion; methods of evaluating store promotion; techniques of display

Time in hours _____

Keeping Records and Controlling Stock

Analyze store records for buying purposes; identify stock shortages; identify levels of store organization; make stock forecasts; interpret store financial information

Phases of store record keeping; reasons for stock shortages; effects of stock turn; the overall store organization and levels of authority

Time in hours _____

Observing Government Regulations

Identify government regulations and their effects; make suggestions for complying with government regulations

Various government regulations and how they pertain to retail selling

Time in hours _____

Code for employer's use in marking student's progress:

Performed some operations in area

Performed most operations in area

Performed some operations with reasonable proficiency

Performed most operations satisfactorily

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FOOD SERVICE

A Course of Study

Designed for
Cooperative Part-Time Students
Employed in Food Service Work

Issued by

Department of Industrial Education
College of Education
University of Missouri
Columbia, Missouri

In Cooperation with

Industrial Education Section
State Department of Education
Jefferson City, Missouri

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2095

MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
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Columbus, Ohio 43212

FROM: (Person) James B. Karnes (Agency) University of Missouri at Columbia
(Address) 103 Industrial Education Bldg., Columbia, Missouri

DATE: July 10, 1967

RE: (Author, Title, Publisher, Date) Industrial Education Dept., FOOD SERVICE. Cooperatively with Industrial Education Dept. and Missouri State Dept. of Education. (1963).

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FOREWORD

This course of study, consisting of an analysis of FOOD SERVICE, together with assignment sheets covering the related (occupational) information to be taught by the school, has been prepared for teaching food service workers on an individual basis in a cooperative part-time program.

The original analysis was prepared by Miss Virginia Griffith while a graduate student in Industrial Education at the University of Missouri. Subsequent revisions of the analysis were made by a few COE coordinators in Missouri with later revisions being made in 1952 by Mr. Marion P. Stevens and in 1958 by Dr. Thomas W. Miller, both formerly Research Assistants in Industrial Education at the University of Missouri. Special credit is due Mr. Nevin E. Andre, Research Assistant in Industrial Education at the University of Missouri, who prepared the present revision of the analysis and the assignment sheets.

We wish to acknowledge our indebtedness to Dr. H. H. London, Professor of Industrial Education at the University of Missouri, who supervised the preparation of the material, and to Mr. James B. Karnes, Instructor in Industrial Education at the University of Missouri, who edited the manuscript. Credit is due Dr. H. Pat Wardlaw, Assistant Commissioner of Education, Mr. Merton Wheeler, Director of Industrial Education, and other staff members of the State Department of Education for their efforts in the development of the Industrial Education Curriculum Series of which this course of study is a part.

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Training Plan and Progress Record

INTRODUCTION

In preparing this course of study, it has been assumed that the attainment of occupational competency in any type of work involves three different, yet closely related, types of learning. They are:

1. Mastery of the practical job skills and procedures performed by the worker in the occupation.

2. Comprehension of the technical and related information basic to an intelligent understanding and practice of the occupation.

3. Development of those personal-social traits which are essential for the successful worker.

The first group of the "learning units"--the job skills and procedures -- has been arranged in the analysis under the heading of "Job Training." The second group of learning units -- the technical and related information -- has been arranged under the heading of "Related Information." And the third group -- the personal-social traits -- has been listed under "Personal-Social Traits Essential for the "Food Service Worker" in the introductory section addressed to the student.

In a cooperative educational program it is necessary for both cooperating agencies -- the school and the employer -- to understand clearly just what each is to be responsible for in the training of the student-worker. Experience has shown that most of the practical job skills and procedures of an occupation can best be learned through supervised work on the job. Experience has shown also that the school can best teach most of the technical and related occupational information needed by young student-workers. This division of responsibility has been made in the arrangement of the course of study; that is, it is expected that the student-worker will master the job skills and procedures through practical work on the job under the immediate supervision of the employer, and that he will receive instruction in related occupational information in the school under the direction of the coordinator.

Skills and related information are matters for direct instruction, but personal-social traits are acquired only through practicing them during the process of acquiring skills and information and in one's daily conduct. Therefore, both the employer and the school, as well as the home, must assume responsibility for developing in the student-worker those habits, attitudes and character traits which are essential for success in his occupation and in life. Both the employer and the school should be constantly on the alert to see that the student-worker places desirable interpretations on his experiences and that he does not practice habits and exhibit character traits detrimental to his success.

Since the coordinator's class will be made up of fifteen or more students, each differing from the other significantly, studying a dozen or more occupations which differ markedly in their requirements, it follows that it will be impossible for him to teach, through the group method, the occupational information which relates to the specific job

of each student-worker. In order to be effective, this type of instruction must be individualized. There is, of course, some related information, such as occupational health and safety, workmen's compensation, wage-hour laws, fair labor standards, unemployment compensation and the like, which is of common interest and concern to all student-workers, and may be effectively taught by the group method. But if the coordinator is to make a real contribution to the in-service vocational education of his students, he must devote a major portion of his classroom instruction to content which deals specifically with the work of each boy and girl enrolled.

With this requirement in mind, and in order to facilitate individual instruction, these assignment sheets have been prepared. Each contains certain record data as to number and range of units covered, introductory paragraphs designed to develop interest, explain the importance of the assignment, and to convey to the student what he is expected to learn, specific assignments including reading, learn activities and a series of new-type questions designed to check his attainment.

Obviously, it is desirable to teach the related information in the school at the time it will be used most advantageously on the job. This means that the two phases of the student-worker's training should parallel each other in a progressive manner. The coordinator will find the assignment sheets well adapted to this end. He can select from day to day the assignment which covers the informational units related to the work being done on the job. With this arrangement, the coordinator will become, during a major portion of his classroom time, a supervising study and helping teacher.

In selecting books for the course, an effort has been made to restrict the number to an adequate coverage of the material, and to select those of recent publication so that current practices can be consistently presented. It is recommended that copies of these books be secured and kept in the coordinator's classroom for ready use by the student.

The key sheets available in a separate manual, have been prepared to enable the coordinator to score quickly the objective tests which are a part of each assignment sheet. These key sheets give the correct answers to the questions, as well as the reference and the page on which each answer can be found. The key sheets should be kept in the coordinator's possession.

TO THE STUDENT WORKER

The beginning of the food service trade dates back to the early inns of England and France. As men found it necessary to travel for long distances by horseback and stagecoach, the need for places to lodge overnight grew. Many people earned additional income by hanging out signs advertising an extra room or two in their homes to be rented for the night. Some inns set aside a downstairs room as a place where weary travelers could secure family meals at a slight cost in addition to their night's lodging. Thus was the beginning of establishments, later to be known as restaurants, in the early days of trade and commerce.

Even though the restaurant business is a very old one, only in comparatively recent years has its growth been striking. Prior to 1910 restaurants were patronized primarily by members of the upper middle class and the wealthy. In following years factors such as the changing business pattern, development of the automobile and the increased work force resulted in an increased sales volume by eating and drinking places of 171 per cent from 1939 to 1945. In 1954, the sales of eating establishments amounted to 8.7 billion dollars, while in 1961, the sales reached a record of 16.5 billion dollars.

Opportunities in Food Service

The food service business is one of the greatest industries of this country, ranking as the fifth largest in terms of retail sales. It has been estimated that combining all the sources of prepared meals, exclusive of the home, an average of 78,000,000 meals are served each day in the 344,740 restaurants.

The health and well-being of the millions of people who eat in restaurants every day is affected by the food served them. Also, much of the social life is centered in dining out. The industry is, therefore, a great public enterprise and has serious obligations to those communities in which restaurants are established.

Reliable publications indicate that the outlook for food service workers is good. From all indications the American public will continue to travel in great numbers and more food will probably be required to meet their needs. This increased demand can be met only through development of more restaurant facilities. Thus, the demand for well-trained food service workers will most likely increase in the next few years.

The usual work week for food service workers ranges from 40 to 48 hours and, in many instances, the working day may consist of two shifts in order to cover the rush hours.

Opportunity for advancement exists in most restaurants and with advancement comes greater responsibility and higher pay.

Requirements for Entry into Food Service

Entry into food service work is usually obtained through on-the-job training. Ordinarily, no previous experience is required; however, experience may be a requisite to employment in some of the larger establishments. Union membership usually is a requirement in only the large restaurants located in cities.

High school courses, in addition to the COE class, which will be helpful to food service workers are home economics, mathematics, and English.

Personal Qualifications for the Food Service Worker

Desirable personality traits are of extreme importance for success in life. They are the factors on which one is usually judged when meeting people and when attempting to secure a job; they also are vitally important in holding a job. Various studies have revealed that about 90 per cent of the discharges are due to lack of desirable personal-social traits with only about 10 per cent due to lack of job skills. However, it must be noted that without job skills it would be exceedingly difficult to find employment. Personal-social traits can be improved, but only through conscientious and continued effort. The following are among the personal-social traits of chief importance to the food service worker:

Carefulness - conservation of foods, equipment, and materials.

Cleanliness - observation of high standards of working conditions and of personal grooming.

Cooperativeness - ability to work harmoniously with others.

Courtesy - respect for the opinions, interests, and desires of others.

Dependability - in performance of work and loyalty to establishment.

Health - observation of habits which promote vitality and vigor.

Initiative - ability to see what needs to be done and to do it without constant supervision or prodding.

Promptness - seldom tardy or absent from responsibilities.

Self-Control - maintenance of a pleasant disposition and temper under control at all times.

Voice - good English usage and a pleasant manner of speaking.

REFERENCES FOR FOOD SERVICE

A. U. S. Department of Health, Education, and Welfare, Food Service Industry Training Programs and Facilities, OE-82007, Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., 1961, $0.65. (13)**

B. Sealtest Foods, Know Your Job, Sealtest Foods, Sales and Advertising Department, 260 Madison Avenue, New York 16, New York, 1948, $0.35. (10)

C. Dietz, Susan M., The Correct Waitress, Ahrens Publishing Company, Inc., 116 West 14 Street, New York, New York, 10011, 1952, $1.25* (9)

D. Dahl, J. O., The Efficient Waitress Manual, Dahl Publishing Company, 911 Summer Street, Stamford, Connecticut, Ninth Edition, 1944, $0.25. (8)

* Subject to educational discount
** Frequency of use in assignments

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
Introduction to Restaurant Business		
	1	1. Importance of the restaurant business
	1	2. Function of the restaurant in the modern community
	1	3. Types of restaurants
	1	4. Services rendered by restaurants
	1	5. Restaurant work as a vocation
	1	6. Your obligations as a restaurant salesperson
Requirements of Food Service Workers		
	2	7. General requirements for efficient food service workers
	2	8. Educational requirements
9. Prepare for going on duty	2	9. Importance of appropriate dress
10. Check grooming before going on duty	2	10. Essentials of good grooming
11. Maintain physical fitness	2	11. Physical requirements for food service workers
	2	12. Your responsibility as a representative of the establishment
13. Work with others	2	13. Fellow worker relationship
	2	14. Importance of following instructions
15. Determine proper appointments	2	15. Basic service fundamentals
	2	16. Importance of developing skill
17. Give information to patrons	2	17. Techniques of giving information to patrons
	2	18. Importance of sanitation in restaurants
19. Observe safe practices	3	19. Hazards encountered by food service workers
20. Measure detergents	3	20. Cleaning materials
21. Clean with abrasive cleaners		
22. Wash dishes by hand	3	22. Methods of cleaning utensils
23. Wash dishes by machine		
24. Polish silver by machine		
25. Clean cooking utensils		

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
26. Care for kitchen knives		
27. Clean tile or linoleum floors	3	27. Techniques of cleaning the food service station
28. Wash woodwork		
29. Care for table tops		
30. Clean gas appliances	3	30. Factors involved in the care of appliances
31. Care for electric appliances		
32. Store cleaning equipment	3	32. Factors involved in the care of cleaning equipment
33. Build patronage	4	33. Techniques of gaining good will through sales and service
	4	34. Importance of satisfying the customer's good will
35. Sell service and satisfaction	4	35. Factors involved in maintaining the customer's requirements
36. Serve handicapped, aged, and children	4	36. Guests requiring special services
	4	37. Services to undesirables
	5	38. Types of service
39. Handle complaints and suggestions	5	39. Standard rules
40. Recognize quality foods by attractiveness	5	40. Techniques in judging food quality
41. Recognize quality of food by color	5	41. Importance of proper texture and consistency of food
42. Recognize quality of food by form		
43. Plan dining room work	5	43. Factors involved in planning work in dining room
44. Handle equipment	5	44. Importance of cleanliness in handling equipment
45. Appear orderly at station	5	45. Importance of order in the dining room
46. Move about station quietly	5	46. Ways of preventing accidents
	5	47. Essentials in practicing economy
Serving the Order		
48. Clean and refill salt and pepper shakers	6	48. Side work duties
49. Clean and refill sugar bowls		
50. Care for condiment bottles		
51. Fold napkins		
52. Arrange flowers		

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
53. Scour china		
54. Polish silver		
55. Stack a tray on the serving table	6	55. Fundamentals of bus service in restaurants
56. Stack soiled dishes on serving table	6	56. Closing duties at the serving station
57. Place table linen	7	57. Essentials of good table setting
58. Arrange glassware and china		
59. Place silver		
60. Set a breakfast cover	7	60. Techniques of breakfast, luncheon and dinner table setting
61. Place a standard cover		
62. Arrange accessories		
63. Set a table while guest is seated		
64. Give a friendly greeting	8	64. Techniques of approaching the customer
65. Maintain a dignified manner		
66. Give prompt attention		
	8	67. Importance of explaining services and menu to customer
68. Ascertain time required to prepare order		
69. Assist customer in completing order	8	69. Information the customer desires
70. Offer suggestions to customers	8	70. Purposes of suggestive selling
71. Give orders	9	71. Methods of giving order
72. Assemble order	9	72. Importance of efficient table layout
	9	73. Factors in timing of orders
	9	74. Techniques of loading a serving tray
75. Check order		
	10	76. Types of table service
	10	77. A la carte orders
	10	78. Serving special orders
79. Check table set-up	10	79. Importance of serving the order properly
80. Serve appetizers		
81. Remove dishes	10	81. Service necessary between courses
82. Serve main course		
83. Serve dessert		
84. Present check to guests	10	84. Essentials of a guest check
85. Bid guests good-bye		
86. Take verbal orders at counter	11	86. Techniques of dealing with customers at cafeteria counter

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
	11	87. Factors in stimulating cafeteria counter sales
88. Serve guests at cafeteria counter		
89. Clear cafeteria counter	11	89. Importance of cafeteria counter appearance
90. Clean cafeteria counter		
91. Prepare the cafeteria counter	11	91. Techniques of preparing cafeteria counters
92. Prepare food at cafeteria counter		
93. Serve from cafeteria counter	11	93. Technique of serving food to customers from cafeteria counter

Food Preparation

94. Prepare pantry for service	12	94. Importance of pantry service in restaurants
	12	95. Common items of equipment used in pantry work
96. Assemble orders		
97. Clean pantry		
98. Take orders at the counter	12	98. Techniques of dealing with guests at counter
99. Serve guests at counter	12	99. Factors in stimulating counter sales
100. Clean counter	12	100. Importance of counter appearance
101. Chop foods	13	101. Equipment used for sandwich and salad making
102. Prepare uncooked vegetables	13	102. Basic salads served in restaurants
103. Arrange salads		
104. Prepare fresh fruit		
	13	105. Importance of sandwiches in restaurant business
106. Spread sandwiches	13	106. Basic sandwich fillings
107. Cut sandwiches		
108. Toast sandwiches		
109. Grill sandwiches		
	14	110. Importance of beverages in restaurants
111. Serve milk	14	111. Basic beverages on the menu
112. Prepare and serve hot chocolate		
113. Prepare iced beverages		
114. Prepare tea	14.	114. Methods of making tea
115. Make coffee in a vacuum glass	14	115. Fundamentals of brewing coffee

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
116. Make coffee in an urn		
117. Clean an urn		
	15	118. General fountain practices
	15	119. Fountain responsibilities
120. Order supplies	15	120. Supplies used at the fountain
121. Clean ice cream containers	15	121. Importance of proper care of fountain equipment
122. Clean ice cream mixers		
123. Care for carbonator		
124. Dip ice cream	15	124. Fountain technique
125. Hand pack ice cream		
126. Mix sodas		
127. Prepare sundaes		
128. Mix milk drinks		
129. Whip cream		
130. Garnish ice cream and sundaes		
Restaurant Management		
131. Plan a menu	16	131. Kinds and types of menus
132. Prepare menus	16	132. Organization and arrangement of menus
	16	133. Value of descriptive words in menus
	16	134. Common foreign terms used on written menus
135. Arrange restaurant for efficient operation	17	135. Types of restaurant organization
	17	136. Methods and devices used in restaurant control
137. Keep restaurant records	17	137. Advantages of keeping restaurant records
	17	138. Importance of efficient personnel
139. Take inventory	17	139. Purpose and use of inventories; use of records as perpetual inventory
140. Handle merchandise	17	140. Ways and means of preventing waste
141. Locate items in stock		
142. Take advantage of discounts	17	142. Nature and value of discounts
143. Determine costs with profit-and-loss statements	17	143. Importance of profit-and loss statements
144. Figure social security tax	17	144. Value of tax records to the restaurant owner
145. File social security tax reports	17	146. Importance of balance sheets

Assignment
Sheet No. 1

Covering
Units 1-6

THE RESTAURANT BUSINESS

The food service industry is "big business." Some idea of the size of this industry can be obtained from the fact that its annual dollar volume exceeds the total amount of money spent on new and used cars. There are about 533,000 commercial and institutional food service establishments, of which more than 200,000 are commercial restaurants, cafeterias, hotels, lunch counters, caterers, and refreshment stands. In some localities the demand for workers may be seasonal; however, over the entire nation the demand is relatively steady. Many people must eat out regardless of the season, resulting in fairly steady employment for food service workers.

Food service workers who are adequately trained and endeavor to improve themselves on the job are more in demand, have less fear of dismissal, have better working conditions and receive more pay than those workers who are less well prepared. For these reasons, it will be of value to the student to have a thorough knowledge of the nature of the work and the opportunities in this field.

In this assignment you will have an opportunity to learn the extent of the restaurant business, the opportunities, and advantages of adequate training in this field.

Assignment:

1. Read the references listed below.
2. Answer the questions below and turn in by _____.

References:

A. U. S. Department of Health, Education, and Welfare, Food Service Industry, pp. 1-6, 50-58, 62-76.
C. Dietz, The Correct Waitress, pp. 7-14.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The success of a restaurant business is in no way connected with the hiring of good waitresses.

T F 2. The various departments of a restaurant will be bonded together by the efficiency of the waitresses.

T F 3. It takes thousands of dollars to create a business, and thousands for cooks, atmosphere, and maintenance, yet the final results of business depends on the waitresses.

T F 4. It is estimated that the owner of a restaurant makes 50% profit on every sale.

T F 5. Eating out is a firmly established daily necessity for millions of people.

T F 6. Of the meals eaten away from home, only 50% are eaten in restaurants, hotels and hospitals.

T F 7. The food service industry has no influence upon the health of the nation.

T F 8. The food service industry is one of the largest in the number of persons gainfully employed.

T F 9. The food service industry is organized to provide eating facilities for persons away from home.

T F 10. Cafeterias, coffee shops, and fountain service take care of business and professional people who have a short meal period.

T F 11. Results of studies indicate that successful food service operations don't participate in community affairs.

T F 12. Current trends indicate consumers will have more money to spend and more time in which to spend it.

T F 13. All food service units provide service for the three traditional meals.

T F 14. At the present time the supply exceeds the demand for experienced food service personnel.

T F 15. Restaurants employ both a production staff and a sales force.

T F 16. The modern food service kitchen, hires short term unskilled workers.

T F 17. Food service is a complex business which entails warehousing, manufacturing, and selling.

T F 18. Food preparation entails the production for every item appearing on the menu or offered for sale.

T F 19. The trend in restaurants today is toward more self-service on the part of the waiter in the kitchen.

T F 20. In a small operation, the hostess and cashier are responsible directly to the manager.

T F 21. Personal hygiene and sanitary work habits play a small part in the serving of safe, wholesome food.

T F 22. Food service workers have no worry about rush periods when the majority of customers want service at the same time.

T F 23. The hostess is responsible for the supervision of the dining room service and the salespersons.

T F 24. The first impression by the hostess is important as she represents the management in the minds of the customers.

T F 25. The service-counter salesperson should possess all the characteristics necessary for the dining room salesperson.

T F 26. The last person on the food service staff whom the customer has contact with is the cashier.

T F 27. Employers usually do not like to hire persons who have been recommended by members of their present staff.

T F 28. The person who applies for a job in writing should use a postal card, as this will indicate that he is economical and make a good impression on the employer.

T F 29. Some employers judge a job applicant by the neatness and thoroughness with which he fills out the application form.

T F 30. It is impossible for the food service worker to choose his position and his location of work.

T F 31. Waiters interested in travel may apply for work with sea-going vessels and railroads.

T F 32. Advancement in food service work comes to those persons who master the skills required by their present job and who show interest in their work.

T F 33. A good method of training a food service worker is to assign him a sponsor.

T F 34. The public schools frequently provide classes in food service sales work and other special groups.

T F 35. Except in resort and tourist districts, restaurant work is unsteady and there is seasonal fluctuation in employment.

T F 36. Due to the similarity of work in food service throughout the nation, a person well trained in one place can usually find a position with comparative ease in another locality.

T F 37. When tipping is allowed, the wage rate is usually higher.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. It has been estimated that approximately _____% of the cost of a meal represents the food cost.

2. The food service industry ranks _____ in size among all the industries of the nation.

3. Of all the people employed in the retail trades, about _____ of _____ work in the restaurant business.

4. More than _____% of each dollar spent in restaurants is paid out to employees in wages.

5. The two major classifications of food service units, classified by the types of service rendered are _____ and _____ units.

6. The head cook in a hotel or distinctive-atmosphere is known as the _____ or _____ _____ .

7. The quickest and most satisfactory means of securing information about available jobs is through_____ and _____.

8. Commonly used methods in newspaper "help wanted" advertising to select a suitable group of applicants for personal interviews are known as _____ and _____ _____ advertising.

9. The most time-consuming method of seeking a job as a food service worker is by making _____ _____ to employers.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The four principal types of service restaurants are:

   (A) _____ (C) _____

   (B) _____ (D) _____

2. The three principal types of self-service restaurants are:

   (A) _____ (C) _____

   (B) _____

3. The four major areas in every food operation that offer interesting career opportunities are:

   (A) _____ (C) _____

   (B) _____ (D) _____

4. Food preparation can be roughly divided into three distinct divisions. They are:

   (A) _____ (C) _____

   (B) _____

5. The work activities of the food service worker can be divided into three activities. They are:

(A) _____ (C) _____

(B) _____

6. The factors that will govern the number of employees in a food service unit are:

(A) _____ (E) _____

(B) _____ (F) _____

(C) _____ (G) _____

(D) _____

7. Seven members of the food service sales staff are:

(A) _____ (E) _____

(B) _____ (F) _____

(C) _____ (G) _____

(D) _____

8. Five sources of finding employment in the restaurant business are:

(A) _____ (D) _____

(B) _____ (E) _____

(C) _____

9. When interviewing for a job, a person should remember certain points of conduct, they are:

(A) _____ (D) _____

(B) _____ (E) _____

(C) _____ (F) _____

10. Locations at which a food service salesperson may find employment are:

(A) _____ (E) _____

(B) _____ (F) _____

(C) _____ (G) _____

(D) _____ (H) _____

Assignment
Sheet No. 2

Covering
Units 7-18

REQUIREMENTS OF FOOD SERVICE WORKERS

The requirements of food service workers are numerous and varied. Their chief responsibility is that of caring for the orders of customers and to make a sincere effort to satisfy them. This in itself is not as simple as it may seem, and is further complicated by the various types of service required in different establishments.

It is extremely important that food service workers be fully aware of the responsibilities they will assume upon the acceptance of a position dealing with the public. Not only will their success depend upon the way they accept their responsibilities, but their remuneration will correspond accordingly.

In this assignment you will have an opportunity to learn what requirements are commonly encountered by food service workers and the importance of these for success in the restaurant business.

Assignment:

1. Read the references listed below.
2. In a one page paper list the responsibilities you have on your job which are directly or indirectly concerned with being a successful salesperson.
3. Answer the questions below, and turn in by _____.

References:

A. U. S. Department of Health, Education, and Welfare, Food Service Industry, pp. 42-43, 46-50, 58-62.
B. Sealtest Foods, Know Your Job, pp. 2-4.
C. Dietz, The Correct Waitress, pp. 15-19.
D. Dahl, The Efficient Waitress Manual, pp. 6-7, 62-64.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Collars, cuffs, bandette and apron should be changed twice a week.

T F 2. Good looks will make you better liked and more successful than good grooming.

T F 3. Uniforms should be hung in a locker when not in use to prevent them from becoming wrinkled.

T F 4. Uniforms should be changed just as often as necessary to keep them fresh and clean.

T F 5. Most restaurants encourage the use of moderate jewelry.

T F 6. Underclothing should be changed at least every other day.

T F 7. Leather heels are recommended on shoes used by food service workers.

T F 8. Charm is largely dependent upon mental and physical habits.

T F 9. The waitress should arrange her job to meet the demands of her social life.

T F 10. The Board of Health rules of most states require that a waitress wear a hair net.

T F 11. In most establishments it is permissible to smoke in the dining room or kitchen while on duty.

T F 12. Many communities require that food handlers pass a physical examination.

T F 13. Female food service workers should wear shoulder-length hair styles because it is easier to keep neat when wearing a headband.

T F 14. Excessive use of cosmetics should be avoided at all times, especially while on duty as a food service worker.

T F 15. It is a good practice for male employees to wear open-necked or polo shirts while working as food salespersons.

T F 16. It is not necessary to wear a spotless and well-pressed uniform to impress the customers' mind with efficient and sanitary food handling.

T F 17. Two essential parts of your personal appearance are a pleasant facial expression and a pleasing voice.

T F 18. Guests should be greeted with familiar salutations such as "honey" or "dearie".

T F 19. In questions of service, the customer is always right.

T F 20. Regardless of how skillfully a food service worker may perform his duties, he is a failure if he does not work cooperatively with the management.

T F 21. Most restaurant operators are aware of the fact that the salesperson's appearance, manner, and service will do much to gain the good will of customers.

T F 22. A customer judges the standards of the food service establishment by the appearance, attitude and actions of the salesperson.

T F 23. It is very important for an efficient salesperson to maintain harmonious relations with the people with whom he works.

T F 24. There are no generally accepted education requirements for employment as a food service salesperson.

T F 25. Most employers prefer college graduates as salespersons.

T F 26. Many food service establishments give their sales staff an opportunity to obtain vocational training after they have been employed.

T F 27. Individuals who are very tall, very short, excessively thin or greatly overweight are able to find employment readily as food service workers.

T F 28. Healthy people are better workers and will not be absent from work as often as people who are in poor health.

T F 29. Food service workers are sometimes required to undergo tests for veneral disease, tuberculosis, diphtheria and typhoid.

T F 30. Persons with ailments of the legs and feet are always hired to work as food service workers.

T F 31. Loyalty is mostly a show of keen interest in the business.

T F 32. Giving special patrons extra-sized portions does little harm and is usually not condemned by managers.

T F 33. It is not necessary for a food service worker to have the ability to follow instructions.

T F 34. Most employers measure the job skill by the speed with which the salesperson works.

T F 35. High standards of personal hygiene and sanitary work habits must be maintained if the food service is to meet its obligation of serving safe, wholesome food.

T F 36. Persons with proper posture will work as a salesperson with less fatigue.

T F 37. An elaborate hair style should be worn for both social and business purposes.

T F 38. Many people have found that a change of shoes during the working day will do much to relieve foot fatigue.

T F 39. An attractive uniform reflects favorably on both the wearer and the establishment.

T F 40. Jewelry should be worn as it adds to the appearance of the food service worker and produces a more home-like atmosphere in the restaurant.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Efficient food service workers should always dress in clean clothes which are free of _____, _____, or _____.

2. Where hair-do's are concerned, _____ is the key to charm.

3. The first duty of the food service worker to herself and to her employer is _____.

4. An attractive smile and an inoffensive breath depend to a great degree upon _____ _____.

5. Food service workers should wear nail polish of a light tint or _____ _____.

6. Food service workers should stand erect with the head up, because good posture is an indication of _____ _____ and _____.

7. Two vital factors to food service workers are _____ and _____ under pressure.

8. Food service workers should not expect to receive help unless they are willing to _____ _____ in return.

9. Mutual helpfulness implies _____.

10. One cannot receive cooperation from others unless he himself is _____.

11. The salesperson who wins the recognition of management for good work is the one who is _____ in the place where he is employed.

12. A _____ salesperson is one who is where he is supposed to be when he is supposed to be there.

13. The first requirement for a well-groomed person is _____ _____.

14. Food service salesgirls should wear headbands or _____ when on duty.

15. Most stains which get under the fingernails can be removed by rubbing them with a piece of _____ _____.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Seven fundamentals of a good waitress are:

   (A) _____ (E) _____

   (B) _____ (F) _____

   (C) _____ (G) _____

   (D) _____

2. Three groups of persons toward whom the food service worker has an obligation to be pleasant to are:

   (A) _____ (B) _____ (C) _____

3. Three important factors necessary in securing the friendship of others are:

   (A) _____ (B) _____ (C) _____

4. Five physical requisites that contribute to the food service worker's ability to be successful on the job are:

   (A) _____ (D) _____

   (B) _____ (E) _____

   (C) _____

5. To meet the food service manager's requirements the salesperson should have certain personality traits. They are:

   (A) _____ (E) _____

   (B) _____ (F) _____

   (C) _____ (G) _____

   (D) _____

6. The capable food service worker must be able to perform the following functions to attain success in the restaurant business:

   (A) _____ (B) _____ (C) _____

7. Honesty, as applied to a food service worker, involves correct accounting for three items besides money. They are:

   (A) _____ (B) _____ (C) _____

8. Professional skills demanded of a food service worker are:

(A) _____ (C) _____

(B) _____ (D) _____

9. Carefulness in work may be shown in various jobs, some are:

(A) _____ (E) _____

(B) _____ (F) _____

(C) _____ (G) _____

(D) _____ (H) _____

Assignment
Sheet No. 3

Covering
Units 19-32

CARE OF EQUIPMENT, SANITATION, AND SAFETY

Cleanliness is a factor of extreme importance in the restaurant business. Public officials believe sanitary conditions are so vital in food service that most cities have ordinances governing this. Equipment must be safe as well as clean in all successful restaurants. The health of all the patrons of a restaurant will depend upon the way equipment is cleaned and how sanitary it is.

There are two sources of danger which must be guarded against--spoiled food and foreign substances. The usual precautions of preparing and handling food in a sanitary manner will generally prevent the danger of spoiled food.

In this assignment you will have the opportunity to learn various methods of cleaning equipment and the value of sanitary and safe procedures which are followed in the food service industry.

Assignment:

1. Read the references listed below.
2. Over a period of one week, make a written list of all the unsafe acts you see performed at the establishment where you work, then indicate after each your suggestion as to how the situation may be corrected or avoided.
3. Answer the questions below, and turn in by _____.

References:

A. U. S. Department of Health, Education, and Welfare, Food Service Industry, pp. 18-19, 25, 162-163, 165.
B. Sealtest Foods, Know Your Job, pp. 5, 13-15.
C. Dietz, The Correct Waitress, pp. 27, 52-53.
I. Information Sheet #1, this manual.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The food service worker should never touch the food in a patron's order with her fingers.

T F 2. Glasses should always be carried by grasping them by their rims.

T F 3. A guest should never be made to feel that it is necessary to wipe silver or dishes with his napkin.

T F 4. Failure to pass through designated doorways is a frequent cause of accidents.

T F 5. Broken glass should be picked up with the bare fingers.

T F 6. Ankles are easily twisted in high heels and heels that are run down.

T F 7. The physical arrangement of the restaurant is up to the management but the day-to-day cleanliness is the responsibility of the food service worker.

T F 8. Turning dishware upside down will eliminate the chance for dust and foreign matter to fall into them.

T F 9. Drying eating and drinking utensils with a towel is a good practice.

T F 10. It is recommended that the rinsing water used for hand-washing glasses be only clear water.

T F 11. Ice-chilled glasses should be allowed to warm a little before they are thrust into hot water.

T F 12. Bread drawers and storage compartments should be washed daily with soap and water.

T F 13. Polish should never be used on the tops of syrup jars, as it might seep into the tanks and spoil the contents.

T F 14. To prevent clogging of sink drain pipes pour a solution of boiling hot water and sal soda into pipes once a week.

T F 15. Refrigerators should be cleaned and regularly defrosted at least weekly.

T F 16. A good metal polish or abrasive cleaning powder should be used to clean chrome plated surfaces.

T F 17. Stainless steel surfaces with burned-on food spots should be removed with a gritless cleaning powder or fine steel wool.

T F 18. Toasters should be cleaned at weekly intervals.

T F 19. Sanitation is a public trust shared by every person associated with the food service.

T F 20. One of the most important functions in the food service business is sanitation.

T F 21. It is important for the salesperson to return the soiled dishes promptly to the washing department.

T F 22. In some establishments salespersons are expected to sort, scrape, and soak soiled dishes.

T F 23. Hands should always be washed after touching the hair or face, and before leaving the washroom.

T F 24. When food has fallen from a plate onto a tray, replace it on the plate and serve it.

T F 25. Tops of milk bottles should be wiped with a clean cloth before removing the caps.

T F 26. Side towels should always be carried over the shoulder or under the arm.

T F 27. It is not important to rinse ice cream dippers before re-using.

T F 28. Individual spoons for dishing food are not used in restaurants.

T F 29. Silver spoons should be removed from bowls of mayonnaise, chopped eggs, or other dressings before putting them away.

T F 30. The outside and rims of jars and mouths of pitchers should never be wiped before they are replaced in the ice box.

T F 31. The failure to clean up spilled food immediately may cause an accident.

T F 32. It is a good practice to leave cupboard doors ajar.

T F 33. To prevent accidents it is important to watch the movement of other employees in the vicinity.

T F 34. China and glassware must be handled carefully to avoid breakage.

T F 35. If a public health inspector finds a situation in a restaurant very bad, there is very little he can do about it.

T F 36. Inspections of food service establishments are not made as frequently as is desirable.

T F 37. Soft water has more effective cleaning properties than hard water.

T F 38. Of all the restaurant accidents, falls and strains cause the greatest loss of time.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. In a restaurant most accidents are due to _____.

2. The U. S. Public Health Service recommends that eating and drinking utensils should be immersed _____ minutes in _____ F water or _____ minute in _____ water.

3. Good housekeeping will keep the fountain setting _____ and _____, and will attract _____ back again.

4. A reputation for being a clean place in which to eat can be maintained by a restaurant if each worker will _____ the _____ for upholding high standards of cleanliness.

5. In handling silverware, it is proper to touch the handles, but do not touch _____ _____, _____ _____ or _____ _____ with fingers.

6. Moist food should never be handled with the fingers but always with a _____ or _____.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. Butter should be handled with (A) the fingers; (B) a fork; (C) ice tongs; (D) pliers.

_____ 2. Most accidents are due to (A) fate; (B) faulty equipment; (C) bad luck; (D) carelessness.

_____ 3. Brushes in an electric brush scrubber should be removed and washed (A) once a week; (B) every other day; (C) every day; (D) never.

_____ 4. The public attempts to protect itself against bad food by (A) refusing to patronize establishments that serve bad food; (B) having all establishments inspected by departments of health; (C) making all owners responsible for the food they serve; (D) telling their friends not to go to certain restaurants.

_____ 5. Most cleaning in a restaurant is done by using water with the addition of any substance having cleansing quality which is known as (A) detergent; (B) solvent; (C) emulsion; (D) evaporative.

_____ 6. In order for water to clean most efficiently, it should be at a temperature of (A) at least 220°; (B) about 135°; (C) not more than 100°; (D) approximately 180° F.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The board of health in all states will demand clean and sanitary:

(A) _____ (B) _____ (C) _____

2. Three methods of washing glassware used in restaurants are:

(A) _____ (C) _____

(B) _____

3. The three major areas concerning sanitation are:

(A) _____ (C) _____

(B) _____

4. Members of the food sanitation operations are:

(A) _____ (C) _____

(B) _____

5. The three major areas of responsibilities for the food salesperson to assist in the development of standards of cleanliness are:

(A) _____ (C) _____

(B) _____

6. Three factors that are extremely important in achieving success in the restaurant business are:

(A) _____ (C) _____

(B) _____

7. Four liquids which are ideal for removing chewing gum, grease, or oil are:

(A) _____ (C) _____

(B) _____ (D) _____

8. The six types of accidents which occur most frequently in restaurant work are:

(A) _____ (C) _____ (E) _____

(B) _____ (D) _____ (F) _____

Information Sheet #1*

SANITATION, CLEANING MATERIALS, CARE OF EQUIPMENT AND SAFETY

Three points in restaurant work are vitally important to keeping a successful business--sanitation, care of equipment and safety.

Sanitation

Food and drink which are carelessly handled and prepared become sources of diseases and even death. Diseases may be spread to customers through food and drink or through utensils contaminated by diseased food handlers, by pests, or by careless handling.

The public is protected by means of inspection by the department of health. If the situation in a restaurant is very bad, the health department will close the establishment permanently or until such time as the condition is remedied. Inspection staffs are inadequate at times and inspection cannot be made as frequently as would be desirable. For daily protection, the public must depend on the efficiency of restaurant managers and employees.

Many excellent suggestions for sanitation are available from the United States Public Health Service, Washington, D. C.

Cleaning Materials

Dirt of several types must be removed in cleaning the restaurant and its equipment.

1. Loose dirt on the floors should be removed by brush or vacuum cleaner.

2. Chewing gum, grease or oil are removed with turpentine, gasoline, bezine or kerosene. Make sure there are no open flames when using these fluids.

3. Most other types of cleaning use water alone or with the addition of a detergent or an abrasive or both. The cleaning process consists of four steps:

   a. Wetting the soiled surface
   b. Removing the soil with water containing the detergent
   c. Thorough rinsing
   d. Drying (in most cases)

Some important facts about water are:

1. Soft water cleans more efficiently than hard. The hardness of the water may be reduced by the use of softening agents.

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*Adapted from Establishing and Operating a Restaurant, U. S. Department of Commerce, U. S. Government Printing Office, Washington, 1957, pp. 144-172.

2. Hot water cleans more efficiently than cold. Hot water (180°F) melts grease and dissolves detergents readily.

Care of Equipment

One of the most important responsibilities of the manager and employees is the care of equipment. Good care is facilitated by proper installation and followed by periodical cleaning, careful operation and proper maintenance. Instructions for operation of machines and cooking equipment are usually furnished by the manufacturers. It is essential for the manager to see that all employees thoroughly understand the use of the equipment and its proper operation and periodical cleaning and maintenance.

Safety

Accidents in a restaurant usually occur during the busy rush periods. Steps should be taken by the manager in cooperation with employees to remove hazards and educate all to be safety-minded.

The most prevalent type of accidents are cuts, falls, strains, bumps, infections, and burns. Falls and strains cause the greatest loss of time and money.

Special attention should be given to the hazards involved in the handling of machines and other electrical equipment, hazards to the public, and fire hazards.

Assignment
Sheet No. 4

Covering
Units 33-37

RELATION WITH THE PUBLIC

A food service worker must remember that some patrons are not quick in deciding what they want and must be dealt with patiently. Friction with customers must be avoided. In the restaurant business, as in all businesses, remembering the Golden Rule of Business, "The CUSTOMER is always right," may save the employee many embarrassing experiences.

The efficient food service worker must learn to understand the needs of the customers and to serve them in a friendly but dignified manner. It is also important to cultivate an understanding of people, both customers and your fellow workers. Harmony and efficiency are possible only when an understanding of people is at your command.

In this assignment you will have an opportunity to learn the importance of an alert, cooperative, friendly attitude toward your customers and fellow employees. Many people fail in their chosen occupation, not because they cannot do the work but because they cannot get along with other persons.

Assignment:

1. Read the references listed below.
2. Prepare a one-page paper on your understanding of the phrase, "The salesperson is the representative of management."
3. Answer the questions below, and turn in by _____.

References:

A. U. S. Department of Health, Education, and Welfare, Food Service Industry, pp. 27-31.
C. Dietz, The Correct Waitress, pp. 54-56.
D. Dahl, The Efficient Waitress Manual, pp. 49-51.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Most parents do not hesitate to take their youngsters to restaurants.

T F 2. It is the responsibility of the food service worker to remove any bits of paper, rags, food, or other objects on a stairway that may cause someone to slip.

T F 3. Many restaurants do not have provisions for serving children.

T F 4. Food service workers should secure a high stool or put an extension chair on a regular chair when guests with small children arrive.

T F 5. Some restaurants provide children's portions or a child's menu for their small guests.

T F 6. No distinction should be made between adults and children when filling cups and glasses.

T F 7. It is unwise for the waitress to help the mother remove a child from the high chair and put on wraps when the party leaves.

T F 8. A harmonious atmosphere can exist only when the employer and his staff are loyal to each other.

T F 9. The food service worker should avoid showing confidence in his own ability as this is a sign of conceit.

T F 10. The average behind-the-counter salesgirl must work in closer harmony with customers than most waitresses.

T F 11. There are two sets of rules governing habits and personality traits--one for social life and one for business life.

T F 12. One of the most important functions performed in the restaurant is giving comfort to persons away from home.

T F 13. The customer's good will may be obtained by the quality of food and appreciation of the excellence of the service.

T F 14. The food service operation should use every reasonable means to please the customer.

T F 15. The first step in gaining a favorable customer "image" is that of providing a well-balanced meal at a reasonable price.

T F 16. Physical aspects will help win the customer's good will and make him want to return.

T F 17. Cleanliness doesn't play a part in creating a favorable customer image.

T F 18. The food service worker has an important selling job to do.

T F 19. The satisfaction of a customer depends upon the way in which each member of the sales staff performs his duties.

T F 20. The customer is an absolute essential in the operation of a business.

T F 21. Good food alone can win the good will of most customers.

T F 22. The business life of a food service operation depends upon building a clientele of satisfied customers.

T F 23. Salespersons should act on the assumption that most customers are unreasonable.

T F 24. The waitress should assist women with packages, handbags, and wraps.

T F 25. Newspapers should never be given to customers when seated at a table.

T F 26. Most customers like to be seated promptly and have their orders taken as soon as they are ready to make a selection.

T F 27. As a general rule, customers may be served faster at a counter than when seated at a table.

T F 28. When children's service is available, it should be brought to the attention of the mother.

T F 29. The salesperson should be thoroughly familiar with the menu and be able to explain it to customers with difficulties.

T F 30. The salesperson should not be concerned with methods of preparing the items that he serves.

T F 31. Customers usually ask very few questions about the food products served in restaurants.

T F 32. The preparing time for cooked-to-order foods is no concern of the salesperson.

T F 33. If a customer is courteously told how long it will take to prepare an order, he usually will wait much more patiently.

T F 34. First courses may often be suggested and served while a customer is waiting for cooked-to-order food.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Friendliness consists of the quality of _____ and the desire to express _____ _____.

2. The ability to see what needs to be done, and do it, is known as _____.

3. The success of your occupation as a waitress lies, not with your _____ or _____, it lies with _____.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Physical elements of a restaurant that help establish a favorable customer "image" are:

   (A) _____ (C) _____

   (B) _____ (D) _____

2. The salesperson's role in fulfilling the objective of the food service unit requires a willingness to aid management in:

   (A) _____

   (B) _____

   (C) _____

3. What essential items must be displayed in customer-employee relations to build a clientele of satisfied customers?

   (A) _____ (E) _____

   (B) _____ (F) _____

   (C) _____ (G) _____

   (D) _____ (H) _____

Matching

Directions: In the left hand column is a list of items. The right hand column contains descriptive phrases or synonymous terms. Match the descriptions to the terms by placing the letter of the description in the blank at the left of the appropriate term.

_____ 1. friendliness	A.	willingness to hear or observe
_____ 2. cheerfulness	B.	to see without being told what needs to be done
_____ 3. tolerance	C.	believe in yourself
_____ 4. dependability	D.	desire to express good will
_____ 5. "stick-to-it-iveness"	E.	ability to finish what you start
_____ 6. open-mindedness	F.	vigor and glowing animation
_____ 7. resourcefulness	G.	"To live and let live"
_____ 8. initiative	H.	finding a way to get things done under difficulty
_____ 9. enthusiasm	I.	expression of good will
_____ 10. confidence	J.	punctuality and willingness, honestly and effectively

Assignment
Sheet No. 5

Covering
Units 38-47

DINING ROOM REGULATIONS

There are numerous regulations which apply to the operation of the restaurant business. Food service workers should have a knowledge of the health laws governing them and their place of employment. They should have a thorough knowledge of the "unwritten" regulations which govern their personal actions such as alertness, loyalty, poise, promptness, and other traits.

Some business places are stricter than others in the following of food service regulations. It is important that you as a young food service worker develop your own high standards without being forced to do so by the rules of your manager. Only by adopting and practicing these generally established rules and regulations will you be able to become a successful food service worker.

In this assignment you will have an opportunity to study the statutory and "unwritten" regulations which govern food service workers.

Assignment:

1. Read the references listed below.
2. Check with your local Board of Health to ascertain the nature of the ordinances regulating eating establishments. In a paper not to exceed two pages, make a list of the ordinances which you consider essential to the welfare of the public.
3. Answer the questions below and turn in by _____.

References:

A. U. S. Department of Health, Education, and Welfare, Food Service Industry, pp. 154-166.
C. Dietz, The Correct Waitress, pp. 49-51.
D. Dahl, The Efficient Waitress Manual, pp. 54-60.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Food service workers should not visit with fellow workers during service hours.

T F 2. It is a poor policy to tell your troubles to either fellow employees or patrons.

T F 3. Patrons who are old friends or who especially appeal to you should be given better service or extra helpings.

T F 4. As a rule, women patrons tip less than men.

T F 5. If a patron's request is unreasonable, you should try to argue him into seeing the right side.

T F 6. If silver is dropped on the floor, the food service worker should very calmly pick it up, wipe it off, and replace it in the silver box.

T F 7. China or dishes should always be wiped so patrons can see that they are clean.

T F 8. Food service workers should never hint or indicate in any way that they desire a tip.

T F 9. Food service workers should always work quietly and quickly, but regardless of how rushed they may be, should never run.

T F 10. A hurried atmosphere in a restaurant does not encourage hearty dining by patrons.

T F 11. Ash trays, sugar bowls and salt and pepper shakers should be cleaned at the tables when they are empty.

T F 12. If a patron accidentally spoils some food and asks for another portion, he should not be charged for the portion spoiled.

T F 13. When cleaning the table, linen and silver should be gathered together into one bundle.

T F 14. Food service workers should never pass in front of guests unless it is absolutely necessary.

T F 15. Banquet service entails many accident possibilities that are not encountered in regular service.

T F 16. If a food service worker accepts a guest's wrap or bag for checking or hanging up, the restaurant becomes responsible for it if stolen or damaged.

T F 17. Drunken patrons should be reported to the manager at once so they may be assisted out of the restaurant quietly and quickly.

T F 18. If a mistake is made on a guest's check, it should be erased and the correction made.

T F 19. A very common error when making change for a customer is to return both the change and the original bill the customer gave you.

T F 20. English service is such that guests make their own choice and serve themselves from the main table.

T F 21. When French service is used, the headwaiter places the food on the plates and the food service workers place the plates in front of the guests.

T F 22. Regular guests should be given more cordial treatment than is accorded to new guests.

T F 23. If a friend or relative asks, you should serve him his meal at a reduced price.

T F 24. The food service worker should never ask his employer for advice relative to personal matters.

T F 25. A person obsessed by fears and worries is not likely to achieve success.

T F 26. Much of the responsibility for the way foods look and taste rests with the food service worker.

T F 27. Foods which have proper color give the guest the impression that the food is of a superior quality.

T F 28. Soups should be served in pre-heated bowls and should be covered to keep them hot.

T F 29. Hot foods should be picked up first when filling a customer's order in the kitchen.

T F 30. A food service worker should be well versed on the substitutions he is allowed to make in a meal.

T F 31. Efficient food service workers try to plan their work and dovetail duties connected with the serving of several guests.

T F 32. It is very important to plan the work in advance; however, the sequence in which it is performed is not so important.

T F 33. Supplies should be arranged on the side table in an orderly manner so they will look neat to the guests seated at near-by tables.

T F 34. Dishes should be placed gently on the edge of the table and then slid quietly into place.

T F 35. Ice cold beverages should not be poured directly into hot glasses.

T F 36. Napkins should not be used for cleaning as they might become permanently stained.

T F 37. Guests should be warned when plates, containers, or handles are very hot.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Great care must be exercised to make sure that the food service worker's hands or _____ never touch the top of a plate.

2. One important point for food service workers to remember in regard to the temperature of food is that hot foods should be served on a _____ plate and cold foods served on a _____ plate.

3. If a large party dines at your restaurant, and you know which person is the hostess for the party, she should be served _____.

4. Service which is very elegant and includes burning alcohol lamps and rolling tables is called _____ service.

5. When the food service worker holds the plate in one hand and serves the food to the guest's plate with the other, it is known as _____ service.

6. To show a guest _____, you must receive and entertain him kindly and graciously.

7. Hospitality should be extended to your _____ _____ as well as to your customers.

8. The appealing appearance of foods served to patrons depends upon judgment by sight which is sometimes called _____ _____.

9. When speaking of the "form" of food, we are usually referring to its _____ and _____.

10. Restaurant work can be made much easier for the worker and more economical to the restaurant if it is well _____ in advance.

11. When the fewest number of motions is used to accomplish a task, the work may be performed more efficiently and with less _____ to the workers.

12. When it is necessary to pass a fellow worker, he should be passed on the _____ if at all possible.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Five types of table service as found in restaurants are:

   (A) _____ (C) _____ (E) _____

   (B) _____ (D) _____

2. Most authorities agree that fine quality in foods may be determined by the following four factors:

(A) _____ (C) _____

(B) _____ (D) _____

3. A guest's judgment, by sight, of foods is based upon the reaction to the following five essentials of quality food:

(A) _____ (D) _____

(B) _____ (E) _____

(C) _____

4. Careful planning of work will save and reduce three important elements in efficient restaurant work. They are:

(A) _____ (B) _____ (C) _____

Assignment
Sheet No. 6

Covering
Units 48-56

PREPARING THE SERVICE STATION AND SIDE WORK DUTIES

Food service workers have many duties other than waiting on customers. In some of the larger restaurants a person known as a bus boy is employed to help the food service worker; however, in most establishments it is the duty of the food service worker to see that the service station is clean and ready for new customers at all times. Sugar bowls, salt and pepper shakers, syrup jugs, and various other items should be cleaned and filled during slack periods.

It is important for the efficient food service worker to note and then perform the many small duties which are so necessary in restaurant work. Employers appreciate employees who can do this work without being constantly told what needs to be done.

In this assignment you will have an opportunity to learn what duties are expected of the food service worker other than the actual serving of customers.

Assignment:

1. Read the references listed below.
2. In a one-page paper list all of the duties you perform at your serving station that are not directly related to the servicing of customers.
3. Answer the questions below and turn in by _____.

References:

A. U. S. Department of Health, Education, and Welfare, Food Service Industry, pp. 85-87.
B. Sealtest Foods, Know Your Job, p. 12.
D. Dahl, The Efficient Waitress Manual, pp. 38-47.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Bus boys usually are employed in hotel dining rooms to keep the waitress's side stand supplied.

T F 2. Trays are stacked to eliminate breakage and facilitate unloading.

T F 3. Salt and pepper shakers, sugar bowls and catsup and mustard jars must be filled each day.

T F 4. White pepper has a tendency to make the containers in which it is kept appear cloudy.

T F 5. Black pepper is stronger in flavor and more attractive in the container than white pepper.

T F 6. The best way to polish salt and pepper shaker tops is by hand, with silver polish.

T F 7. Table linen should be changed quickly and neatly after each guest leaves.

T F 8. Silver sugar bowl lids should be washed after polishing to remove all excess polish.

T F 9. When original catsup bottles are used, they should be wiped with a damp cloth to prevent caking around the top.

T F 10. Metal ash trays should be polished in soapy water once a day.

T F 11. Food service workers should promptly report all wet or greasy spots on floors or stairs.

T F 12. A heavy breakage report will focus unfavorable attention on a careless food service worker.

T F 13. When carrying a loaded tray, be sure to have a heavy plate above the arm and others evenly distributed.

T F 14. Glasses of water should be carried on the edge of the tray.

T F 15. Side work, when well done, takes very little time, and usually only one person is responsible for it.

T F 16. Sugar bowls should be emptied and cleaned only once a day.

T F 17. Care should be taken to keep the sugar free from lumps and foreign material.

T F 18. A stiff brush should be used to clean the holes in the lids of salt and pepper shakers before they are washed.

T F 19. The outside of syrup jugs should be washed with soap and water after filling.

T F 20. Torn menu folders should be mended with scotch tape.

T F 21. Flowers should be arranged in large and fancy containers.

T F 22. Individual creamers should be washed and thoroughly cooled before refilling.

T F 23. The top of the serving tray should be wiped clean before it is loaded to prevent the bottoms of the dishes from being soiled.

T F 24. Fingers, if they are clean, may be used to place ice cubes in glasses.

T F 25. Silver should be cleaned according to the special directions of the restaurant.

T F 26. Food service workers should clear and reset the unoccupied tables in their serving stations just prior to going off duty, if the serving period is not ended.

T F 27. Before any food service workers leave their stations, everything should be in order in accordance with the instructions of the restaurant.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Salt and pepper shakers should be emptied and washed in soapy water at least once a _____.

2. Silver will be bright and sparkling if it is dropped in a pan of very hot water with _____ _____ and allowed to stand for a while.

3. Oakite is a good silver polish, but must be used only in _____ _____ pans.

4. To avoid breaking dishes, the efficient food service worker will train himself to become _____ _____.

5. Butter should be sliced beforehand, and a good way to prevent it from becoming soft is to have a _____ _____ _____ ready to lay the chips on.

6. Duties assigned daily to the food service worker other than those related to actual serving of food are commonly called _____ _____.

7. Sugar bowls should be emptied, washed, thoroughly dried, and refilled _____ _____ _____ _____.

8. The inside of salt and pepper shakers should be washed with a _____ _____.

9. Salt and pepper shakers should not be filled after washing until they are _____ _____.

10. When folding napkins, the fold should be made _____ and the edges should meet _____.

11. The edges and bottoms of serving trays should be kept clean and dry to protect both the _____ and the serving table surface.

12. After using silver cream to clean silver, all traces of the cleaner should be removed from the silver by thoroughly washing, rinsing, and polishing with a _____ _____.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. As salt and pepper shakers are too small to be washed inside, the easiest way to remove clotting is to use a (A) soft rag; (B) few grains of rice in the water; (C) little shot and soapy water; (D) toothpick.

_____ 2. A few grains of rice added to each salt shaker will (A) keep the salt clean; (B) look very nice; (C) absorb moisture; (D) allow less salt to flow from the shaker.

_____ 3. Silver cleaned by a solution of hot water and sal soda should be removed from the container by (A) using a ladle or rubber gloves; (B) emptying the solution out; (C) cooling the solution with cold water and then lifting the silver out with the fingers; (D) use of a strong magnet.

_____ 4. After washing and polishing the tops of salt and pepper shakers, they should be dried by (A) waving them through the air; (B) wiping them with a dry clean cloth; (C) leaving them in the rinsing sink; (D) placing them in a heated oven.

_____ 5. Discolored marks inside cups and pots caused by coffee or tea may be removed by (A) polishing with steel wool; (B) use of a wet cloth that has been rubbed on a cake of sal soda; (C) soaking in hot water; (D) use of a wet cloth that has been rubbed on a cake of Sapolio.

_____ 6. As a rule, "side work" is done (A) during serving periods; (B) after closing time; (C) in the early morning; (D) during slack periods.

_____ 7. When the serving period is over, the tables should be (A) reset; (B) turned upside down; (C) grouped together; (D) stripped.

_____ 8. Holes in the lids of salt and pepper shakers should be unclogged by using (A) a stiff wire brush; (B) a high pressure water stream; (C) a clean toothpick; (D) a broom straw.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. What items are included in a side work schedule?

(A) _____

(B) _____

(C) _____

(D) _____

(E) _____

(F) _____

(G) _____

Assignment
Sheet No. 7

Covering
Units 57-60

SETTING THE TABLE

Good will has been defined as "the disposition of the pleased customer to return to a place where he has been well treated." This definition includes fine food, pleasant atmosphere, and efficient service. One of the requirements for efficient service is that the food service worker be capable of correctly and neatly setting the table.

Have you ever been in a restaurant when the person waiting on you brought you a plate and the necessary silverware and just "piled" them in front of you for you to untangle? Did you consider that restaurant and salesperson efficient? The answer is obvious. Just as you resent poor service, so do other people who eat in restaurants. It takes very little effort to be neat and correct, yet it pays big dividends in good will and efficiency.

In this assignment you will have an opportunity to learn the correct way of setting a table, thereby giving customers the feeling that you are competent and courteous.

Assignment:

1. Read the references listed below.
2. Make a careful study of various ways of setting tables (Ref. D. pp. 18-23) then list the differences, if any, that exist in table service items used between:

   a. breakfast service and luncheon service
   b. breakfast service and dinner service
   c. luncheon service and dinner service

3. Answer the questions below and turn in by _____.

References:

A. U. S. Department of Health, Education, and Welfare, Food Service Industry, pp. 80-85.
C. Dietz, The Correct Waitress, pp. 41-48.
D. Dahl, The Efficient Waitress Manual, pp. 18-23.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. When breakfast is served "club" style, fruits, juices, toast and coffee should always be served at separate times.

T F 2. Individual packages of cereal should be cut through the middle so that it will be easy for the guest to empty the contents into a bowl.

T F 3. Butter is seldom served on the same plate with the bread.

T F 4. Guests should never be required to ask for their check.

T F 5. Orders for "cooked to order" foods should be placed with the kitchen personnel last.

T F 6. Salads should be placed to the right of the guest.

T F 7. To pour coffee or tea, the waitress should lift the cup and saucer from the table with her left hand and pour with her right hand.

T F 8. Beverages should always be served with the main course.

T F 9. The guest's check should be placed to his right, face up.

T F 10. One prerequisite to good service is that the waitress know what is on the menu.

T F 11. Although all restaurants do not use the same type of service, certain fundamental duties that pertain to the serving of food are common to all.

T F 12. Keeping the tables attractive is a definite responsibility of the food service salesperson.

T F 13. When bus boys are used to help the waitress, it is the duty of the bus boy to see that adequate preliminary preparations have been made for serving the guests.

T F 14. The waiter should provide tables that are properly set before service is given.

T F 15. A cover includes the space at the table within which one place is set.

T F 16. When doily service is used, the doilies or place mats should be laid in the center of the cover about one inch back from the edge of the table.

T F 17. Silverware should never be placed on the doily.

T F 18. When silence pads are used, they should be placed on the table so that the edges do not hang below the tablecloth.

T F 19. The tablecloth should be arranged so that the longest edges are toward the guest.

T F 20. The folded napkins are placed at the left of the forks with the open corners about five inches from the front edge of the table.

T F 21. At formal dinners it is permissible to place the folded napkin on the service plate.

T F 22. Knives and forks should be placed about nine inches apart so that a plate may be easily placed between them.

T F 23. Knives are placed at the right side of the cover with the cutting edge of the blade turned away from the plate.

T F 24. Spoons are laid, bowls up, at the left of the knives.

T F 25. Silver for dessert service is placed just before the respective course at the right side of the cover.

T F 26. A dessert fork should be placed to the right of the cover next to the plate just before serving the dessert.

T F 27. If knives are not used in the cover set-up, the forks and spoons are placed to the right of the cover.

T F 28. The bread and butter plate is placed to the left of the dinner plate directly above the tines of the meat fork.

T F 29. The water glass should be placed at the base of the knife handle.

T F 30. Wine, liquor and beer glasses are placed to the left of the water glass.

T F 31. Sugar bowls and salt and pepper shakers are generally placed on the side nearest the wall when small tables are located in the center of the room.

T F 32. On large tables only one set of sugars and creamers is needed.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Many restaurants serve dry toast in _____ and buttered toast under a _____.

2. Restaurants which do not use tablecloths as standard equipment often place _____ _____ under the service plate

3. Water glasses should be filled approximately _____ full.

4. Vegetable dishes should be placed at the _____ of the main dish or meat plate.

5. Salads should be placed to the _____ of the dinner plate.

6. After leaving the menu with a guest, the waitress should return for his order in about _____ minutes.

7. Pats of butter should be placed on the bread and butter plate with a small _____.

8. The group of tables or counter space, for the service of which a waitress is usually responsible, is called her _____.

9. Many establishments will assign a _____ _____ to help the waitress keep her station in order.

10. An individual cover is usually set within a space about _____ inches wide and _____ inches deep.

11. The water glass should be placed at the _____ of the _____ and filled to the proper level.

12. Napkins and silver should be placed about _____ from the edge of the table and at _____ angles to it.

13. The knife should be placed to the _____ of the cover.

14. If an additional knife is furnished for butter, it should be placed at the _____ of the dinner knife.

15. If a butter spreader is used, its cutting edge should be turned _____ the butter plate.

16. When an open-topped sugar bowl is used, a _____ _____ _____ is placed at the right of the bowl.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The suggested order for serving the courses in a dinner meal is:

(A) _____ (F) _____

(B) _____ (G) _____

(C) _____ (H) _____

(D) _____ (I) _____

(E) _____

2. Tables that are properly set before service is given will include:

(A) _____ (C) _____

(B) _____ (D) _____

3. Two items for which the food service worker is responsible when a side table is used are:

(A) _____

(B) _____

4. Four duties of the food service worker at the serving station which involve good housekeeping techniques are:

(A) _____

(B) _____

(C) _____

(D) _____

Assignment
Sheet No. 8

Covering
Units 64-70

RECEIVING GUESTS AND TAKING THE ORDER

Many details should be observed when greeting guests and taking their orders. Questions such as, "How should I greet a guest?", and "How and where do I stand when taking the order?", "How long after the guest is seated should I wait before asking for the order?", are frequently confusing to food service workers.

The essential elements necessary to acquire any skill are speed, accuracy, and confidence. This applies to the food service worker just as it does to workers in any other occupation. To be an efficient food service worker, confidence in your ability to meet guests is necessary. It is highly important that you learn the correct way of approaching guests and taking their orders.

In this assignment you will have an opportunity to become familiar with the proper techniques used in greeting guests. Observe and practice them diligently, because not only will they make your employer and guests regard you more highly, they also are applicable to good manners in any situation.

Assignment:

1. Read the references listed below.
2. Answer the following questions and turn in by _____.

References:

A. U. S. Department of Health, Education, and Welfare, Food Service Industry, pp. 27-34.
B. Sealtest Foods, Know Your Job, pp. 6, 8-9.
C. Dietz, The Correct Waitress, pp. 20-26.
D. Dahl, The Efficient Waitress Manual, pp. 10-17.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The waitress should present herself to take an order as soon as the guest is seated.

T F 2. The food service worker always writes in the prices of the various items on each order.

T F 3. All a la carte dishes produce about the same amount of profit.

T F 4. As soon as customers have been seated, hand the menu to the gentleman.

T F 5. Customers are less inclined to order a good meal if they have a long wait while food service workers visit.

T F 6. A good saleswoman will suggest a salad with a la carte meal.

T F 7. It is a good practice to feed a guest's vanity as well as his appetite.

T F 8. Good service is quite common in our restaurants of today.

T F 9. An efficient food service worker should not be concerned with the length of time it takes to prepare a meal.

T F 10. The waitress does not necessarily need to know the merchandise and prices of her restaurant.

T F 11. Baked Virginia ham is a good "ready-to-serve" food suitable for suggestion to the guest who is in a hurry.

T F 12. Apple sauce is a suitable food accompaniment for fish.

T F 13. The efficient waitress will organize a daily cleaning and sidework schedule and adhere to it.

T F 14. One item of sidework is that of dusting daily the furnishings in your service station.

T F 15. Efficient planning is the keynote to smooth, uninterrupted service and also to higher tips.

T F 16. A good salesperson refills water glasses, serves sugar, condiments, butter, and other services required without being reminded.

T F 17. Food service workers should help and assist persons who need special care, such as elderly people or small children.

T F 18. It is a great asset to the waitress if she can remember the names of regular patrons.

T F 19. A prompt approach to the customer is just as important as a friendly greeting.

T F 20. Customers are more willing to wait patiently if a glass of water, napkin, and a clean menu are placed before him.

T F 21. It is part of the food service worker's job to offer assistance in finding the desired items and tactfully indicating featured offerings to the customer.

T F 22. Customers should be given enough time to study the menu before being asked for their order.

T F 23. To avoid errors, all orders should be repeated to the customers.

T F 24. Generally speaking, selling requires no other talents than those you put to work in everyday living.

T F 25. The customer likes to be seated promptly and that his order be taken as soon as he is ready to make a selection.

T F 26. Suggestive selling is defined as any method of selling goods other than those asked for by the customer.

T F 27. The most satisfactory type of suggestive selling is based on a knowledge of the customer's likes and dislikes.

T F 28. Foods typical of a geographical region should not be suggested to customers, as they may not care for that kind of food.

T F 29. No consideration need be given to the amount of money the customer wishes to spend for a meal.

T F 30. The food service worker should make no attempt to help a customer meet his nutritional requirements when ordering.

T F 31. Food suggestions should always be made in a positive manner.

T F 32. The use of such terms as "hot" rolls, "chilled" watermelon, and "old-fashioned" strawberry shortcake helps to create a favorable mental impression.

Multiple-Choice

Directions: Listed below are some commonly ordered foods that are served with various accompaniments to suit the varied tastes of customers. Indicate which accompaniment(s) you would suggest, or serve, to the guest for each order, by placing in the space at the left of each item, the letter of your suggestion.

_____ 1. Baked beans: (A) salad dressing; (B) grated cheese; (C) chili or catsup; (D) lemon or cream.

_____ 2. Bananas: (A) crackers; (B) grated cheese; (C) cream or lemon juice; (D) butter.

_____ 3. Berries: (A) cup or demi-tasse; (B) crackers; (C) lemon or sauce; (D) cream, powdered sugar.

_____ 4. Clams: (A) sliced lemon; (B) horseradish and cocktail sauce; (C) honey, jam, or jelly; (D) knife or fork.

_____ 5. Fried fish: (A) jelly; (B) maple syrup; (C) tartar sauce; (D) mustard.

_____ 6. Ham: (A) mustard, catsup; (B) butter; (C) lemon; (D) powdered sugar.

_____ 7. Hot cakes: (A) lemon or cream; (B) powdered sugar; (C) bread or crackers; (D) honey, jam, or jelly.

_____ 8. Iced coffee: (A) cream and powdered sugar; (B) cherry served in center; (C) tartar sauce; (D) sliced lemon.

_____ 9. Iced tea: (A) cheese; (B) cream; (C) crackers; (D) lemon section.

_____ 10. Meat pies: (A) cream; (B) meat sauce; (C) serving spoon, knife, and fork; (D) lemon juice.

_____ 11. Milk toast: (A) cup or demi-tasse; (B) extra hot water; (C) sugar; extra butter; (D) syrup.

_____ 12. Pie: (A) sugar and extra butter; (B) cheese or ice cream; (C) crackers; (D) whipped cream.

_____ 13. Roast lamb: (A) slice of lemon; (B) bread or crackers; (C) meat sauce; (D) tartar sauce.

_____ 14. Salads: (A) honey; (B) grated cheese; (C) butter; (D) salad dressing.

_____ 15. Soup: (A) milk or cream; (B) bread or crackers; (C) long-handled spoon; (D) soup fork.

_____ 16. Watermelon: (A) salt, knife, fork; (B) lemon or cream; (C) bread or crackers; (D) toast and butter.

_____ 17. Toast: (A) cream; (B) sugar; (C) jelly or marmalade; (D) maple syrup.

_____ 18. Sandwiches: (A) pickle or olive; (B) cheese; (C) butter; (D) jelly.

_____ 19. Coffee: (A) extra hot water; (B) melted butter; (C) cream; (D) lemon.

_____ 20. Tea: (A) extra tea bag; (B) lemon or cream; (C) powdered sugar; (D) crackers.

Identification

Directions: Listed below are some commonly requested a la carte foods that the food service worker should know approximately how long it takes to prepare. In the blank to the left of each order, indicate the approximate number of minutes (rounded off to nearest five minutes) required to prepare each.

_____ 1. veal chops

_____ 2. roast saddle of lamb

_____ 3. broiled chicken

_____ 4. pork chops

_____ 5. hash, browned

_____ 6. oyster stew

_____ 7. ham, broiled

_____ 8. fish, broiled

_____ 9. spring chicken en casserole

_____ 10. sirloin, for two

_____ 11. porterhouse steak for two

_____ 12. extra sirloin

_____ 13. tenderloin for two

_____ 14. small sirloin for one

_____ 15. mutton chops

Assignment
Sheet No. 9

Covering
Units 71-75

GIVING AND ASSEMBLING THE ORDER

Have you ever given an order for a hamburger without onions and then had it served to you with onions? Whose fault would it be--the customer's, the chef's, or the food service worker's? We can certainly say that it was not the fault of the customer and probably not that of the chef. The only other person involved is the food service worker.

From the foregoing, you can see the importance of getting the order from the customer correctly and of giving the order to the chef correctly. Customers want just what they order and are resentful if the order is changed in any way. For this reason, it is imperative that food service workers be very careful when giving the order and when assembling it to serve to the guest.

In this assignment you will have an opportunity to learn the importance of correctly giving and assembling an order. Remember, you are the chief representative of your restaurant in the eyes of the public, and the customer will judge it by the service you render.

Assignment:

1. Read the references listed below.
2. Answer the questions below and turn in by _____.

References:

A. U. S. Department of Health, Education and Welfare, Food Service Industry, pp. 80-90.
B. Sealtest Foods, Know Your Job, p. 7.
C. Dietz, The Correct Waitress, pp. 37-38.
D. Dahl, The Efficient Waitress Manual, pp. 48-49.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Workers should be just as orderly and well behaved in the serving room as in the dining room.

T F 2. The new waitress should make it a point to study the layout of the serving room during slack periods.

T F 3. Hot foods should be picked up after cold foods have been assembled.

T F 4. Standing hot foods do not deteriorate as quickly as cold foods.

T F 5. The efficient food service worker must know every station in the kitchen or serving room.

T F 6. Orders should be called out in a loud clear voice.

T F 7. Cooked-to-order foods should be called for last.

T F 8. The chef usually is not interested in getting orders out promptly.

T F 9. In assembling the order, all silverware and accompaniments needed should be collected.

T F 10. Before an order is served it should be rechecked to see that all silverware is clean, and that dishes and glassware are spotless and unchipped.

T F 11. The kitchen layout and number of service stations will determine the route the salesperson must follow in assembling her order.

T F 12. In giving an order, the correct names for foods should be used rather than slang phrases.

T F 13. One reason for making a distinction between an order on the dinner menu and the one on the a la carte menu is that there may be a difference in the size of the servings.

T F 14. A food service worker is never justified in asking to be served rapidly or out of turn.

T F 15. Soups should be covered in order to help retain the heat.

T F 16. When hot bread is to be served, it should be picked up first.

T F 17. Tea and coffee pots should be rinsed with cold water before they are filled with hot beverages.

T F 18. The tray should be loaded with heavy plates and saucers close to the edges in order to make it easier to carry.

T F 19. When loading the tray, cups should be placed on saucers.

T F 20. Hot and cold dishes of food should be placed on the tray so that they do not touch each other.

T F 21. Pot spouts should be turned away from plates of food.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. In the serving room, the dish table is usually situated next to the _____ door so that a full tray may be quickly unloaded.

2. Unless protected by being in a pot, _____ will cool quicker than any other hot food.

3. The waitress must know the proper _____ in which to order and pick up foods in the kitchen.

4. Orders should be given at the correct _____ and in the most efficient _____.

5. The procedures used for giving and collecting orders in the kitchen vary somewhat with the _____ and _____ of the kitchen.

6. The waitress who is _____ and _____ in giving and assembling orders will help to maintain harmonious relations between the kitchen and the dining-room personnel.

7. The new waitress must quickly learn the functions of each unit and exactly what _____ and _____ are available at each of them.

8. When written orders are used, the waitress usually signs either her _____ or her _____ to the order slips.

9. The verbal order should be given in a _____ and _____ _____ a loud voice.

10. When giving the order, the food service worker should notify the kitchen whether it is on the dinner or on the _____ menu.

11. The waitress should not make a practice of saying that is "_____ _____ _____" for her order.

12. The food service worker should know the approximate amount of _____ it will take to prepare an order so that she will know when to return for it.

13. Those foods which require the _____ time to prepare should be ordered first.

14. The waitress should learn to assemble her order so that she can pick up each food as soon as possible after it has been _____.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The waitress gives her order in one of three ways. They are:

   (A) _____

   (B) _____

   (C) _____

2. While the order is being filled, the waitress should collect all the serving equipment that she will need and the cold food accompaniments such as:

   (A) _____ (D) _____

   (B) _____ (E) _____

   (C) _____

3. The following precautions should be observed in checking the order and loading the tray:

   (A) _____

   (B) _____

   (C) _____

   (D) _____

   (E) _____

   (F) _____

Assignment
Sheet No. 10

Covering
Units 76-85

SERVING THE ORDER

Orders may be served in various ways depending upon the custom of the individual restaurant. The more elaborate the restaurant, the more elaborate the method of serving is likely to be. Each food service worker should acquaint himself with the method of serving used in his place of employment.

It is important that those in the restaurant business know the methods of serving which may be encountered in specific situations. However, several rules for service are approved by social custom for use in all restaurants and these should be thoroughly understood by all food service workers.

In this assignment you will have an opportunity to learn the various methods of serving the order and the general rules that apply to all situations.

Assignment:

1. Read the references listed below.
2. For this assignment you are to itemize the procedures in serving an order. With these procedures in mind, serve an order to a guest. After serving the order, note your procedural errors and report these, together with suggestions for improvement, to your coordinator.
3. Answer the questions below and turn in this assignment by _____ .

References:

A. U. S. Department of Health, Education and Welfare, Food Service Industry, pp. 90-98.
B. Sealtest Foods, Know Your Job, p. 7.
C. Dietz, The Correct Waitress, pp. 28-33.
D. Dahl, The Efficient Waitress Manual, pp. 28-40.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. All food is placed from the left in order to reduce the danger of spill.

T F 2. When removing food or empty dishes, it is best to remove them from the same side on which they were served.

T F 3. If you see a guest accidentally drop a napkin, you should immediately pick it up and hand it back to him.

T F 4. At a large table, the waitress should always move the sugar bowl within reach of the guest when serving coffee.

T F 5. The efficient food service worker will ask guests when they prefer their beverage to be served at the time she takes the order.

T F 6. Guests should not receive the check with the face turned down as this gives the appearance of trying to hide the amount shown on the check.

T F 7. Guests are very apt to eat more leisurely at night, thus requiring more time for each service.

T F 8. If a patron orders a chop or steak, the food service worker should turn the order in immediately so that it will be ready when the first course is finished.

T F 9. When stacking a tray from a table that has been used, the cups should not be removed from the saucers.

T F 10. Any paper napkins that may have been used at a table should be rolled into a ball and placed in one of the empty glasses.

T F 11. It is safer to carry loads on the shoulder than below the waist.

T F 12. Liquids are poured from the left of the guest.

T F 13. If milk is brought to the table in half pint bottles, the serving glass should be placed upside down over the bottle top.

T F 14. Should a guest need extra silver after starting his meal, it should be placed at his right.

T F 15. When serving another course, the soiled dish is removed with the right hand the next course is placed with the left hand.

T F 16. The hand closest to the guest should be used for serving when guests are seated at booths or wall tables.

T F 17. Hot or cold dishes should be handed directly to the customer.

T F 18. If an establishment has a policy of "pay when served" the worker should courteously call the customer's attention to this fact.

T F 19. Tomato and fruit juices are best served on small plates.

T F 20. Cold water should be poured in finger bowls if they are used.

T F 21. Soup service should be removed when the guest has completed the soup course.

T F 22. When bread is served on trays, it should be placed at the right of the salad plate.

T F 23. Hot beverages served with the main course should be placed to the right of the cup and saucer.

T F 24. Glasses containing an iced drink should be placed to the right and a little below the water glass.

T F 25. A dessert service should be placed in the center of the cover.

T F 26. When plate service is used, place the dinner plate in the center of the cover.

T F 27. The salad should be placed at the right of the forks when it is served with the main course.

T F 28. The proper procedure is to serve extra butter without asking the guest if he desires it.

T F 29. The beverage should be placed to the right of the teaspoons.

T F 30. Platters and other serving dishes should be removed first when clearing the table.

T F 31. The salad plate is removed last when clearing the table.

T F 32. After the main course has been completed, the empty milk glass is removed from the left side.

T F 33. Water glasses should remain on the table and be kept filled as long as the guest is seated.

T F 34. Soiled linen can be changed very skillfully and will not disturb the guest if properly done.

T F 35. When a man and woman are dining together, the check should be presented to the man unless separate orders have been written.

T F 36. The waitress should always mention the amount of the sales check and the denomination of the bill when she accepts payment for a check.

T F 37. The food service worker should return some of the change from a bill in small silver.

T F 38. Disappointment should never be shown when the size of a tip is less than that customarily received.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. All food except beverages should be served from the _____.

2. The reason for using the right hand for removal and the left hand for placement of serving is to minimize the danger of a _____.

3. An easy way to learn the rule that dictates which hand to serve food with is by saying, "Serve with the hand _____ _____ the customer."

4. As a general rule, speedy service depends chiefly on the space and the _____ used in the serving room.

5. If the amount of space and serving system are up to standard, it should be possible to serve a guest an a la carte luncheon in _____ minutes.

6. Coffee is usually served from a coffee pot at the table when _____ service is used.

7. When serving banquets or formal groups, the _____ or the guest of _____ should be served first.

8. Forks should be placed to the _____ of the service plate.

9. One very important rule to be observed is to always say a cheerful _____ _____ at the close of each order.

10. The most elaborate form of table service is the _____ service.

11. The English style of service is sometimes referred to as _____ _____.

12. Most banquet meals are served using the _____ type of table service.

13. A form of buffet service used in many Swedish restaurants is the _____.

14. A cheerful attitude on the part of the salesperson at the breakfast service will help to _____ _____ _____ _____ for customers.

15. Fruit dishes, fruit juice glasses, and cereal bowls should always be placed on _____ _____ before serving.

16. When finger bowls are used, they should be filled about _____ full of water.

17. Dinner guests are seldom in a hurry and may expect a more fastidious and leisurely _____ of _____ than they would expect for breakfast or lunch.

18. When clearing the table, the _____ _____ plate should be removed first.

19. The _____ and _____ plate is removed from the table last.

20. Hot tea and coffee service should be left on the table until after the completion of the _____ _____.

21. The guest should not be _____ _____ for the check.

22. The check should be presented either immediately after the last course has been served or as soon as the guest has _____ _____.

23. The check should be accurately totaled and laid _____ _____ on the table to the _____ of the cover or placed on a small change tray.

24. It is courteous to ask if any other _____ is desired before presenting the check.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Trays used for bringing food from the kitchen to the dining room should be loaded with the following three factors in mind:

   (A) _____ (C) _____

   (B) _____

2. When trays are loaded for the removal of dishes from the dining room to the kitchen, the three factors to consider are:

   (A) _____ (C) _____

   (B) _____

3. One of the rules to be observed when delivering table orders is to avoid piling dishes upon each other. Three things which may happen if this rule is not observed are:

   (A) _____ (C) _____

   (B) _____

4. Most restaurant operators strive to give satisfactory service to their guests, and this is achieved only by adhering to these three standards:

(A) _____

(B) _____

(C) _____

5. Five types of table service used in various restaurants throughout this nation are:

(A) _____ (D) _____

(B) _____ (E) _____

(C) _____

6. The three traditional forms of table service most commonly used in catering to the public are:

(A) _____ (B) _____ (C) _____

7. As a rule, luncheon customers may be classified into two groups, which are:

(A) _____ (B) _____

Assignment
Sheet No. 11

Covering
Units 86-93

CAFETERIA SELF-SERVICE UNITS

Food service units are classified by the type of service rendered. The cafeteria self-service unit differs from the service unit by eliminating the extensive menus and elaborate table service.

Cafeteria customers are able to make their food selections from foods displayed at a service counter and assemble the kinds and quantity of food desired. A cafeteria offers quick and economical service for those desiring such types of service.

Cafeterias meet the needs of shoppers and business workers who are in a hurry.

In this assignment you will have an opportunity to learn counter serving techniques and the many different procedures of operation found in self-service cafeteria units.

Assignment:

1. Read the reference listed below.
2. In a short one-page paper, list the main differences, as you see them, between cafeteria service and table service.
3. Answer the questions below and turn in this assignment by _____.

Reference:

A. U. S. Department of Health, Education, and Welfare, Food Service Industry, pp. 34-37; 41-42; 54-58; 127-143.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Many customers will experience difficulty in making a quick decision when confronted by several appealing foods.

T F 2. A good counter salesperson will suggest foods to hesitant customers.

T F 3. A counter salesperson need not know the prices of the food as this is the checker's job.

T F 4. Counter displays are one of the least important types of advertising in which salespersonnel take part.

T F 5. It is the menu planner's job to group the foods on the counter in regard to kind and form.

T F 6. Color has no role in the displaying of food at a counter.

T F 7. A yellow and brown color harmony may be used to advertise waffles.

T F 8. The service-counter salesperson should possess the same characteristics as the dining room salesperson.

T F 9. Careless counter workers can cause a lot of waste and lower profit to the business.

T F 10. Cafeterias may employ floor girls to supply extra servings to customers.

T F 11. The work of floor girl is the beginning job in a food cafeteria.

T F 12. A cafeteria checker must have poise and composure in order that he or she be undisturbed by challenging customers.

T F 13. The last person on the food service staff that has contact with the customer is the food checker.

T F 14. If a counter worker on a cafeteria line is inefficient and slow, it will interfere with the efficiency of the entire line.

T F 15. A well-arranged counter will reflect the creative ability, ingenuity, and individuality of the management.

T F 16. Broccoli looks more appetizing and stays hot longer when placed in deep pans at the serving counter.

T F 17. Garnishes have no purpose except to add to the attractiveness of the food.

T F 18. The salad counter is packed with a bed of cracked ice.

T F 19. Colored vegetables, such as tomatoes and beets, should be placed in rows side by side.

T F 20. Large and small plates should be placed in the same rows at the dessert counter.

T F 21. Low and tall dishes may be arranged neatly in the same row at the dessert counter.

T F 22. Broccoli, asparagus spears, glazed carrots and fingers of eggplant should be served in sauce dishes.

T F 23. When replenishing the contents of a serving pan, it is best to pour the fresh material into the soiled container already in the steam table.

T F 24. Dishes on the cafeteria counter should be kept moving from back to front so that no one dessert will stand on the counter for a long time.

T F 25. Freshly made coffee should be ready just after the meal service begins.

T F 26. For the sake of economy, coffee making utensils should be used for making tea also.

T F 27. Water which has not quite reached the boiling point should be used for making tea.

T F 28. Customers who ordered a second cup of coffee should receive their order in a clean cup.

T F 29. Sanitary standards maintain that regular and consistent cleaning routines after each meal are necessary.

T F 30. A stiff brush should be used to wash the walls of the steam table.

T F 31. Bread storage spaces should be washed every two weeks with a hot detergent solution.

T F 32. The inside of coffee urns should be washed with detergent solution and rinsed with clean water once a week.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The counter salesperson delivers the order at the _____ _____ and has no further responsibility for the guest.

2. The selling task of the counter salesperson is simplified by the food display which gives "_____ _____" and stimulus to the _____ of the customer.

3. It is hard for a customer to resist the dual appeal of food that is attractively arranged and has an appetizing _____.

4. Food service workers on a cafeteria counter have an individual responsibility for operating their unit _____.

5. Salads should be arranged in such a way to provide color _____ and contrast.

6. An attractively arranged salad counter will display the salads as "_____" of pleasingly colored food.

7. A reserve supply of creamers should be kept in the _____.

8. The person responsible for supplying the serving counter is called a _____.

9. The number of portions of food sold may be counted on a small machine called a _____.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Twelve characteristics used as criteria for determining the efficiency of a cafeteria counter salesperson are:

   (A) _____ (E) _____ (I) _____

   (B) _____ (F) _____ (J) _____

   (C) _____ (G) _____ (K) _____

   (D) _____ (H) _____ (L) _____

2. The work of operating a cafeteria serving counter falls into three parts, which are:

   (A) _____

   (B) _____

   (C) _____

3. Places where self-service units are found are:

   (A) _____ (D) _____

   (B) _____ (E) _____

   (C) _____

Assignment
Sheet No. 12

Covering
Units 94-100

PANTRY AND COUNTER SERVICE

Food service workers occasionally are required to help in the kitchen during slack periods in some restaurants. Regardless of the policy of the establishment where you work, you should be acquainted with duties performed in the kitchen with regard to this type of work.

Many food service units have a counter to provide rapid service for the hurried person. Food service workers should realize that most people who want service at the counter are in a hurry. This does not mean that they expect inferior food or service, but they do expect prompt service.

In this assignment you will have an opportunity to learn the special techniques to give efficient counter service. Also, you will have an opportunity to learn what duties may be expected of a food service worker in regard to pantry service in the kitchen.

Assignment:

1. Read the references listed below.
2. Answer the following questions and turn in by _____.

References:

A. U. S. Department of Health, Education, and Welfare, Food Service Industry, pp. 121-122.
I. Information Sheet #2, Pantry Service for Restaurants.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. If a dining room has both counter and table service, different menus should be used for each service.

T F 2. The area beneath the counter is carefully planned to provide storage space.

T F 3. Food preparation and dish washing for a counter is done in the kitchen.

T F 4. The counter salesperson has the same responsibilities to the customer as the table-service waiter.

T F 5. Counter appointments should be grouped so as to be used by 6-8 persons.

T F 6. It is a poor practice at counters to place the check as soon as the order is completed.

T F 7. Pantry service for restaurants should be under the supervision of a mature worker.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The counter salesperson's position with the customer requires the service to be from the _____.

2. Customers are to be served in the order they are _____.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Two main distinguishing characteristics of counter service are:

   (A) _____ (B) _____

2. The principal classifications of menu items are:

   (A) _____ (C) _____

   (B) _____

3. The two basic designs for the shape of counters are:

   (A) _____ (B) _____

4. Foods prepared at the pantry are:

   (A) _____ (E) _____

   (B) _____ (F) _____

   (C) _____ (G) _____

   (D) _____ (H) _____

5. Five duties involved in cleaning the pantry are:

   (A) _____ (D) _____

   (B) _____ (E) _____

   (C) _____

Information
Sheet No. 2

PANTRY SERVICE FOR RESTAURANTS*

This service requires a mature worker. She has a great deal of responsibility for the preparation of dainty as well as substantial dishes. The food materials she handles in her work are both perishable and expensive.

How to Prepare for Service

1. Chill all dishes used for salads or cold desserts.
2. Warm all dishes used for hot food.
3. Prepare sandwich fillings before serving.
4. Prepare, celery, radishes, scallions, salad greens, etc.
5. Prepare salad mixtures and garnishes.
6. Prepare material for fruit cup and appetizers.
7. Prepare sauces and whipped creams.
8. Place hot breads in roll warmer.
9. Prepare individual creamers and milk bottles.
10. Prepare salad dressings.
11. Prepare individual jelly and marmalade.
12. Prepare enough butter servings for the meal. Stack the trays of prepared butter in the refrigerator.
13. Collect serving utensils, spoons, ladles, dippers, etc., of the correct size.

Foods prepared and served at the pantry are:

1. Salads
2. Desserts
3. Relishes
4. Cereals
5. Sandwiches
6. Cream, milk and butter
7. Bread, rolls, and other hot breads
8. Beverages

How to Clean the Pantry

1. Clean the mixer.
2. Wash the utensils.
3. Clean the work tables.
4. Clean the refrigerator.
5. Clean the sink.

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*Adapted with permission from Food Service by Helen Livingstone, McKnight and McKnight Publishing Company, Bloomington, Illinois, 1950.

Assignment
Sheet No. 13

Covering
Units 101-109

PREPARATION OF SALADS AND SANDWICHES

Various studies have shown that approximately two-thirds of all people who stop at a restaurant for a cup of coffee will also order their favorite sandwich. In some restaurants the food service worker may be required to prepare sandwiches or any special plates which guests may order.

For these reasons it is important that the food service worker be familiar with the techniques of preparing various sandwiches and salads. An attractive salad can add much to the meal served a guest.

In this assignment you will have an opportunity to learn the various techniques used in making sandwiches and salads. Sandwich and salad preparation is an art -- master it well.

Assignment:

1. Read the references listed below.
2. During the next four days you are to take special note and keep a list of the different kinds of sandwiches and salads ordered. In a short paper summarize all the sandwiches and salads ordered and rank them in order of frequency of demand.
3. Answer the questions below and turn in by _____.

References:

B. Sealtest Foods, Know Your Job, pp. 36-39.
I. Information Sheet #3, How to Prepare Salads.
Information Sheet #4, How to Prepare Sandwiches.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Salad dressings should be chosen to blend appropriately with the salad ingredients.

T F 2. The salad is always served as a course with the meal.

T F 3. Soft foods, such as chicken, fish, and eggs, used in salads should be combined with a crisp vegetable to make them more palatable and attractive.

T F 4. French dressing and mayonnaise are examples of cooked dressings.

T F 5. Roquefort dressing is a variation of French dressing.

T F 6. All ingredients for mayonnaise must be kept under refrigeration.

T F 7. Thousand Island dressing is a variation of Russian dressing.

T F 8. All sandwich fillings are made in the exact way.

T F 9. A garnish should be served with a sandwich to add flavor and eye appeal to the sandwich.

T F 10. Lettuce or other crisp greens should be added just before a sandwich is to be toasted.

T F 11. The filling in a sandwich should not be spread to the very edge of the bread.

T F 12. Sandwiches should not be so moist that fillings drip when the sandwich is eaten.

T F 13. A small sized work space is all that is needed for efficient sandwich service.

T F 14. A special board should be used on which all chopping, slicing, and spreading of bread is done.

T F 15. A separate spreader should be used for each different sandwich spread mixture.

T F 16. All ingredients for sandwiches should be prepared well in advance.

T F 17. Pickles, olives, and onions may be kept in the same container.

T F 18. Wax paper should be placed between each slice of meat in order to prevent drying out.

T F 19. It is most practical to use cheaper grades of mayonnaise for making sandwiches.

T F 20. All sliced bread and sandwich materials should be handled with tongs or knives.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The salad green which is most often used is _____.

2. The simplest and most generally used salad dressing is _____ dressing.

3. Approximately _____ per cent of all customers who order food at a fountain will ask for a sandwich.

4. An instrument which is useful for dipping sandwich fillings is the _____ _____ _____.

5. Foods such as chicken, greens, and cheese are easily cut with _____.

6. Butter may be softened so that it will spread easily by adding a small amount of _____ _____.

7. The thickness of bread used for double-decker sandwiches should be approximately _____ inch.

8. Sliced meats should be approximately _____ inch in thickness.

9. The bread used for single sandwiches should be about _____ inch(es) thick.

10. The seasoning of sandwiches should be tested by a common method which is known as the _____ _____.

11. A two-pound loaf of sandwich bread will yield about _____ medium slices.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Three reasons why salads are so popular with guests are:

   (A) _____ (C) _____

   (B) _____

2. The basic parts of a salad are:

   (A) _____ (C) _____

   (B) _____ (D) _____

3. Garnishes for salads are:

   (A) _____ (E) _____

   (B) _____ (F) _____

   (C) _____ (G) _____

   (D) _____

4. The two types of salad dressings are:

(A) _____ (B) _____

5. French dressing is a mixture of the following principal ingredients:

(A) _____ (B) _____ (C) _____

6. The essential ingredients of mayonnaise are:

(A) _____ (C) _____

(B) _____ (D) _____

7. The three ways in which fillings are prepared for most simple sandwiches are:

(A) _____ (B) _____ (C) _____

8. Seven ways in which sandwiches may be served are:

(A) _____ (E) _____

(B) _____ (F) _____

(C) _____ (G) _____

(D) _____

9. Five methods of cutting bread for sandwiches are:

(A) _____ (D) _____

(B) _____ (E) _____

(C) _____

10. Six types of bread often used for making sandwiches are:

(A) _____ (D) _____

(B) _____ (E) _____

(C) _____ (F) _____

Information
Sheet #3

HOW TO PREPARE SALADS*

Salads are a great addition to the menu. They are popular because they add variety, introduce attractive colors and refreshing flavors to the meal.

A salad is made of a foundational material, a green salad, a salad dressing, and a garnish. The salad green is selected from those available, lettuce is the most often used. The foundation material is made from either meat, seafood, vegetables, cheese, eggs, or combinations of various types. The salad dressing is chosen to blend appropriately with the ingredients.

The size and kind of salad served varies with the place it takes in the menu. It is served as a course with the meal, as the main dish of the meal or as a dessert.

The place in the menu plus the taste of the guest dictates the form and combinations used in making salads.

Salad Garnishes

Salads are garnished with greens, chopped nuts, cheese balls, preserved fruit, olives, pickles, pimento strips, etc.

All soft food materials used for salads, such as chicken, fish, eggs, potato, etc., are combined with a crisp vegetable to render them more palatable and attractive.

Salad Dressings

There are two types of salad dressings--cooked and uncooked. The uncooked are French dressing and mayonnaise. The cooked dressings include those made with oil and those made without oil.

French dressing is the simplest and most generally used salad dressing. It is a mixture of oil, acid and seasoning. Vinegar or lemon juice or both are used as the acid; any edible salad oil is used; salt, paprika, pepper and sugar are the seasonings most widely used.

By the addition of special seasonings and food materials and by varying the chief ingredients, many variations of French dressing are possible. Variations of French dressing are cream dressing, tomato, Roquefort, Chiffonade, and Parisian dressing.

The essential ingredients of mayonnaise are salad oil, acid, egg or egg yolk and seasonings. The preparation depends upon the proportion of acid, oil, and egg. All ingredients should be kept at room temperature, Variations of mayonnaise dressing are cream dressing, club dressing, Russian dressing and Thousand Island dressing.

*Adapted with permission from Food Service by Helen Livingstone, McKnight and McKnight Publishing Company, Bloomington, Illinois, 1950.

Information
Sheet #4

HOW TO PREPARE SANDWICHES*

Simple Sandwiches

Fillings for simple sandwiches are sliced, chopped or finely ground. Sliced fillings should be cut to an even thickness. Use an ice cream dipper to measure the amount of chopped or ground filling. All fillings should cover the slice of bread exactly.

1. Cream the butter until it spreads easily.
2. Prepare the filling and garnish.
3. Place the slices of bread in two rows on a work table.
4. Spread all the bread with butter, using a spatula. Spread all the back row of slices first.
5. Place a portion of the filling on each slice in the front row. Keep the fillings uniform.
6. Cover the front row of slices with the slices in the back row.
7. Stack two or three sandwiches together. While holding in position with the finger-tips of one hand, cut through the sandwiches with a sharp knife.
8. Sandwiches are wrapped with a slightly dampened towel or wax paper, or placed in glassine bags until serving time.
9. The garnish is placed on the plate with the sandwich when served.

Grilled Sandwiches

1. Assemble the sandwich.
2. Brush the outside top and bottom slice with melted butter.
3. Toast on both sides in the broiling oven or on an electric sandwich toaster. Caution: Lettuce or other crisp greens are added after toasting.

*Adapted with permission from Food Service by Helen Livingstone, McKnight and McKnight Publishing Company, Bloomington, Illinois, 1950.

Assignment
Sheet No. 14

Covering
Units 110-117

PREPARATION OF BEVERAGES

Which is correct, "Do you care for anything to drink?" or "Do you care for coffee or tea?" From a previous assignment you should know that the latter question is the most effective way of asking guests for their orders. Now, after the guest decides to have coffee or tea, will it be good coffee or tea? Many people are very particular about their drink. Have you ever heard someone say, "This coffee tastes like mud." Do you think this customer will come back for more "mud"?

It is important that all food service workers know how to prepare and serve good coffee and tea. From early breakfast until closing time, there will be a constant demand for coffee--good coffee.

In this assignment you will have an opportunity to learn the techniques of making coffee and tea and the various methods of serving each.

Assignment:

1. Read the references listed below.
2. Make a chart with each hour that you work represented. During the next four days keep a record of the number of cups of coffee and tea you serve each hour. At which period is the most coffee served? At which hour is the most tea served?
3. Answer the questions below and turn in by _____.

References:

B. Sealtest Foods, Know Your Job, p. 18.
I. Information Sheet #5--Beverages.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The terms Mocha or Java are trade names indicating a typical flavor rather than the place where the coffee was grown.

T F 2. Most coffees are blends of several varieties.

T F 3. Coffee beans are cured after they have been roasted and ground.

T F 4. Most restaurants use a "regular" grind of coffee.

T F 5. Coffee will lose its flavor if it is stored too long.

T F 6. The kinds of tea differ according to the variety of plant from which the leaves are taken.

T F 7. Green tea is fermented and kiln-dried.

T F 8. Black tea is first fermented and then kiln-dried.

T F 9. When tea is allowed to stand on the leaves too long, tannic acid will develop.

T F 10. Tea is classified according to the size of the leaf.

T F 11. The more tender leaves of tea grow near the root or trunk of the tea bush where the hot sun cannot bleach them.

T F 12. The quality of tea varies according to the country in which it is grown.

T F 13. Tea deteriorates more rapidly in storage than does roasted coffee.

T F 14. The product obtained by grinding roasted cacao bean is known as cocoa.

T F 15. Cocoa contains more fat than chocolate and consequently is richer.

T F 16. Chocolate is usually pressed into a cake and cocoa is usually sold as a powder.

T F 17. Cocoa and chocolate should be stored in a cool dry place.

T F 18. All beverages except water are considered to be either stimulating or nutritive.

T F 19. When coffee is made in an urn, the water should be heated to the boiling point.

T F 20. The hot water from the water urn should be poured over the coffee bag two or three times before it is ready to be served.

T F 21. Coffee which has already been brewed should be maintained at a temperature between 110° and 115° Fahrenheit.

T F 22. The coffee urn should be cleaned with steel wool.

T F 23. If coffee is made in a silex, the heat should be turned off when about half the water has risen into the top part.

T F 24. Although tea is the simplest of all beverages to make, it also is the one which is most often poorly made.

T F 25. Two tea bags should be used for each individual cup of tea made.

T F 26. The best way to serve tea is to serve the teapot and the tea bag at the side so that the customer can make his own cup of tea.

T F 27. When making ice tea, the teabag should steep for over 10 minutes in the boiling water.

T F 28. Whipped cream is sometimes added to a cup of hot chocolate.

T F 29. Urns and brewers for making coffee should be thoroughly washed and rinsed with hot water once a week.

T F 30. Coffee sacks should be washed in cold water.

T F 31. The tops of coffee urns should be tightly closed immediately after the urns have been washed.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. Coffee is made from the berry seeds of the (A) caffeine bush; (B) coffee tree; (C) Java tree; (D) carrie tree.

_____ 2. The country which is the largest supplier of coffee is (A) Brazil; (B) Mexico; (C) Java; (D) Arabia.

_____ 3. Green coffee beans are roasted to (A) make them more attractive; (B) help preserve them; (C) kill all harmful fungus growth; (D) develop flavor.

_____ 4. Coffee should not be cooked overly long because the (A) grounds will burn; (B) caffeine will not harden; (C) caffeine will be extracted; (D) water will boil away.

_____ 5. Tea that has stood on the leaves too long should not be used because it (A) becomes bitter; (B) is unsafe; (C) is unsanitary; (D) becomes tasteless.

_____ 6. Black tea yields a beverage which is darker in color than green tea and which (A) contains less tannin; (B) is richer; (C) contains more tannin; (D) is more expensive.

_____ 7. Both cocoa and chocolate contains (A) tannic acid; (B) caffeine; (C) starch; (D) oil of vitriol.

_____ 8. The most important of all beverages is (A) milk; (B) coffee; (C) tea; (D) water.

_____ 9. When making large quantities of coffee, the correct proportion of coffee to water is one pound of coffee to each (A) 1/2; (B) one; (C) two; (D) three gallons of water.

_____ 10. An excellent cleansing agent to use for scrubbing the lining of coffee urns is (A) laundry soap; (B) soda; (C) pumice stone; (D) steel wool.

_____ 11. Coffee sacks should be rinsed in (A) hot water; (B) energine; (C) lemon juice; (D) cold water.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The three kinds of Brazilian coffee are:

   (A) _____ (B) _____ (C) _____

2. The roasts of green coffee, according to color classification are:

   (A) _____ (B) _____ (C) _____

3. The three kinds of tea, according to methods used in drying and curing are:

   (A) _____ (B) _____ (C) _____

4. Three trade names for blended black tea are:

   (A) _____ (B) _____ (C) _____

Information
Sheet #5

BEVERAGES*

Coffee

Coffee is made from the seeds from the berry of the coffee tree, these are usually twin seeds.

Ordinarily, coffee is imported from about 35 sources, but at the present time, most of the coffee imported into the United States comes from South America, principally from Brazil. The Brazilian coffees include Rio, Santos, and Bourbon Santos. What are known as "milds" come from Colombia. Another South American coffee is Bogota, the better grades of which have an excellent flavor. The trade name Mocha or Java signifies a typical flavor, rather than the place where the coffee was grown.

Coffee beans from different sources contribute different qualities to the brew. Most coffee, as purchased by the restaurant, is a blend of several to fifteen varieties.

The seeds or beans are dried by artificial heat. The coffee beans, after curing, are roasted and ground. Green coffees are roasted to develop flavor. The roasts are classified according to color: (a) light, a cinnamon brown color; (b) medium, a deep chestnut, the roast most used in the United States; and (c) dark, popular in the South.

Coffee is bought in the beans or ground. A few restaurants purchase coffee in the bean and grind it fresh as required.

Coffee is steel-cut to the degree of fineness or grind best suited to the method of preparation. Restaurants use an "urn grind", which is finer than the drip designed for home use.

The flavor quality of coffee begins to deteriorate immediately after roasting and the change is significantly noticeable after a few days. The change takes place even more rapidly after the roasted beans have been ground. Coffee should be used as soon after roasting and grinding as possible.

Coffee must not be cooked for an indefinite time because the caffeine will be extracted.

Tea

Tea consists of the dried leaves of the tea bush. The kinds of teas are green, black, or oolong; they differ according to the methods used in drying and curing rather than the variety of plants.

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*Adapted with permission from Food Service by Helen Livingstone, McKnight and McKnight Publishing Company, Bloomington, Illinois, 1950, and Establishing and Operating a Restaurant, U. S. Department of Commerce, U. S. Government Printing Office, Washington, 1957.

Green tea is unfermented and is steam dried. Black tea leaves are withered and completely fermented, then rolled and kiln dried. Oolong tea leaves are only partially fermented.

Tea that has stood on the leaves for any length of time is not used because it becomes bitter and unpalatable and develops an undesirable substance called tannic acid. The beverage made from black tea is darker in color and contains less tannic than the beverage made from green tea. The principal type of tea now available in the United States is black tea.

Tea is classified according to the size of the leaf used. The more tender leaves are at the tip of the branches and have a delicate flavor. They are used in the higher grades. The quality of the tea varies with the country in which it grows, the tenderness of the leaf, the degree of fermentation and other details of its preparation for the trade.

Pekoe, Orange Pekoe, and English Breakfast are trade names for blended teas.

Tea deteriorates on storage but not nearly as rapidly as roasted coffee. Tea also tends to pick up flavors and odors from substances stored near it. Tea should be stored in air-tight containers and never opened or allowed to remain open in the presence of odoriferous substances.

Chocolate and Cocoa

Chocolate and cocoa are made from the cacao bean. The product obtained by grinding the roasted cacao bean is known as chocolate. Chocolate contains more than 50 per cent of a high quality fat called cacao butter and is pressed into a cake. When an appreciable quantity of fat is removed from chocolate the remaining product is known as cocoa and is sold in a powder.

Cocoa and chocolate contain starch and are cooked until the mixture thickens and is thus rendered more palatable and digestible. Chocolate contains more fat than cocoa and consequently is richer.

Both cocoa and chocolate should be stored in a dry, cool place. Cocoa tends to lump if stored in a moist atmosphere or at high temperature. When chocolate is stored at high temperature, some of the cacao butter softens and forms a grayish film on the outside of the chocolate; this makes the product appear stale but the flavor may not be impaired.

The Preparation of Beverages

Water, the beverage provided by nature to relieve thirst, is the most important of the beverages.

All other beverages are considered as either stimulating beverages or nutritive beverages.

How to Prepare Coffee

Probably no single item has built or ruined more restaurant reputations and business than coffee. The reputation of many a famous restaurant is due largely to its excellent coffee.

Everyone should know how to brew coffee properly. Following are instructions for brewing coffee in a variety of coffee-makers.

Urn-Brewing Methods:

1. Flush stale water from boiler and water pipe. (Open boiler faucet and water supply valve.)

2. Fill the hot water urn and bring to a boil, lighting the gas or turning on the steam.

3. Fill the coffee bag. Two gallons of water per pound of coffee is a good allowance.

4. Place the coffee bag on the rim inside the coffee urn.

5. Draw the hot water from the water urn into the measure and pour it over the coffee bag. Repeat this 2 or 3 times.

6. Remove the coffee bag when the liquid has drained through it. Water should drip through within six minutes.

7. After removing coffee bag, mix brewed coffee by drawing off one gallon and pouring into top of urn.

8. Cover the urn.

9. Taste the coffee. Check heat to make sure brew will stay at 185° - 190° F.

10. Remove grounds from urn bag. Rinse thoroughly and place in container of cold water. Urn bags should always be kept submerged in cold water when not in use to keep them clean and sweet.

Urn baskets and filters must be kept scrupulously clean. Clean urn between each use with stiff scrubbing brush. Never use steel wool.

The foregoing directions are specifically for battery urns, but basically they apply to any type of urn.

Making coffee with a silex:

1. Place water in the lower flask.

2. Place it on the heating element.

3. Place the filter in the top and add the coffee.

4. Insert the top part in the flask after the water begins to boil.

5. Turn off the heat when the water has all risen to the top part.

6. After the coffee has run back into the lower flask, remove the top with the coffee grounds.

7. Serve immediately or place on warming unit. (Never allow coffee to boil.)

8. Empty the coffee grounds immediately--clean the top. Discard the filter.

How to prepare hot tea:

Hot tea is the simplest of all beverages to make, but the one that is the most frequently poorly made. If the following simple rules are followed, a good cup of hot tea will result.

1. Rinse out the tea pot with boiling water.

2. Place a tea bag in the pot and fill it with boiling water Allow one tea bag for each individual cup of tea.

3. Serve the tea pot on a small plate.

Milk for tea use, instead of cream, will produce a better cup of tea, flavor-wise.

Many restaurants serve the hot water in a teapot or cup and the tea bag at the side so that the customer can make his own cup of tea. This is an unwise procedure as only a mediocre cup of tea can result. The boiling water must be poured directly on the tea.

How to prepare iced tea:

1. Pour one gallon of boiling water over one 2-ounce tea bag (or two 1-ounce tea bags) in a crock or stainless steel container.

2. Let steep for 6 to 10 minutes (no longer) stir and remove bags, pressing them against the container's side to squeeze out the liquid.

3. Serve in ice filled glasses with lemon slices.

How to serve milk:

1. Use a clean polished glass.

2. Clean the milk bottle.

3. Remove the top at the table and pour it into the glass.

4. Serve the glass on a small plate.

<u>How to prepare hot chocolate</u>:

1. Open the regulation package and turn the contents into a cup or an individual pot.

2. Add the hot water and stir.

3. Whipped cream is often added to the single cup of chocolate.

Assignment
Sheet No. 15

Covering
Units 118-130

FOUNTAIN SERVICE

Fountain service is similar to regular restaurant table and counter service in that all customers expect prompt, efficient, and courteous service. Just as on regular counter service, the food service worker on a fountain must be fast and capable of handling many orders at one time.

Many restaurants have a small fountain for the purpose of serving special requests for desserts and between-meal snacks. When such fountain service exists, it is usually the duty of the food service worker to assemble the order. It is therefore important that all food service workers have some knowledge of the techniques and methods of preparing fountain orders.

In this assignment you will have an opportunity to learn the various fountain orders and how to fill them. You will also gain a thorough knowledge of the importance of correct fountain procedures.

Assignment:

1. Read the reference listed below.
2. Answer the following questions and turn in this assignment by _____.

Reference:

B. Sealtest Foods, Know Your Job, pp. 10-12; 16-35.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. A few minutes should be spent in reviewing the day's happenings with the person who relieves you before going off duty.

T F 2. Each day's menu should be memorized in order that you may be able to answer questions quickly and correctly.

T F 3. Your lunch period should be so arranged that it will not conflict with rush hours.

T F 4. Non-essential, personal phone calls should be very limited while on duty.

T F 5. When a food service worker is having lunch, he should sit in an end booth or at the end of the counter.

T F 6. The apron not only protects clothing, but also may be used to wipe the hands.

T F 7. If pots and pans appear to be clean, it is not necessary to rinse them before they are used.

T F 8. Several glasses of carbonated water should be drawn off and discarded each morning before any is used.

T F 9. Chocolate and cream pumps should be scalded and dried thoroughly each day.

T F 10. Newly received merchandise should be inspected for quality and short weight.

T F 11. Menus should be changed first thing in the morning.

T F 12. Mirrors should be washed and polished once every three or four weeks.

T F 13. Metal spoons and straw holders should be washed and polished each day.

T F 14. Soda fountain equipment represents a fairly small investment by the employer.

T F 15. Excess frost in ice cream sleeves retards cooling efficiency.

T F 16. Ice cream containers or cans should be dropped into the ice cream sleeves.

T F 17. Bakelite covers and syrup pump tops should be cleaned with hot water and soap.

T F 18. An ice pick should never be used to remove ice from the syrup rail.

T F 19. Hot water should not be used to thaw either soda or plain water cooling coils.

T F 20. Condenser fins on an air cooled refrigeration machine should be cleaned yearly with a stiff wire brush.

T F 21. If dust collects on a condenser, the machine will have to operate longer to accomplish the same amount of work.

T F 22. The outside of the electric drink mixer should be cleaned with a good silver polish.

T F 23. All broken china or glassware should be disposed of immediately.

T F 24. The care you exercise in controlling waste and breakage determine your personal efficiency in the eyes of your employer.

T F 25. Extreme temperatures of either heat or cold will cause wax coated paper cartons to warp.

T F 26. Wooden utensils should be stored at rather warm temperatures.

T F 27. Improperly packed bulk ice cream will cause a financial loss to the employer.

T F 28. The delicate and perishable nature of ice cream necessitates careful handling.

T F 29. All mixed milk drinks should be whipped for about five minutes to insure proper blending.

T F 30. Price should be the determining factor in buying commercially prepared syrup.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Bar mops should be discarded before they become _____ and _____.

2. Dipper wells should be free of refuse and kept full of water that is _____ and _____.

3. Stools, booths, tables, and chairs should be washed each _____ with hot, soapy water.

4. Leather-covered counter stool seats should be washed with _____ _____.

5. Freshly received merchandise should immediately be placed at the _____ of the refrigerator.

6. As a general rule, carbonated water should be between _____ and _____ degrees F at the draft arms.

7. A solution of _____ of _____ may be used when cleaning refrigerators in order to help avoid objectionable odors.

8. The temperature in the salad compartment should not exceed _____ degrees Fahrenheit.

9. Ice which has accumulated on refrigerator coils should be removed by melting it off with _____.

10. Most present-day refrigeration systems are charged with _____ refrigerant.

11. A good safety practice at a fountain is to keep a _____ on the ends of ice picks when they are not in use.

12. When starting to dip from a new container of ice cream, it is best to start at the _____ of the container.

13. The ice cream dipper should never be dipped more than _____ inch(es) into the surface of the ice cream.

14. The first requirement of a good ice cream sundae is _____ _____.

15. It takes approximately _____ minute(s) on the mixer to blend a milk drink smoothly.

16. Chocolate syrup is demanded in approximately _____ to _____ per cent of all fountain items ordered.

17. Whipped cream should be kept in a cool place as it has a tendency to _____ as it becomes warm.

18. One way to cause whipped cream to "hold up" in warm weather is to add a little _____ to the cream before it is whipped.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. All articles left by customers should be (A) turned over to the police; (B) taken home; (C) turned over the the management; (D) left where they are.

_____ 2. Food stuffs should always be picked up or handled with (A) your fingers; (B) the proper utensil; (C) a napkin; (D) an ice pick.

_____ 3. The best way to describe the odor of sulphur dioxide refrigerant is that it smells like (A) soap; (B) gasoline; (C) apples; (D) rotten eggs.

_____ 4. The smell of sulphur dioxide may be eliminated by sprinkling the soiled spot with (A) soap powder; (B) vinegar; (C) salt; (D) household ammonia.

_____ 5. The long gear and the pinion gear of a hand type juicer should be lubricated with (A) petroleum jelly; (B) motor oil; (C) lard; (D) salad oil.

_____ 6. If food should catch fire in a pan, the safest thing to do is (A) pour water on it; (B) call the manager; (C) smother flame with salt; (D) smother flame with flour.

_____ 7. If a dripping dipper is placed in ice cream, the drops of water will (A) melt the ice cream; (B) not affect the ice cream; (C) freeze into ice crystals and ruin the ice cream; (D) improve the quality of the ice cream.

_____ 8. A good preservative to use in syrups is (A) sulphur dioxide solution; (B) powdered benzoate of soda solution; (C) ammonia solution; (D) bicarbonate of soda solution.

_____ 9. In order for cream to whip efficiently, it should be (A) fresh; (B) sweet; (C) diluted with water; (D) at least 24 hours old.

_____ 10. When chilled to the freezing point, sweet cream will (A) yield more "swell" when whipped; (B) not whip; (C) turn to butterfat; (D) whip only slightly.

Assignment Sheet No. 16 | Covering Units 131-134

WRITING AND PLANNING THE MENU

What is the difference between a table d'hote meal and an a la carte meal? If a guest asked you what is meant by "chicken fricassee" could you answer correctly? Many such terms are found on our menus in today's modern restaurants. Food service workers should be able to answer questions about the menu and tell how certain dishes are prepared.

In previous assignments you have learned the importance of efficient food preparation and service. You will now discover that the food service worker must, in many instances, be an interpreter as well. Many people would like to try new and different dishes but are hesitant because they do not know exactly what the dish is.

In this assignment you will have an opportunity to learn some of the common terms used on menus. Remember, the more information you have about the menu, the better you can serve your guests.

Assignment:

1. Read the references listed below.
2. Answer the questions below and turn in by _____.

References:

A. U. S. Department of Health, Education, and Welfare, Food Service Industry, pp. 145-150.
B. Sealtest Foods, Know Your Job, pp. 9, 44.
I. Information Sheet #6, Additional Information on Menu Planning.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Menu making in a small restaurant is a complicated procedure.

T F 2. The appearance of a menu determines the customer's introduction to the restaurant.

T F 3. Statistical surveys indicate that very few people order the first dish which is listed on a menu.

T F 4. The best practice is to arrange all items on the menu according to price.

T F 5. The chef should have the responsibility for planning menus.

T F 6. A restauranteur must consider food values and the basic principles of good nutrition when planning menus.

T F 7. Persons who plan menus for the public must guard against letting personal preferences become the guiding factor.

T F 8. When writing menus, a planner may disregard the correct meaning of foreign terms and use them just to give the menu an atmosphere of class.

T F 9. The method of computing the selling price of restaurant foods is very complicated.

T F 10. The food cost percentage is the same for all types of restaurants.

T F 11. When a customer chooses an article which has been "sold out", it should be suggested that he go to another restaurant in order to get what he wants.

T F 12. It is the responsibility of the food service worker to provide the customer with information about the food he eats.

T F 13. The customer who is obviously in a hurry should be informed that counter service is quickest.

T F 14. The talents needed in selling are, generally speaking, about the same as those required in everyday living.

T F 15. The information on a well-arranged menu should be so headed and classified that the reader can readily find it.

T F 16. The type used for "specials" on menus is often heavier than that on the rest of the menu.

T F 17. The appearance of the menu is a factor in the early impressions which customers form of a restaurant.

T F 18. The sole value of a menu is as a sales medium.

T F 19. The menu of the day describes the foods which are available at all times.

T F 20. Menu arrangements are always standardized.

T F 21. "Club" breakfast menus list the different food items which may be ordered individually.

T F 22. When presenting breakfast menus to the customer the salesperson should point out special or featured breakfasts.

T F 23. The arrangement of the a la carte dinner menu is similar to that of luncheon menus.

T F 24. It is important for everyone selling food to be familiar with certain foreign terms adopted by Americans in menu writing.

T F 25. Overhead expense will usually equal and may sometimes exceed the cost of food purchases.

T F 26. Table flowers, menu folders, etc., should not be considered as a part of the cost of serving a meal.

T F 27. Customers usually underestimate the percentage of profit which is made on restaurant food sales.

T F 28. The profit on food sales exceeds 10 per cent in a well-managed restaurant.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Before new menus are distributed to customers, they should be carefully checked for correct _____, _____, and _____.

2. One of the most important functions in the restaurant is that of _____ _____.

3. In order to control food costs, it is essential that recipes and food portions be _____.

4. To maintain a 40 per cent food cost, the selling price of an item or meal should, on the average, be _____ times the cost of the food.

5. Dishes priced separately on the menu are known as _____ _____ _____ dishes.

6. A meal served in several courses at a set price is known as a _____ _____ meal.

7. Because it tells the initial story about food to the customer, the menu is sometimes called the _____ of the restaurant.

8. Another name for the menu of the day is the _____ _____ _____.

9. The luncheon menu is composed of lists of _____ _____ dishes and several _____ _____ meals.

10. In the case of selective choice menu the main dishes usually are listed under _____.

11. Meat or chicken stewed and served in a rich sauce is _____

12. A small cup of coffee is sometimes known as a _____.

Matching

Directions: In the left hand column is a list of items. The right hand column contains descriptive phrases or synonymous terms. Match the descriptions to the items by placing the letter of the description in the left blank at the left of the appropriate item.

_____	1. a la carte	A. savory foods served as appetizers
_____	2. au jus	B. the main dish of a meal
_____	3. brochette	C. French for perfect
_____	4. a la king	D. any colorful or attractive decoration
_____	5. consomme	E. on the bill of fare, or prepared as ordered
_____	6. rissole	F. a mixture of garden vegetables
_____	7. hors d-oeuvres	G. meat broiled on a skewer
_____	8. condiment	H. the bill of fare or fountain newspaper
_____	9. entree	I. browned
_____	10. fizzes	J. served in a cream sauce
_____	11. garnish	K. cut in thin strips
_____	12. menu	L. clear meat stock served hot or jellied
_____	13. marinate	M. menu of the day
_____	14. parfait	N. after the style or fashion
_____	15. carte du jour	O. served in its natural juice
_____	16. jardiniere	P. a carbonated fruit flavored drink
_____	17. julienne	Q. a spicy seasoning
		R. to pickle or salt and preserve in oil or vinegar

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The menu must be planned to do three things. They are:

   (A) _____ (C) _____

   (B) _____

2. Three types of information customers get from the menu are:

   (A) _____ (C) _____

   (B) _____

3. In order to help guests make a satisfactory food selection, the food service worker should know:

   (A) _____ (C) _____

   (B) _____ (D) _____

4. Two types of menus used in most restaurants today are:

   (A) _____ (B) _____

5. The three kinds of menus are:

   (A) _____ (B) _____ (C) _____

6. Under what headings are featured luncheons listed:

   (A) _____ (C) _____

   (B) _____

Information
Sheet No. 6

ADDITIONAL INFORMATION ON MENU PLANNING*

Menu-making for small restaurants can be a relatively simple process. Many establishments specialize in two or three items regularly. Others build their reputation on one dish only. A number of restaurants have a simple but well-rounded menu.

The appearance of the menu is the first point to consider in menu designing. The menu is the customer's introduction to the restaurant. It informs him of the dishes available, manner in which they are prepared, and the cost. It is planned to sell the food, to conform to the atmosphere, and to advertise the restaurant.

The menu card should be simple, handy in size, easy to read and understand. Many small restaurants use a duplicating machine of some kind for preparing the menu. Enough are usually made to permit the discarding of soiled or torn menus. Before using, it should be carefully checked for correct spelling, phrasing, and pricing.

A prominent place on the menu for "special" dishes is at the top of the list for that course. Statistics show that more people order the first dish on that list than any other.

It is not a good practice to arrange items according to price. If the lower priced items are listed first, the customer's attention will be focused on these and the higher priced dishes may be neglected.

Menu-Maker

Menu planning is one of the most important functions in the restaurant. It requires knowledge, thought, study, investigation, and ingenuity.

Menus should be made when you are fresh, alert and full of enthusiasm. The best menu will be made by the resourceful person who is on the lookout for the new dish, the new recipe, the new idea, the new phrase, or the new way.

While the chef may be an excellent cook and be consulted when planning menus, he should not be left with the entire responsibility. The menu maker must first have a considerable amount of specific information and also, he must keep the customer's point of view. Basic factors that the menu-maker should have are:

A. Must know food values and the basic principles of good nutrition.
B. Must know the capacity of all departments and plan menus of ease of production.

*Adapted from Establishing and Operating A Restaurant, U. S. Department of Commerce, U. S. Government Printing Office, Washington, D.C., 1957.

C. Must obtain full value from all purchases and plan the menu to take care of all food purchased.
D. Must keep in touch with market conditions.
E. Must follow the day's sales and know your customer's preference.
F. Must know how far ahead to plan menus.
G. Must insure variety.
H. Must know food costs.

In planning a menu, the customer's point of view must be considered. Items that are important to note are:

A. Menus must not be misleading.
B. Foreign terms must be used correctly.
C. Customers look for seasonal foods.
D. Selections should suit women as well as men.
E. Menus should be planned at different price levels.
F. Customers like to be surprised to find new dishes and new names on the menu.

Controlling Food Costs

The menu-maker should know the approximate cost of every item on the menu, and the approximate yield from every food ordered.

It is essential to standardize recipes and food portions. Yields must be the same each time the recipe is prepared and the sales, based on a certain number of portions of definite size, can be calculated with a fair degree of accuracy.

The general method of calculating selling prices is a simple one. If the restaurant operates on a 40 per cent food cost, this means that the cost of food as purchased by the restaurant is 40 per cent of sales. The meal or item that sells for a dollar has an average raw food cost of 40 cents. To maintain a 40 per cent food cost, the selling price of an item or a meal should average 2½ times the cost of the food. If the restaurant operates on a 50 per cent food cost, the selling price should be twice the cost prices.

The food-cost percentage varies in different restaurants, of course, depending on the menu and the type of operation; luxury restaurants operate on lower food-cost percentage than eating places which sell food at moderate prices (that is, the mark-up on food cost is greater in the higher-price restaurants).

Assignment
Sheet No. 17

Covering
Units 135-146

RESTAURANT MANAGEMENT

Many factors contribute to success in the restaurant business. One of the most important of these factors is efficient management. The manager must know how to buy and prepare food material, how to buy equipment, how to negotiate contracts, how to keep accurate and adequate records, etc. Many restaurants have failed because the manager did not have a thorough knowledge of the fundamentals of good management.

The importance of good restaurant management can not be over stressed. The food service worker who progresses on the job may very well move into the management phase of the business some day. For this reason, all food service workers should become acquainted with the techniques involved in good management.

In this assignment you will have an opportunity to learn the value and technique of good restaurant management.

Assignment:

1. Read the reference listed below.
2. Consult with the manager of your restaurant as to what factors he considers to be the most important in good management. In a brief paper, summarize what you consider the most important factors in successful management as based on your own experience and the discussion with your manager.
3. Answer questions below and turn in by _____.

Reference:

I. Information Sheet No. 7, Restaurant Management.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. There are practically no disadvantages to buying a restaurant business which is already a "going concern."

T F 2. An established business can never be bought at a bargain price.

T F 3. In purchasing a business, one will be battling the prejudices and habits of the customers against the former owner.

T F 4. Business will suffer until changes are made and the public learns about the changes.

T F 5. There is no value to investigate the assets and liabilities of a business when purchasing a restaurant.

T F 6. Operators of small restaurants often make the mistake of buying fixtures which are larger and more expensive than necessary for their volume of business.

T F 7. As a general rule, sellers will not tend to exaggerate the good features of a business which they are trying to sell.

T F 8. A lawyer should draw up the purchase agreement to protect both parties.

T F 9. Most restaurants are started and owned by corporations.

T F 10. An individual proprietorship is usually operated by two or more persons.

T F 11. A partnership is the association of two or more persons in the conduct of an enterprise.

T F 12. One big advantage to a partnership is that the money and experience of two or more persons is combined to start a business.

T F 13. All corporations have a large number of stockholders.

T F 14. Corporations must be legally chartered and filed with the appropriate state authority.

T F 15. Adequate records, by their very nature, must be quite complicated.

T F 16. It cannot be expected that a record system will furnish any information as to how your restaurant compares with others of the same type.

T F 17. Some types of records will help to guard against loss of cash receipts.

T F 18. Many types of restaurant businesses should not use a cash register.

T F 19. The best policy is to pay the purchases by check.

T F 20. Tax laws and regulations require that certain records be kept by operators of restaurants.

T F 21. The employer and employee each pay 50 per cent of the Federal Unemployment Tax.

T F 22. Assets are the amounts owed by the business.

T F 23. The balance sheet gives a picture in dollars and cents of the financial status of a business at a given time.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. You become the owner of a restaurant by _____ _____ _____ restaurant or _____ _____ _____ _____.

2. When buying a restaurant, a (an) _____ should be obtained from the seller stating that the fixtures and equipment have been paid for and are free from mortgage.

3. Before any transaction for the purchase of a restaurant is complete, you should seek _____ _____.

4. Business success and good _____ _____ seem to go hand in hand.

5. _____ _____ _____ are used when paying for purchases from the cash register.

6. The guest check is sometimes referred to as a guest _____.

7. Guest check books should be _____ numbered so that all checks may be accounted for.

8. A _____ _____ provides a simple and easy method of keeping a record of every sale dollar.

9. Every businessman who pays wages to _____ or _____ employees must deduct and withhold specified amounts from their wages for federal income taxes.

10. The _____ _____ _____ statement is a summary in dollars and cents of the business operations of the restaurant during a given period.

11. Sales, minus the cost of food sold, will equal the _____ _____.

12. The gross margin, minus total operating expenses, will equal _____ _____.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. What are two basic questions to ask when purchasing a restaurant:

   (A) _____

   (B) _____

2. Records are important as they give the proprietor the following information:

   (A) _____

   (B) _____

   (C) _____

   (D) _____

   (E) _____

   (F) _____

   (G) _____

   (H) _____

   (I) _____

   _____

3. Cash registers are used in business places for:

   (A) _____ (C) _____

   (B) _____ (D) _____

4. Guest checks provide two types of records:

   (A) _____

   (B) _____

5. Records to be kept in accordance with tax laws are:

   (A) _____ (C) _____

   (B) _____ (D) _____

6. Two financial statements which must be prepared for any type of business are:

   (A) _____ (B) _____

Information
Sheet No. 7

RESTAURANT MANAGEMENT*

To become the owner of a restaurant you can either buy an established business or start a new one.

The advantages and disadvantages of buying an established business are:

Advantages:

1. The business sometimes can be bought at a bargain price.
2. You pick up the existing goodwill, when acquiring an established patronage.
3. By eliminating that initial period of waiting for business to build up, your income starts quicker, with less drain on your resources.

Disadvantages:

1. The owner may have a bad reputation, in which case you will be battling customers' prejudices.
2. You must face the fact that many potential customers have formed the habit of not patronizing the restaurant.
3. If the former owner has made a bad choice of equipment, arranged the restaurant badly, or been unwise in his menu selection, you will suffer from these mistakes until you remedy them and the public learns about the change in management.

If you decide to purchase a restaurant, first demand why the owner wishes to sell; and second, what are your chances of continuing the operation successfully. Each purchase must be judged carefully on its own merits.

Certain things should be investigated carefully to determine the value of a going business. The chief assets and liabilities of the seller should be separately evaluated.

When buying a going business, be sure that the owner did not over extend himself on the value of fixtures and equipment. Many small restaurant owners make the mistake of buying fixtures too big and too expensive for his volume of business, and in doing so ties up precious capital.

Find out if there is a mortage on the equipment.

An affidavit should be obtained from the seller stating that the fixtures have been fully paid for and are free from mortgage.

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*Adapted from Establishing and Operating a Restaurant, U. S. Department of Commerce, U. S. Government Printing Office, Washington, D. C., 1957, pp. 14-26; 173-182; 188-204.

The profits claimed by the owner should be tested carefully for authenticity. The seller tends to exaggerate the good features of the business he is selling.

Legal advice should be sought before the transaction is closed. Both buyer and seller will want a lawyer to draw up the agreement in order to protect both parties fully.

Forms of Business Organizations

Most small restaurants are started by a single individual and operated as sole proprietorship, but some are initially organized as partnerships and corporations.

The individual proprietorship is owned and operated by one person, who supplies all the capital, takes all the risks and enjoys all the profits.

The partnership is the association of two or more persons in the conduct of an enterprise. The rights and duties of the partners toward each other and toward the public are regulated by the partnership agreement and by the State partnership laws.

An advantage of a partnership is that it permits pooling the capital, skill, experience, and business contacts of two or more co-owners, thereby increasing the scope of the business and enhancing its credit standing.

The corporation is an investment for the ownership and management of an enterprise that enables a person to invest a given sum in an enterprise without becoming personally liable for its indebtedness beyond the amount invested. Incorporation is not limited to large enterprises. There are thousands of corporations with only three or four stockholders and a small scope of activity. A corporation comes into existence when a certificate of incorporation or a charter is accepted and filed with the appropriate State authority.

Record Keeping

It is important that all restuarants, to be successful, should keep adequate records of the business. They can be simple and easy to keep, so that a minimum amount of time need be devoted to records. Good record keeping and success in business go hand in hand. They inform the proprietor how the business is doing, net profit earned, food costs, payroll costs, trends in sales, stock inventory, money owed, money in the bank, and a comparison on how well his restaurant is doing compared with others of the same type.

Safeguarding Cash

Some records help to guard against loss of cash receipts through thefts, errors in making change, or failure of a guest to pay his check.

A cash register is recommended for every restaurant. Besides being a safe place to keep money during the day, it records each sale and totals the sales as well as the number of checks rung up. Many registers accumulate separate totals for food, cigars and cigarettes, paid-outs, and the like.

Cash payment vouchers should be used in paying for some purchases from the cash register, a receipt is placed in the register for each amount of cash removed.

A guest check, sometimes called a guest order, provides the record for the service of food and collection of cash. The check contains space for the order and correct amount to be paid by the customer. Order books should be serially numbered so that all checks may be accounted for.

It is essential that all payments be made by check. A canceled check, marked paid, and carrying the creditor's name on the back of it serves as a receipt.

A large part of the operator's dollar is paid out for food, most of the remainder goes for expenses, and only a small part of it becomes net profit. The cashbook provides a simple and easy method of keeping a record of every sales dollar. This cashbook, should be kept according to good business practices, and any simple bookkeeping book will provide information for keeping a good cashbook.

Tax Records

It is necessary for the restaurant operator, or any business place, to keep certain records to comply with tax laws and regulations. Records must be kept in connection with Federal income, social security and unemployment, and, in a number of states and cities, income and sales taxes. For the operator who keeps records, only a few additional records or changes are necessary for tax purposes.

Since it is impractical to discuss at this time the many problems and regulations concerning taxes, the restaurant operator who keeps good records will have no problems. Every business man who pays wages to one or more employees is required to deduct and withhold specific amounts from the wages of his employees for Federal income taxes. The Federal unemployment tax is imposed upon employers and not deducted from the wages of employees. The operator should acquaint himself with all the regulations of State and Federal taxes.

Financial Statements

In the restaurant business, as in any other business, there are two financial statements which you must prepare. These are the profit and loss statement and the balance sheet.

The profit and loss statement is a summary, in dollars and cents, of the business operations of the restaurant during a given period.

It is a comparison of income and expenses to determine the net profit during that period. The profit and loss statement summarizes the business operation thus:

Sales minus cost of food sold equals gross margin.

Sales minus total operating expenses equals Net Profit.

The balance sheet is a statement of the assets (things owned by the business), the liabilities (amounts owned by the business), with the differences equaling the net worth, or capital, of the business enterprise.

ASSETS - LIABILITIES = NET WORTH OR CAPITAL

It is a picture, of dollars and cents, of the financial status of the business at a given time, usually at the close of the fiscal year.

In the operation and preparation of these business practices. training should be received or expert advice consulted in the operation of these important records.

TRAINING PLAN AND PROGRESS RECORD
for
FOOD SERVICE

JOB TRAINING: What the Worker Should Be Able to Do	Profiency Shown	RELATED INFORMATION: What the Worker Should Know
Requirements of Food Service Workers		
Maintain physical and mental fitness; observe safe practices; care for appliances, equipment, and utensils; sell service and satisfaction Time in hours _____		Physical and mental requirements of food service workers; hazards encountered by food service workers; factors involved in care of appliances, equipment and utensils; factors involved in maintaining good will
Serving the Order		
Perform side work duties; set covers for breakfast, lunch, and dinner; greet and serve customers at tables and at counters Time in hours _____		Factors involved in side work duties; methods of setting breakfast, lunch, and dinner covers; techniques of greeting and serving the customer
Food Preparation		
Perform pantry duties; assemble food orders; prepare beverages; prepare fountain drinks and dishes Time in hours _____		Nature of the various pantry duties; sequence of assembling food orders; fundamentals of preparing beverages; general fountain practices
Restaurant Management		
Plan and prepare menus; maintain restaurant's records; inventory stock; handle and locate merchandise in stock Time in hours _____		Kinds and types of menus; methods and devices used in restaurant control; purpose and use of inventories; ways and means of preventing waste

Code for employer's use in marking student's progress:

Performed some operations in area

Performed some operations with reasonable proficiency

Performed most operations in area

Performed most operations satisfactorily

TRAINING PLAN AND PROGRESS RECORD
for
FOOD SERVICE

Employer's Copy

JOB TRAINING: What the Worker Should Be Able to Do	Profiency Shown	RELATED INFORMATION: What the Worker Should Know
Requirements of Food Service Workers		
Maintain physical and mental fitness; observe safe practices; care for appliances, equipment, and utensils; sell service and satisfaction Time in hours _____		Physical and mental requirements of food service workers; hazards encountered by food service workers; factors involved in care of appliances, equipment and utensils; factors involved in maintaining good will
Serving the Order		
Perform side work duties; set covers for breakfast, lunch, and dinner; greet and serve customers at tables and at counters Time in hours _____		Factors involved in side work duties; methods of setting breakfast, lunch, and dinner covers; techniques of greeting and serving the customer
Food Preparation		
Perform pantry duties; assemble food orders; prepare beverages; prepare fountain drinks and dishes Time in hours _____		Nature of the various pantry duties; sequence of assembling food orders; fundamentals of preparing beverages; general fountain practices
Restaurant Management		
Plan and prepare menus; maintain restaurant's records; inventory stock; handle and locate merchandise in stock Time in hours _____		Kinds and types of menus; methods and devices used in restaurant control; purpose and use of inventories; ways and means of preventing waste

Code for employer's use in marking student's progress:

Performed some operations in area

Performed some operations with reasonable proficiency

Performed most operations in area

Performed most operations satisfactorily

TRAINING PLAN AND PROGRESS RECORD
for
FOOD SERVICE

Student's Copy

JOB TRAINING: What the Worker Should Be Able to Do	Profiency Shown	RELATED INFORMATION: What the Worker Should Know
Requirements of Food Service Workers		
Maintain physical and mental fitness; observe safe practices; care for appliances, equipment, and utensils; sell service and satisfaction Time in hours _____		Physical and mental requirements of food service workers; hazards encountered by food service workers; factors involved in care of appliances, equipment and utensils; factors involved in maintaining good will
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Code for employer's use in marking student's progress:

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Performed some operations with reasonable proficiency

Performed most operations in area

Performed most operations satisfactorily

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

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AGDEX 111/22

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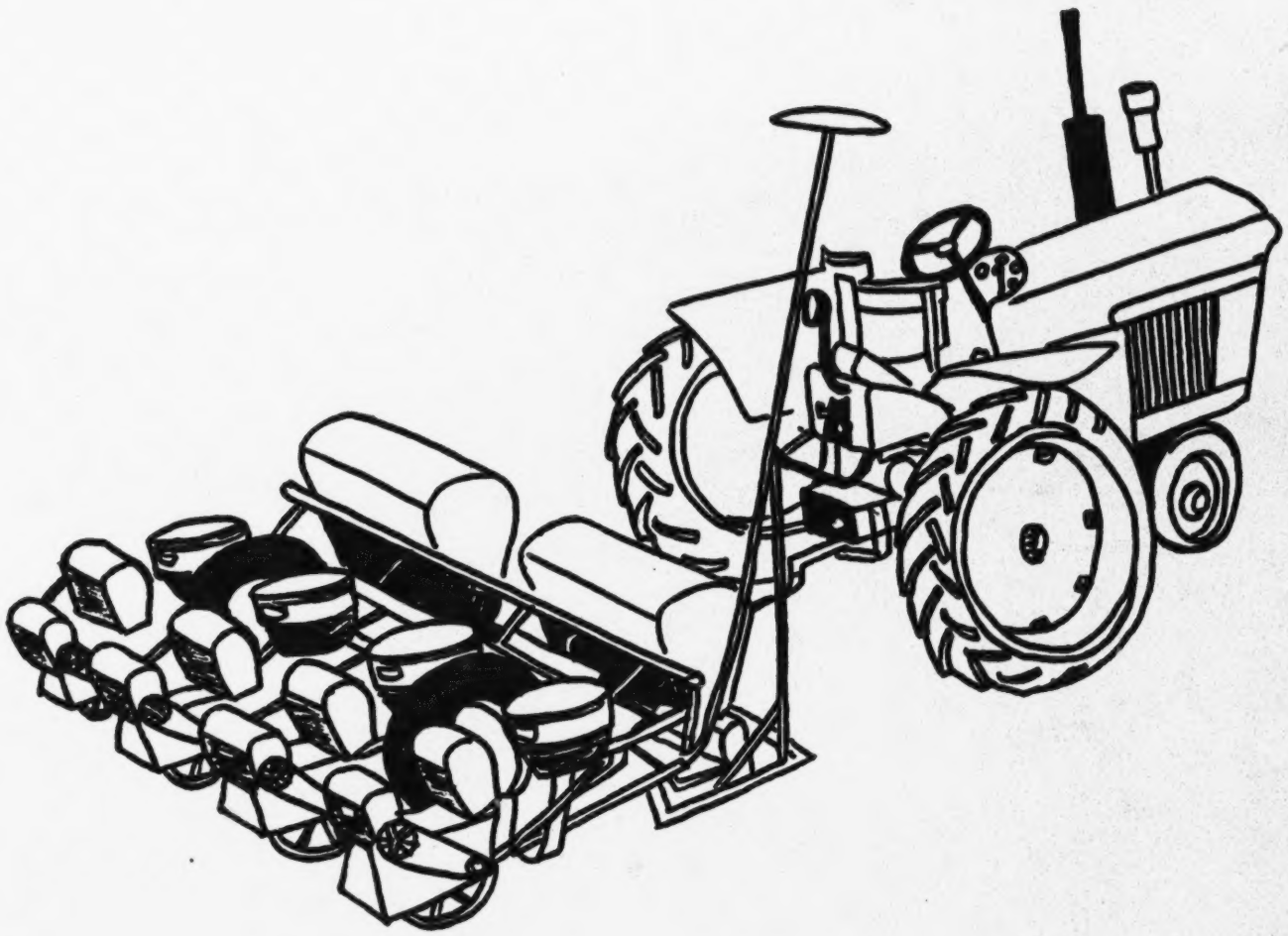
RATE OF PLANTING CORN

A LABORATORY EXERCISE



VT 021158

Department of Agricultural Education
The Ohio State University
and
Vocational Agriculture Service
Ohio Department of Education
Columbus, Ohio
1963

FOREWORD

There have been many improvements in our corn growing practices in the past 20 years such as better hybrids, more fertilizer, improved tillage methods, drainage, weed, and insect control. If farmers are to receive the full benefits of these improvements they must have adequate plant population to take full advantage of them.

Mr. Clarence Fridline, Vo-Ag Teacher, Mt. Vernon, Ohio, used the laboratory exercise described in this outline to demonstrate the effect of planter seed plate selection and the rotating speed of the seed plate on the accuracy of seed drop. Mr. Fridline found this exercise to be very effective for both adult farmers and high school students.

The exercise first develops the importance of maintaining a high rate of planting. Dr. Gordon Ryder, Extension Agronomist, The Ohio State University, and Drs. H. J. Mederski and E. J. Dollinger of the Ohio Agricultural Experiment Station, have technical advice in developing this section.

The remainder of the exercise deals with the laboratory work and the operation and calibration of the corn planter planting assembly unit. Mr. S. G. Huber of the Agricultural Engineering Department and Mr. Richard Carr, John Deere Engineer, gave assistance with this part of the outline.

MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) Harlan E. Ridenour (Agency) Agricultural Education Curriculum Material Service

(Address) Room 201, 2120 Fyffe Road, Columbus, Ohio 43210

DATE: 24 July 1967

RE: (Author, Title, Publisher, Date) Dr. Harlan E. Ridenour, Rate of Planting Corn, a Laboratory Experience, Agricultural Education Curriculum Material Service, 1963

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Uses of Material Teacher to conduct laboratory exercise
Users of Material Teacher

(4) Requirements for Using Material:
Teacher Competency Teacher of Vo. Agr.
Student Selection Criteria Basic mathematics and science.

Time Allotment 5 hours

Supplemental Media --
Necessary X
Desirable ____ (Check Which)

Describe Corn Planter

Source (agency) Local implement dealer or farmer
(address)

RATE OF PLANTING CORN

A Laboratory Exercise

CONTENTS

I. Determining the Proper Rate of Planting Corn for Most Profitable Corn Yields.

A. Soil fertility level.

B. Relationship of plant populations to stalk breakage and barrenness.

C. Plant populations and season.

D. Determining the rate of planting corn.

II. Operating the Corn Planter to Obtain the Desired Rate of Planting.

A. Equipment and materials needed.

B. Procedure to follow.

III. Principles of Corn Planter Operation

A. Causes of inaccuracy in seed drop.

B. Speed of planting and seed plate cell size.

IV. Corn Planter Calibration.

I. Determining the proper rate of planting for most profitable cornyields.

A. Soil fertility level.

1. Small increases in plant population can result in sizable increases in yield when recommended fertilizer practices are followed. (Chart 1) "Well fertilized Soil Requires Adequate Stand for Best Results." Summary of results - Soil Fertility Demonstration Plots Conducted by H. S. Vo. Ag. Depts., Agronomy Mimeo 155, O. A. E. S., Wooster, Ohio.

a. The average stand on all plots was 14,500 plants / A with a yield of 78 bu/A on no fertilizer plots and 94 bu/A. on fully treated plots.

b. Increasing the stand above the average 14,500 plants/A to 18,000 plants/A only increased the yield 3 to 4 bu / A on the no fertilizer plots.

c. Increasing the stand above the average of 14,500 plants per A. to 18,000 plants/A increased the yield 18 bu/A on fertilized plots.

d. Increasing the stand from 14,500 to 18,000 plants per A. and following recommended fertility practices increased the yield 36 bu/A.

"Agronomists agree that a minimum of 16 to 18 thousand plants per Acre are needed to make the best use of applied fertilizer."

2. Different types of soil give similar responce to high plant populations.

(Chart 2) "Two soil types give similar responce to increased rates of planting." Agronomy Journal Vol. 52, 1960 Hoffand Mederski, O A E S.

With each soil type the maximum yield was obtained at about 18,000 plants per acre. In each case the top yield was above 140 bu/A.

3. When rate of planting matches the productivity of the soil ears should average about one half pound each. If ears average more than one half pound under planting is indicated.

(Chart 3) "Thickness of stand affects ear size." Crops and Soils, May 1959.

(Chart 4) "It's the bushels per acre - not the size of the ears - that bring the profits." Gordon Ryder, Know your Limiting Factors in Crop Production, American Potash Institute.

The weight per corn ear declined as the plant population and bushel yield increased. The average ear.weight decreased from .6 pounds at 9000 plants per acre to .4 pound per ear at 19,000 plant population. Results of a survey concucted by Gordon Ryder, Department of Agronomy, O. S. U. using 8 hybrids with 4 rates of fertility on 55 fields.

B. Relationship of plant populations to stalk breakage and barrenness.

"Efficient use of available fertility and soil moisture in stand is prevented by two main factors - stalk breakage and barrenness."

1. "The ideal stand for commercial corn is the one that makes the best comparison between maximim yield and mimum stalk breakage."

(Chart 5) Yield and Stalk Breakage from Corn Planted at various rates," Crops and Soils, May 1959, G. H. Stringfield, OAES dept. of Agronomy.

High plant populations favor development of stalk rots which bring on stalk breakage.

2. As the plant population increases the number of barren stalks may increase. (Chart 6) "The Number of Barren Stalks Increases as Plant Populations Increase." Agronomy Journal, Vol. 52, 1960 Hoff and Mederski, OAES.

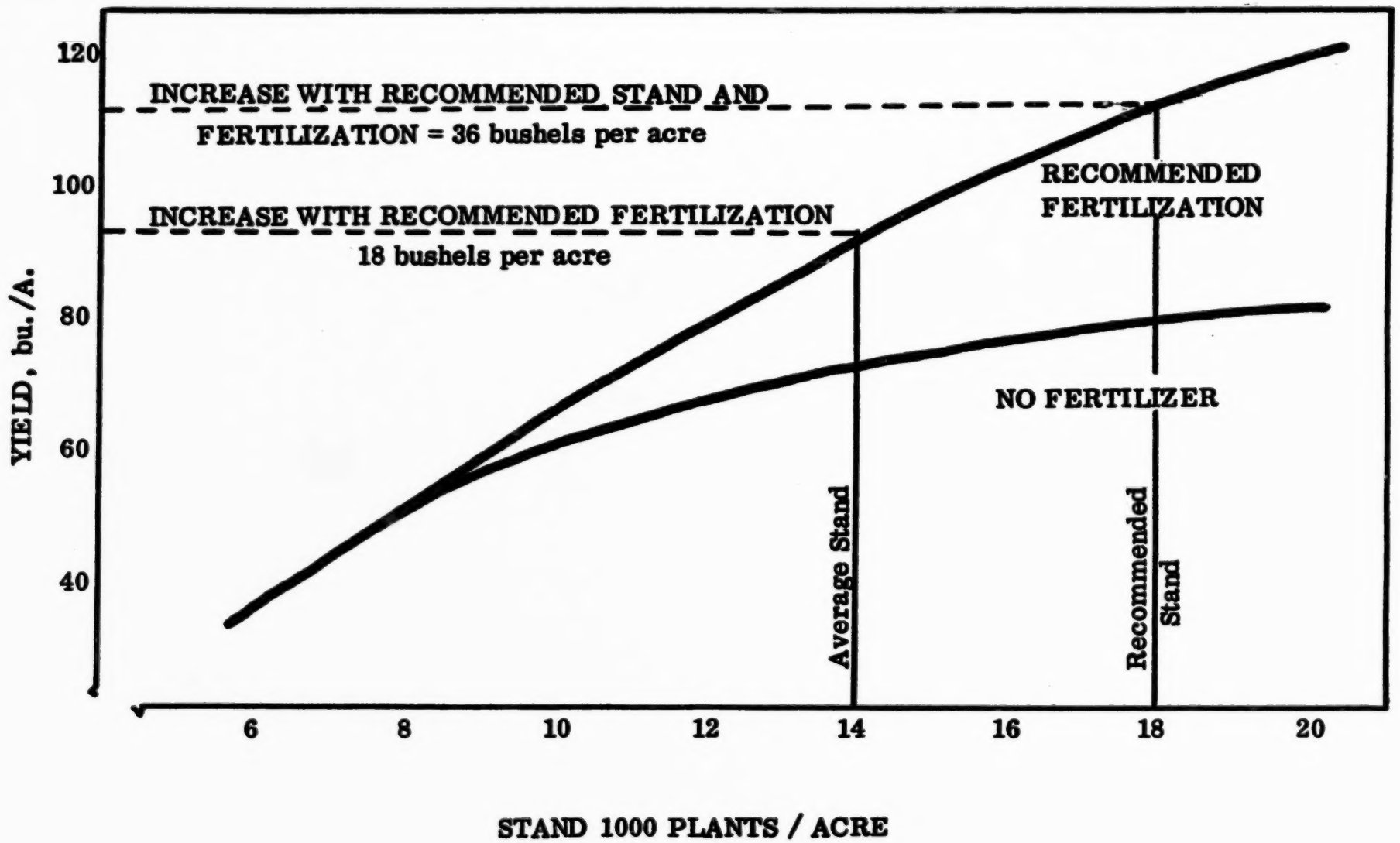
Dr. E. J. Dollinger, Dept. of Agronomy, OAES, states that research in corn breeding has made progress in developing hybrids that are resistant to barrenness (no ears) and resistant to stalk rot which brings on stalk breakage. When high plant populations are to be used care must be taken to select hybrids that are tolerant to heavy stands.

A balance of plant nutrients (Nitrogen, Phosphate, and Potash), is important if healthy corn is to be raised. Nitrogen stimulates vegetative growth and an excess of nitrogen will cause weak stalks. Phosphorus helps bring about early maturity while Potash produces stronger and stiffer stalks.

C. Plant populations and season.

The production of high corn yields depends largely on an adequate supply of moisture, other factors being equal.

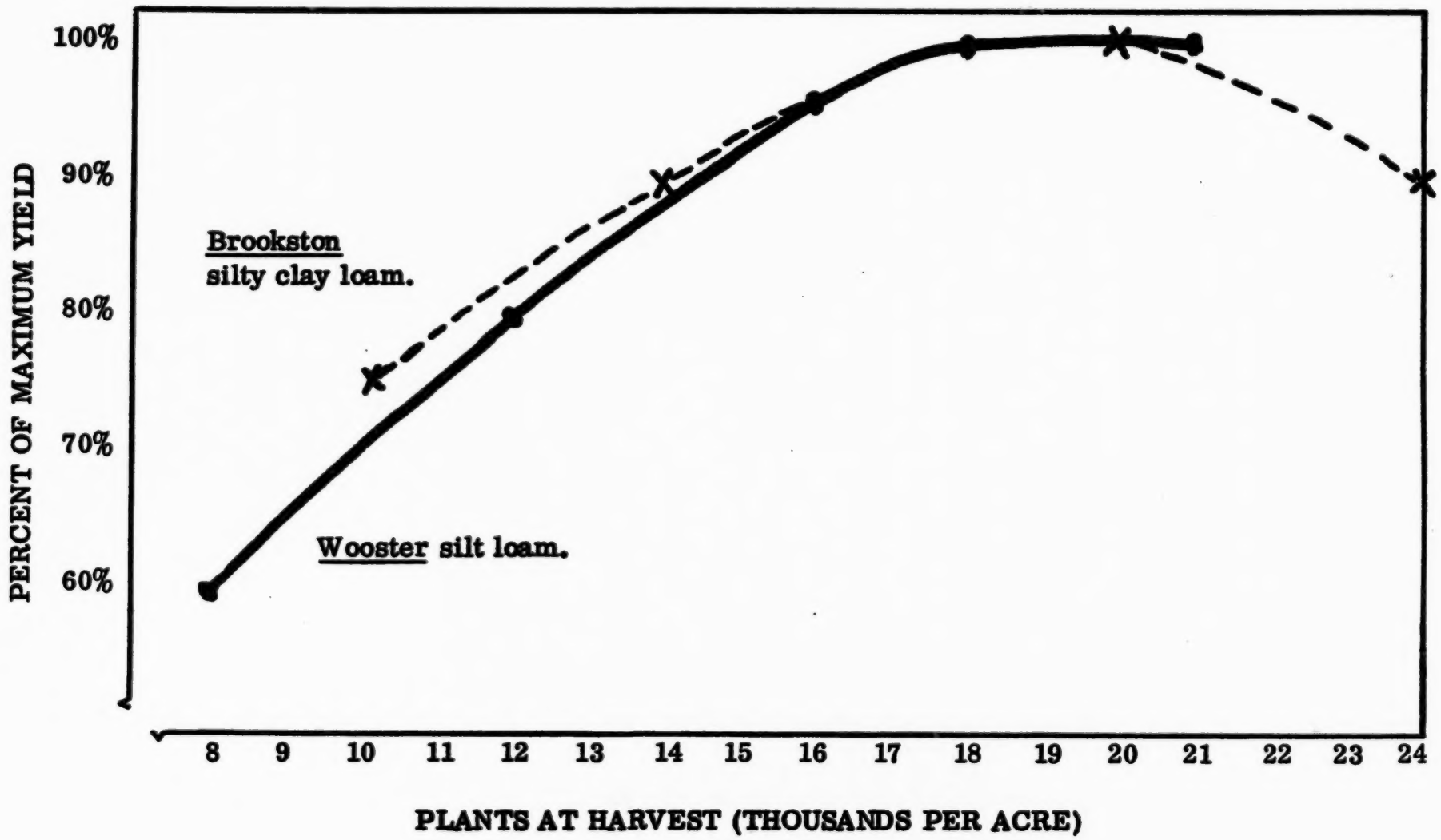
WELL FERTILIZED SOIL REQUIRES ADEQUATE STAND FOR BEST YIELDS



Summary of Results - Soil Fertility Demonstration Plots conducted by H. S. Vo. Ag. Depts. Agronomy Mimeo 155, O. A. E. S. 1959.

CHART 1

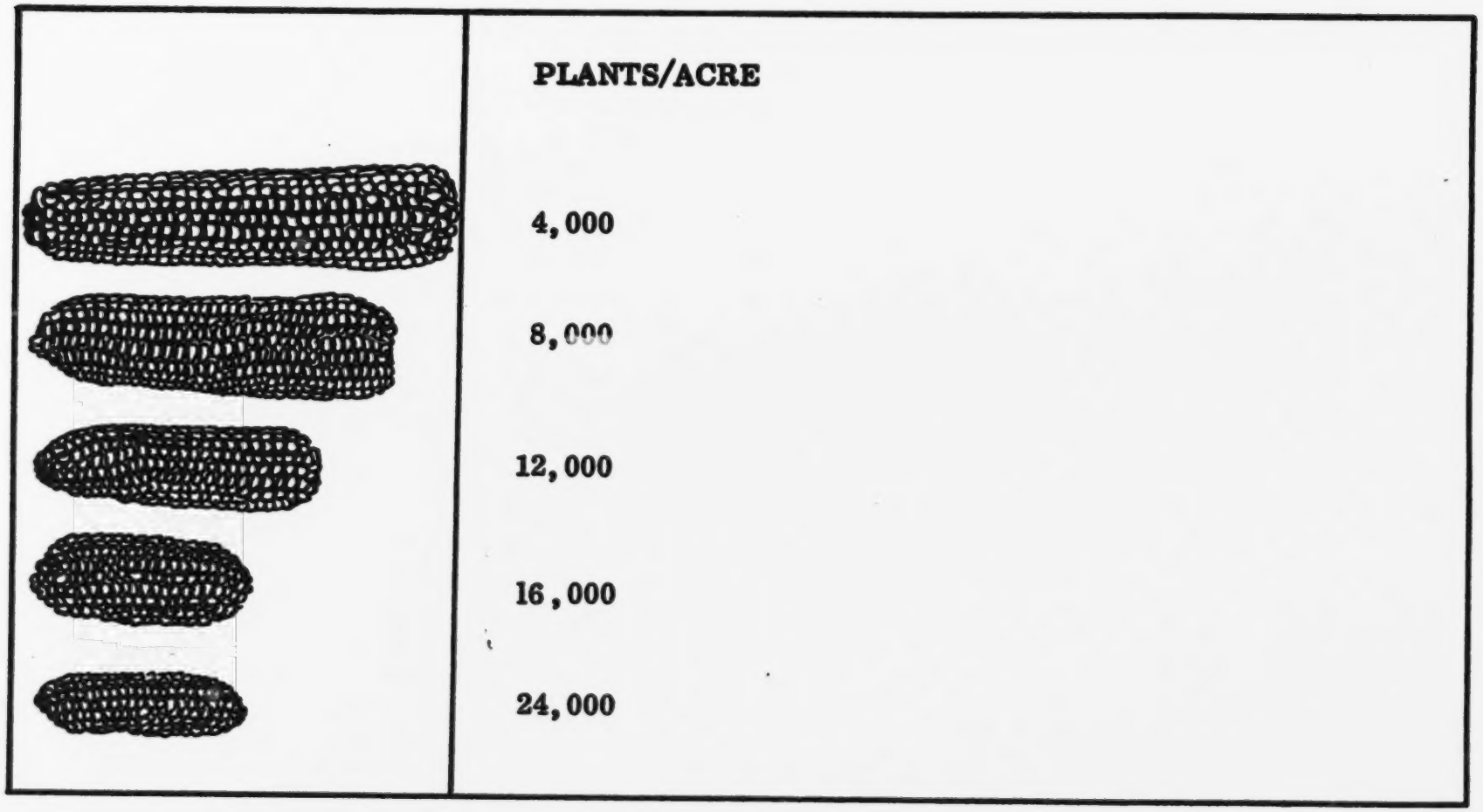
TWO SOIL TYPES GIVE SIMILAR RESPONSE TO INCREASED RATE OF PLANTING.



Agronomy Journal, volumn 52, 1960, Hoff & Medersk.

CHART 2

THICKNESS OF STAND AFFECTS EAR SIZE

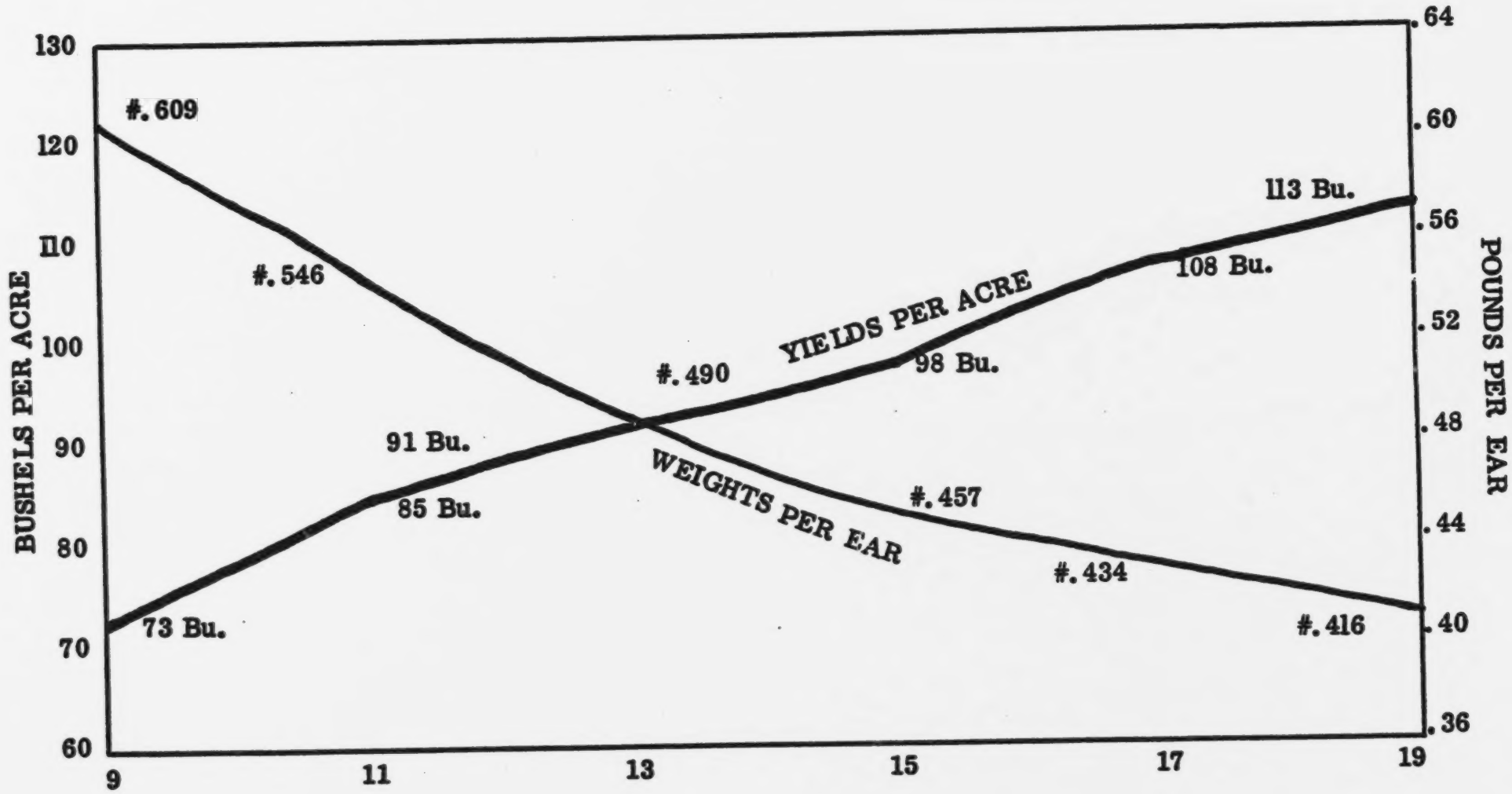


With top yields, ears will average about 1/2 lb. The season will also affect ear size.

Crops and Soils May 1959.

CHART 3

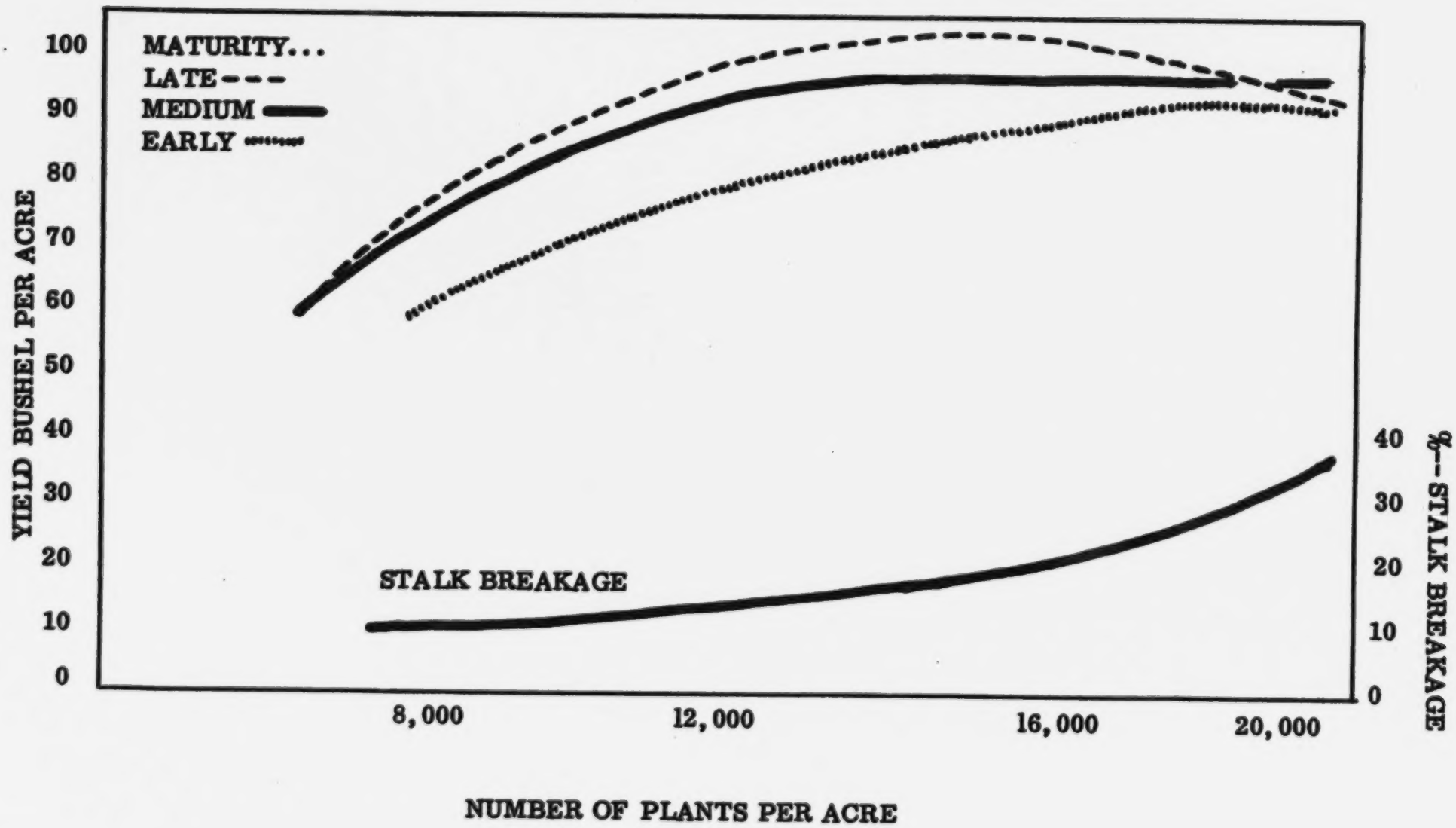
IT'S THE BUSHELS PER ACRE--NOT THE SIZE OF EARS--
THAT BRING THE PROFITS.



Know Your Limiting Factors, AMERICAN POTASH INSTITUTE

CHART 4

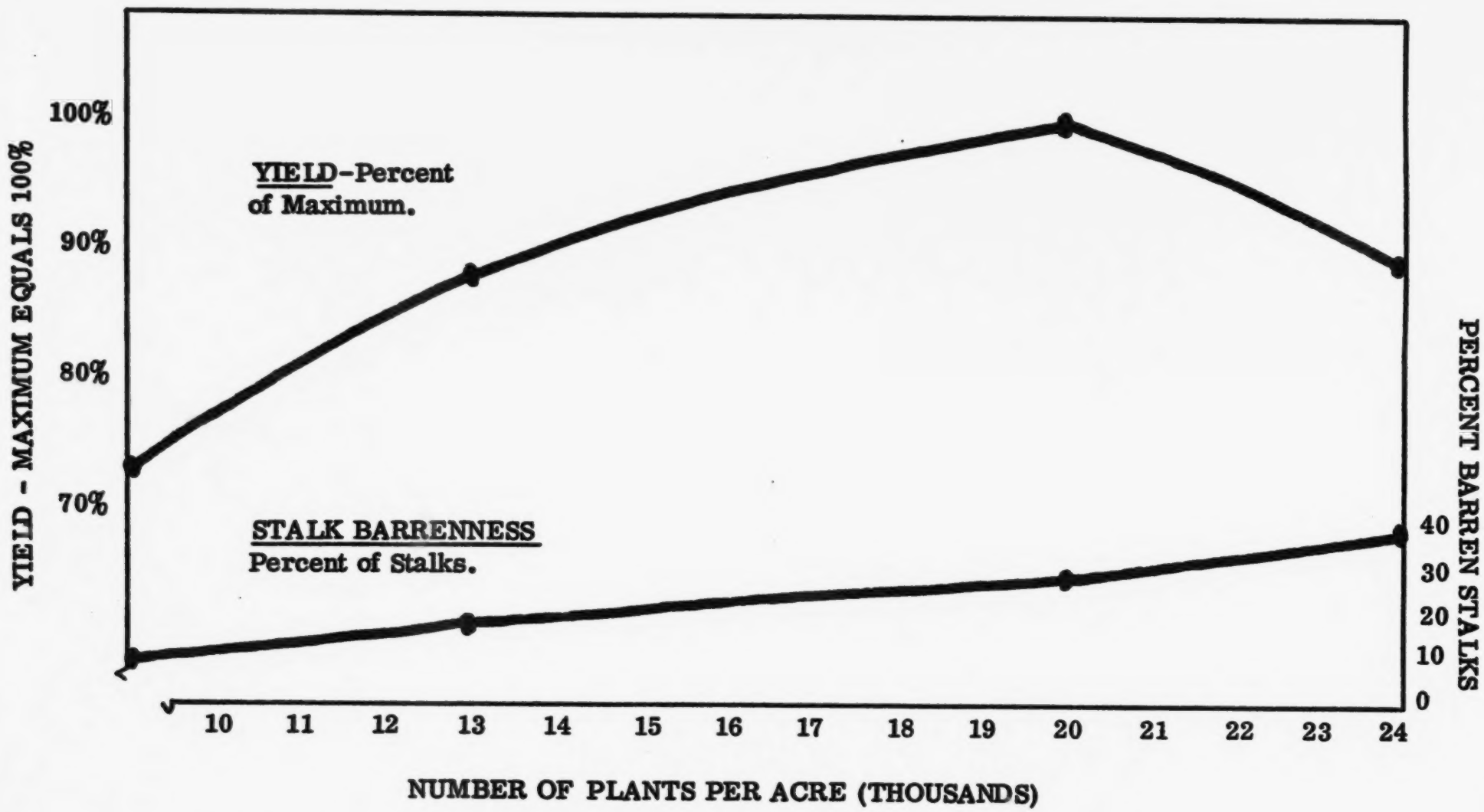
YIELD AND STALK BREAKAGE
FROM CORN PLANTED AT DIFFERENT RATES.



O.A.E.S. 1959, Crops and Soils

CHART 5

THE NUMBER OF BARREN STALKS INCREASES
AS PLANT POPULATION INCREASES



Agronomy Journal, volumn 52, 295-297.

CHART 6

(Chart 7) "Stands Best Suited to Favorable Seasons Pay Best in Longrun," Handbook of Ohio Experiments in Agronomy, Item 73, OAES

Heavy stands during dry seasons will produce low yields but stands adequate for full production in good seasons will produce more in good and average seasons than the loss during dry seasons. These tests also indicated that silking date was delayed one day for each 4000 plants in the stand. Tillering (suckers) and weed growth were also reduced as stand increased. At optimim stands ears averaged about one half pound each.

D. Determining the rate of planting corn.

Farmers are maintaining a fairly high rate of fertility on their corn land and the moisture supply has usually been adequate for high yields. If full benefit of the fertility and moisture supply is to be received, farmers need to have a plant population of 17,000 to 18,000 stalds per acre at harvest. There is an average loss of about 15% from the amount of seed planted to the number of plants harvested. The following table may be used in determining rate of planting.

Table 1. Corn Planting Rates and Row Spacing

Rates of Planting Kernels per acre	Estimated Stand Allowing 15% Stand Loss	Spacing in Row (inches)			
		Row Widths			
		36"	38"	40"	42"
20,000	17,000	8.7	8.2	7.8	7.5
21,000	17,850	8.3	7.8	7.4	7.1
22,000	18,700	7.9	7.5	7.1	6.8
23,000	19,550	7.5	7.2	6.8	6.5
24,000	20,400	7.2	6.8	6.5	6.2
25,000	21,250	6.9	6.6	6.3	5.9

Fig. 1 SIZES OF SEED CORN

Corn is sized according to its width, thickness, and length. The dimensions are recorded in 64 ths. inch. Seed corn companies do not take the time or go to the added expense of close grading, so there will be considerable variation in size of kernel within a grade.

EXAMPLES OF SIZE, DIMENSIONS, AND KERNELS PER POUND

Size	Dimensions	Kernels per pound
Small flat	13 x 18-17	1794
Medium flat	13 1/2 x 21-18	1542
Large flat	13 1/2 x 24-21	1336
Extra large flat	13 1/2 x 28-24	1096
Thick flat	15 x 24-21	1150
Medium round	21-28	1280
Large round	24-21	1106

NOTE: First number is the thickness in 64 ths.
Second number is the width of screen which kernel passed through.
Third number is the width of screen which kernel carried over.

Rounds will plant fewer acres per bushel due to the larger seed size. More food is stored in the rounds giving a healthier plant during the early stages of growth.

To determine the amount of seed corn to buy, divide the planting rate per acre by the number of kernels per pound of seed.

$$\frac{\text{Planting rate per acre}}{\text{Kernels per pound}} = \text{Pounds of seed per acre}$$

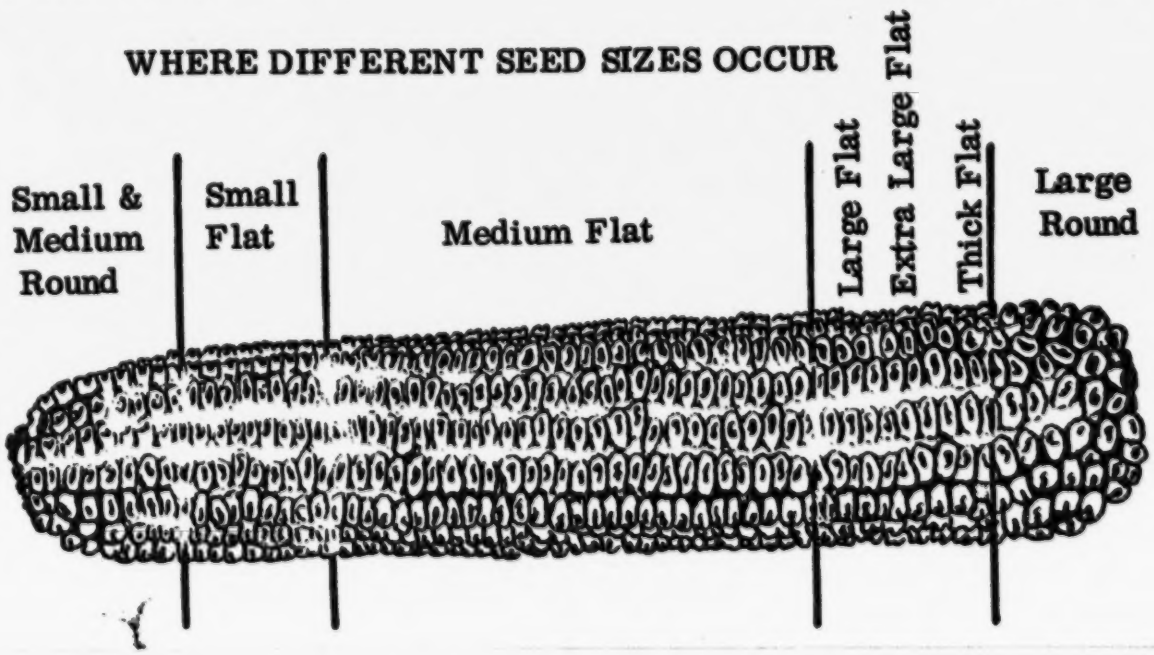
EXAMPLE: Plant 20 acres at rate of 18,000 kernels/acre with medium flat seed.

$$\frac{\text{Planting rate } 18{,}000/\text{A.}}{\text{Medium Flat Kernels/lb. } 1542} = 11.67 \text{ pounds seed per acre planted}$$

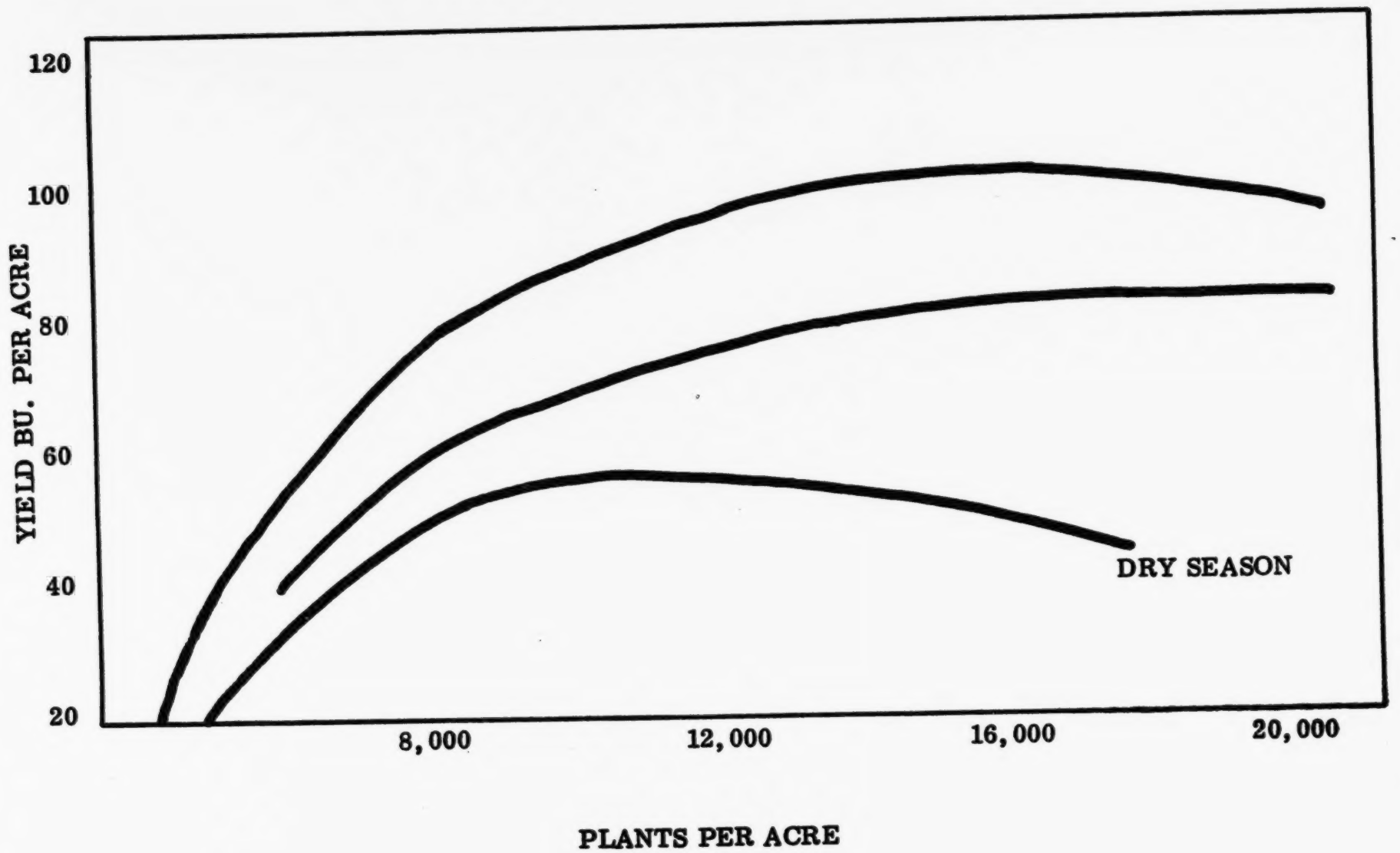
20 acres x 11.67 lbs./A. = 233.4 pounds of seed

$$\frac{\text{Lb. seed for total As. planted } 233.4}{\text{Lbs. seed per bushel } 56} = 4.167 \text{ bu. of seed needed}$$

WHERE DIFFERENT SEED SIZES OCCUR



STANDS BEST SUITED TO FAVORABLE SEASONS
PAY BEST IN LONG RUN



O.A.E.S., Handbook, table 73.

CHART 7

II. Operating the Corn Planter to Obtain the Desired Rate of Planting. Laboratory Exercise

References: 1. Operator's Manual for Corn Planters being used in exercise. Available in quantities from farm machinery manufacturers.

2. "Planter Plate Selection and its effect on seed drop accuracy" Gordon Ryder, Agronomic Tips C - 2, Dept. of Agronomy, O. S. U. (Attached).

3. "High Speed Planting Can Reduce Kernel Drop," Gordon Ryder, Agronomic Tips C - 3 , Dept. of Agronomy, O.S.U., (Attached)

4. "High Speed Planting Cuts Corn Yields," Gordon Ryder, National Plant Food Institute, 1700 K Street North West, Washington 6, D. C.

5. " Planting Corn in the Sixties" pp. 11 - 14 Educational Department, De Kalb Agricultural Association, Incorporated De Kalb, Illinois, (price 25¢)

A. Equipment and Materials Needed.

1. A corn planter "planting assembly unit" may be borrowed from a local machinery or seed corn dealer. This unit includes only the hopper plate holder, seed plates, cut off tongue, knocker roller, plate gear, and clutch parts of the corn planter and is used by dealers in helping farmers select seed plates of the proper size. Most John Deere Dealers will have such a seed plate selector stand available. This planting unit is operated by an electric motor.

If such a unit is not available a corn planter could be used in the shop by raising a wheel and operating the planting unit, at the desired speed, by means of an electric motor.

2. Obtain a set of seed plates for the planting unit. Have both 16 cell and 24 cell plates available. Obtain some plastic plates so they can be compared with metal plates. See attached sheet "Plastic Planter Plates" to determine available plastic plates.

Students may bring planter plates from home for checking.

3. Obtain several different grades of seed corn from seed dealers. See Figure 1, "Sizes of Seed Corn."

B. Procedure to follow:

1. Have the class determine the desirable rate of planting for a field of corn. (See section I this outline).

2. Have the class select a grade of seed corn to use in this exercise.

3. Have the class select the seed plate with the cell size and number of cells they think is best adapted to the grade of corn being used.

Reference: Agronomic Tips C - 2, and Agronomic Tips C - 3 Table II.

4. Have the class select the rate of foward travel to be simulated in this exercise.

a. Determine whether to use 16 cell or 24 cell plates.

b. Set the clutch so that the desired seed plate r. p. m. is obtained to simulate the m. p. h. given in Agronimic Tips C-3, Table I.

Note: At this point the information may be obtained in one of two ways.
(1) Use the tables provided in this exercise and in the operator's manual you are using, and check the seed plate r. p. m. with a speed indicator. Compare with Table I, Agronomic Tips C-3 for accuracy of setting.
(2) This provides an opportunity to teach the principles of mathematics involved in relating the speed of foward travel m. p. h. to the r. p. m. of the seed plate.

Optional Suggested Problems:

(1) If the planter foward travel speed is 5 m. p. h., what is the r. p. m. of the drive wheel?

Circumference of drive wheel = diameter x pi

5280/C = revolutions per mile

revolutions per mile x speed (m.p.h.) = revolutions in 60 min.

revolutions in 60 min. / 60 = r. p. m. of drive wheel

(2) The speed at which the various units of the planter are driven may be calculated by comparing the relationship between the size of the driving pulley, sprocket, or gear with the size of the driven pulley, sprocket, or gear. The following formula is used:

r. p. m. of driver x diameter or no. of teeth in driver =

r. p. m. of driven x diameter or no. of teeth in driven

If any three of these items are known the fourth can be calculated. By applying this formula and following the flow of power from the drive wheel to the seed plate the r. p. m. of the seed plate may be determined.

(The work may be checked by using a speed indicator and comparing with Table I, Agronomic Tips C - 3 for accuracy.)

5. Have the class determine the number of kernels that theoretically should be dropped in one minutes time. (The r. p. m. of the seed plate will be determined by one of the methods outlined in item four above.)

Example: If the planter is set for 20,000 kernels per acre in 40 inch rows using a 16 cell plate and foward travel is 5 m. p. h, the seed plate r. p. m. should be 42.3. Each of the 16 cells will pass the cut off 42.3 times per minute.

16 cells x 42.3 r. p. m. = 678.8 kernels in one minute.

Optional: If desired the number of kernels dropped per acre can be figured mathematically. The above example is figured as follows:

Row width in ft. 3.33 x 5280 ft. = 17,582.4 sq. ft. per mi. (traveled in 12 minutes at 5 m. p. h.)

43,560/17,582.4 = 2.48 miles traveled per A planted

12 min. per mile x 2.48 miles = 29.76 minutes per A

29.76 min./A x 678.8 kernels per minute =

20,201.08 kernels per A (checks closely with 20,000)

6. Using the seed corn plate, seed corn grade, and speed selected by the class operate the unit for one minute. Count the kernels dropped and compare with the theoretical number determined in item 5 above.

How many kernels per acre would this represent? (See example in item 5 above.)

7. Demonstrate the effect of seed plate speed (r. p. m.) on accuracy of seed drop.

For this demonstration select the seed plate with the "correct" size seed cells (Part III section 4 this outline) and vary the seed plate speed (r. p. m.) in the trials for an assimulated ground speeds of 3, 5, 7, and 10 m. p. h.

Table 2

Record of the effect of seed plant speed (r. p. m.) on accuracy of seed drop.

Grade of seed corn used _____
Seed plate cell size _____
No. cells in seed plate _____

Assimulated Ground Speed m. p. h.	Seed Plate r.p.m.	Theoretical Seed Drop in one minute	Actual Seed Drop in one minute	Percent Theoretical Drop	No. Cracked Kernels	% Cracked Kernels
3						
5						
7						
10						

Note: Data in Table 2 may be plotted similar to charts 8 and 9.

a. Demonstrate how seed plate r. p. m. increases as speed of forward travel increases.

b. Demonstrate how seed plate r. p. m. may be reduced for a given rate of planting by changing from a 16 to a 24 cell plate.

8. Demonstrate the effect of seed plate cell size on the accuracy of seed drop.

For this demonstration select the rate of forward travel to be used (suggested speed 7 m. p. h.) and vary the seed plate cell size from a close fit upward in size (Part III section 4 this outline).

The effect of seed plate cell size on accuracy of drop at different rates of speed can be illustrated by repeating this demonstration at different speeds.

Table 3

Record of the effect of seed plate cell size on accuracy of seed drop

Ground speed m. p. h. _____
Seed plate r. p. m. _____
Grade of seed corn _____

Seed Plate Cell Size	Theoretical Seed Drop in one minute	Actual Seed Drop in one minute	No. Cracked Kernels	% Cracked Kernels

Note: Data in Table 3 may be plotted on a graph.

9. Compare accuracy of plastic and cast plates.

10. Demonstrate seed box grading.

a. When cells are too short for grade being used.

b. When kernels are too wide for cell use extra wide kernels for this demonstration such as large flat 13 1/2 x 24 x 21 or extra large flat 13 1/2 x 28 x 24. (Turn the seed plate holder groove up to correct this.)

11. Demonstrate the effect of worn parts on accuracy of seed drop by inserting worn cut off tongue and knocker roller.

COOPERATIVE EXTENSION WORK IN AGRICULTURE
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COLLEGE OF AGRICULTURE AND HOME ECONOMICS OF
THE OHIO STATE UNIVERSITY AND THE UNITED STATES
DEPARTMENT OF AGRICULTURE COOPERATING

AGRONOMIC TIPS

C - 2

DEPARTMENT OF AGRONOMY 1885 NEIL AVENUE COLUMBUS 10, OHIO

March, 1962

Planter Plate Selection and Its Effect on Seed Drop Accuracy

Uniform stands and higher plant populations are more certain by selection of the correct planter plate. The seed plate size should be checked for each lot of seed corn, particularly when changing hybrids. Most seed corn has a recommended plate number for each bag of seed. The shape and sizes of the corn kernels vary because of differences in hybrid, fertility levels in the seed field, moisture conditions. The sizes of graded seed corn vary due to the grading procedures of the seed producers.

Kernel length in flat grades of corn is probably the most critical dimension in the selection of a seed plate for proper cell size. Uniformly sized round grades will plant more accurately than flat grades because they have only one general dimension which is the diameter of the kernel.

The edge drop seed plates in Fig. 1 shows three plates each with different cell lengths and the way kernels of the same length fit into the cells. In the top seed plate, the cells are too short for the kernels shown. Many of these kernels will be wedged in the cell and will not be ejected from the cell by the knock-out roller. Some kernels may be cracked or damaged; others will be pushed out of the cell as it passes under the knock-out housing. Each cell failing to drop a viable kernel, or each cell ejecting a cracked kernel, will reduce the stand 6¼% on each revolution of a 16-cell plate.

The center plate in Fig. 1 shows the proper clearance. The seed cells are 1/16" longer than the longest kernels in a seed lot. This will give ample room for the kernels to drop into the cells as the seed plate rotates at a high speed.

The bottom seed plate in Fig. 1 shows what will happen if the seed cells are too long for the kernels to be planted. Often times, a cell can pick up two kernels standing end-wise in the cell. As these pass under the knock-out housing, they may be broken, cracked or pushed out of the cell completely. Extensive testing has shown that as high as 18 to 20% of the kernels are cracked and damaged when excessively large plates are used.

Seed corn is sized for width, thickness, and length of kernels. The width and thickness are very uniform and relatively easy to size with the

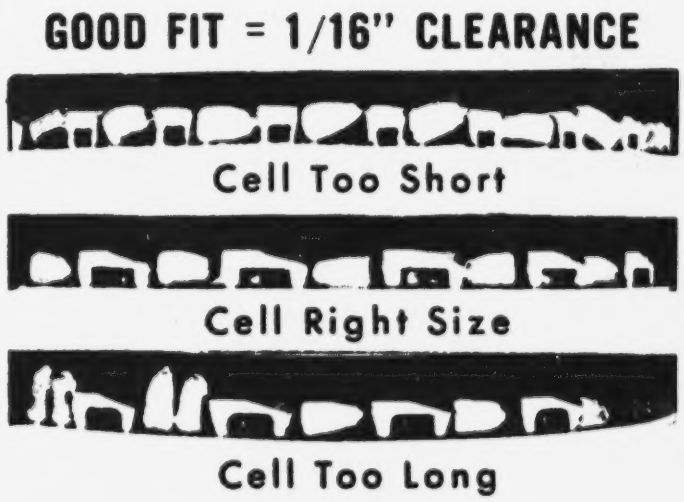

Fig. 1

Fig. 2

present equipment available. The sizing for kernel length is more difficult and time consuming. The variations in kernel length are greater than for either the width or thickness. Most of the seed plates for flat kernels are 20/64" thick to accomodate the kernel width. The cells are from 11/64" to 13/64" wide corresponding to the kernel thickness. The cell lengths range from usually 32/64" to 44/64" long, and each size is usually listed by plate numbers.

The large flat kernels in Fig. 2 are 23/64" wide. In most corn planters these kernels are too wide to pass under the knock-out housing without many of them being cracked or pushed out of the cells. To eliminate this problem, the grooved side of the seed plate holder or false plate should be up or next to the seed plate, allowing these wide kernels to drop into the groove. The depth of the groove varies from 2/64" to 4/64" depending upon the make of planter. The extra clearance in the plate holder groove allows the wide kernels to pass under the knock-out housing with less damage to the kernels.

Matching uniformly sized round grades with the proper seed plate in relatively easy ample clearance can be allowed for accurate cell fill without two kernels fitting into a cell causing excessive cracking. When planting large rounds the plate holder groove may need to be next to the seed plate.

The rotating speed or rpm of the seed plate is a critical factor in a cell fill accuracy of the seed corn plates. The use of 24-cell plates instead of 16-cell plates will reduce the rpm of the seed plate by 33%. The top plate in Fig. 1 has 24 cells. Compare the distance between cells with the 16-cell plates below it. When the rotating speed of the seed plate is reduced, it allows more time for the kernels to drop into the cells and gives greater cell fill accuracy.

Seed box grading occurs when the plate holder groove is in the wrong position or when the cell length is too short, particularly if the seed corn has much more than 4/64" variation in kernel lengths. The smaller kernels are sorted out of the corn in the box, thus permitting a layer of the longer and/or wider kernels to build up in the bottom of the seed box. Repeated refilling of the seed boxes increases the thickness of this layer which causes a reduction in cell fill. This causes a poorer seed drop than anticipated. Seed box grading can be reduced by emptying the boxes after each second or third refill. Save this seed until the seed lot is planted, then select a different plate, if needed, for these larger kernels.

The steps in choosing the proper seed plate for flat grades are:

1) Select the seed plate recommended for the seed corn bag
2) Pick out several of the longest kernels from a handful of corn
3) Fit these long kernels in the seed cell of the recommended plate
4) Allow 1/16" clearance for length
5) If clearance is greater or less, try another plate
6) Adjust plate holder or false plate for proper kernel width
7) Check seed drop in prepared seedbed at usual planting speed

Many factors are involved in causing the harvest stands to be lower than planned. Careful selection of the seed plates and using 24-cell plates at reasonable speeds can lead to greater planting accuracy and higher profits.

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Agronomic Tips Committee

CORN

COOPERATIVE EXTENSION WORK IN AGRICULTURE
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COLLEGE OF AGRICULTURE AND HOME ECONOMICS OF
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DEPARTMENT OF AGRICULTURE COOPERATING

AGRONOMIC TIPS

C -

DEPARTMENT OF AGRONOMY 1885 NEIL AVENUE COLUMBUS 10, OH

April, 196

High Speed Planting Can Reduce Kernel Drop

High-speed corn planting causes reduced seed drop and lower stands even though proper plates are used. Combinations of high planting speed, thick planting rates, and incorrect seed plates frequently decrease the seed drop to below 60% of the planter manual setting. Farmers can accurately determine whether the stand losses are occurring before or after the corn emerges.

On 100 plot locations in the Miami County demonstration program during 1959 and 1960, farmers had a harvest stand of about 25% below the planter setting. The farmers set their corn planters for a 7" seed spacing in 40" rows, driving at about 5 mph or less, using the seed plates recommended for the seed lot planted. The planter setting for this spacing was 22,400 kernels per acre. Stand counts in these plots shortly after emergence showed an average stand of 18,600 plants per acre or 17% less than the planter setting. The harvest stands averaged 16,800 plants or 25% less than the planter setting. Most of the 17% loss is due to the failure of the kernels to drop and only a small portion due to germination.

The rotating speed of the seed corn plate is a most important factor in the accuracy of the seed cell fill. High rpm of the seed plate doesn't allow sufficient time for the kernels to properly fit into the cells. Two factors affect the rpm of the seed plates. Increasing the planting speed and/or increasing the planting rate will increase the rpm of the seed plate. This is shown in Table I.

TABLE I

PLANTER PLATE SPEED

	16-cell plate			24-cell plate		
	Kernels per Acre			Kernels per acre		
MPH	12,000	16,000	20,000	12,000	16,000	20,000
	RPM	RPM	RPM	RPM	RPM	RPM
3	15.3	20.2	25.4	10.2	13.5	16.9
5	25.4	33.7	42.3	16.9	22.5	28.2
7	35.6	47.1	59.2	23.7	31.4	39.5

The rpm increases as the speed of planting increases as shown by reading down in the columns. Reading across the columns, it will be noted that the rpm of the seed plate increases as the planting rate is increased from 12,000 to 20,000 kernels per acre. Table I also shows that the rpm of the seed plate increases nearly four times when both planting speed and planting rate are increased at the same time, for example, from increasing from 12,000 kernels at 3 mph to 20,000 at 7 mph when 16-cell seed plates are used. This high

speed means that 16 kernels are expected to drop out of the seed corn plates during each revolution. Very careful selection of the seed corn plate is necessary if we expect the corn planter to do an accurate job of planting when we are attempting to drop 16 kernels per second.

This problem of low seed drop in high speed planting can be partially remedied by using 24-cell seed plates. Table I shows that the rpm of the 24-cell plates at any one of the speed rate combinations is approximately 33% less than the rpm of the 16-cell plates. The lower speed gives more time for the kernels to drop into the cells which helps to increase the cell fill accuracy. Field trials were made to determine the extent of the seed drop decrease at three speeds using three seed corn plate sizes with a 4-row corn planter using 16-cell edge drop planter plates. In these trials, a uniformly sized lot of corn (13x21-18) was selected. The variation in length was quite small, 95% of the kernels were within a 4/64" variation.

In Table II the seed corn plate designations are:

Too short - longest kernels fit snugly for cell length.
Right length - longest kernels had 1/16" clearance for cell length.
Too long - longest kernels had 1/8" clearance for cell length.

The planter was set to drop 20,000 kernels per acre. The kernels were caught in the corn planter boot while driven over a measured distance.

TABLE II

KERNELS DROPPED AT THREE SPEEDS USING THREE DIFFERENT SEED PLATES

Cell Length	3 mph Kernel/Acre	5 mph Kernel/Acre	7 mph Kernel/Acre
Too short	19,500 (3)*	17,500 (4)	11,500 (9)
Right length	20,400 (2)	17,900 (3)	13,800 (10)
Too long	22,500 (3)	22,100 (4)	20,600 (15)

* () % Broken kernels.

The total number of kernels dropped, as shown in Table II, decreased as the planting speed increased. The number of kernels dropped at a given speed increased as the cell length increased. When the right length seed cells were used in these trials, the kernel drop decreased about 10% by changing from 3 mph to 5 mph. An additional 20% decrease occurred when the planting speed was increased to 7 mph. The percent of broken kernels, shown in parentheses, increased with both speed and longer seed cells. The planting was very accurate at 3 mph using a seed plate with the correct cell length. In most instances, a 24-cell plate at 5 mph will meter the corn at a comparable rate to a 16-cell plate at 3 mph.

Each year in Ohio, many acres of corn are fertilized adequately for high yields and planted for an intended harvest stands of 16,000 - 18,000 plants per acre. Stands far below this are common at harvest time. Maximum efficiency of the fertility and other management efforts cannot be obtained with low plant populations. Careful selection of the seed corn plates and a planting speed which will insure accuracy of seed drop will increase corn profits.

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III. Principles of Corn Planter Operation:

A. Causes of inaccuracy of seed drop.

1. Selection of seed plate with improper cell size.

2. High r. p. m. of seed plate caused by:

a. Setting planter to plant more kernels per acre and / or
b. Increasing the speed of travel over the fields. (Seed plate r. p. m. is magnified when both speed of travel and rate of planting is increased.)

B. Speed of planting.

1. As the ground speed increases the number of kernels dropped decreases. Chart 8 - "Corn planting speed and its effect on seed drop," High Speed Planting Cuts Corn Yields, Gordon Ryder.

2. Greater accuracy of seed drop occurs at higher speeds when larger cell seed plates are used. Chart 9 - "Corn planting speed and its effect on seed drop," High Speed Planting Cuts Corn Yields, Gordon Ryder.

3. The proper size seed plat should be selected for a given ground speed. Table 11 - "Kernels Dropped at Three Speeds Using Three Different Seed Plates," Agronomic Tips C - 3, Gordon Ryder.

a. As speed increases the size of the seed plate cell must also increase to maintain accuracy of drop. The larger cells allow more time for the kernels to fit into the cells.

b. As both speed of seed plate travel (r. p. m.) and size of seed plate cells increased the amount of craked corn increased.

c. For a given rate of forward travel and planting rate the seed plate r. p. m. can be reduced about 33 per cent by changing from a 16 cell plate to a 24 cell plate.

Table I "Planter Plate Speed," Agronomic Tips C - 3, Gordon Ryder.

As the rate of planting and forward travel are increased from lowest setting to the highest setting the r. p. m. of the seed plate is increased about 4 times.

16 cell plate - 3 mph @ 12,000 kernels per A = 15.3 rpm.
7 mph @ 20,000 kernels per A = 59.2 rpm.

24 cell plate - 23 mph @ 12,000 kernels per A = 10.2 rpm.
7 mph @ 20,000 kernels per A = 39.5 rpm.

4. Selecting seed plates for proper cell size. References: "Planter plate Selection and its Effect on Seed Drop Accuracy," Agronomic Tips C-2, Dept. of Agronomy, O. S. U., Gordon Ryder.

   a. Flat grades of corn are graded in 64ths of an inch for thickness, width, and length with length being the most difficult to grade accurately.

      Round grades usually plant more accurately because there is only one general dimension, that is diameter.

   b. Most seed corn companies give recommended plate numbers for each grade of seed. Their tests are usually made at 3 mph with 10" spacing which does not apply to many farm situations.

   c. Matching kernels to seed plate cell size.

      (1) Too short - kernels wedged in and will not be ejected or will be cracked. Seed box grading will occur. (See Fig. 2.)

      (2) Correct - Cell is 1/16" longer than longest kernel. Kernels have room to drop into cell at high speed.

      (3) Too long - May pick up two kernels standing on end. May be broken or cracked as they pass under knock out housing.

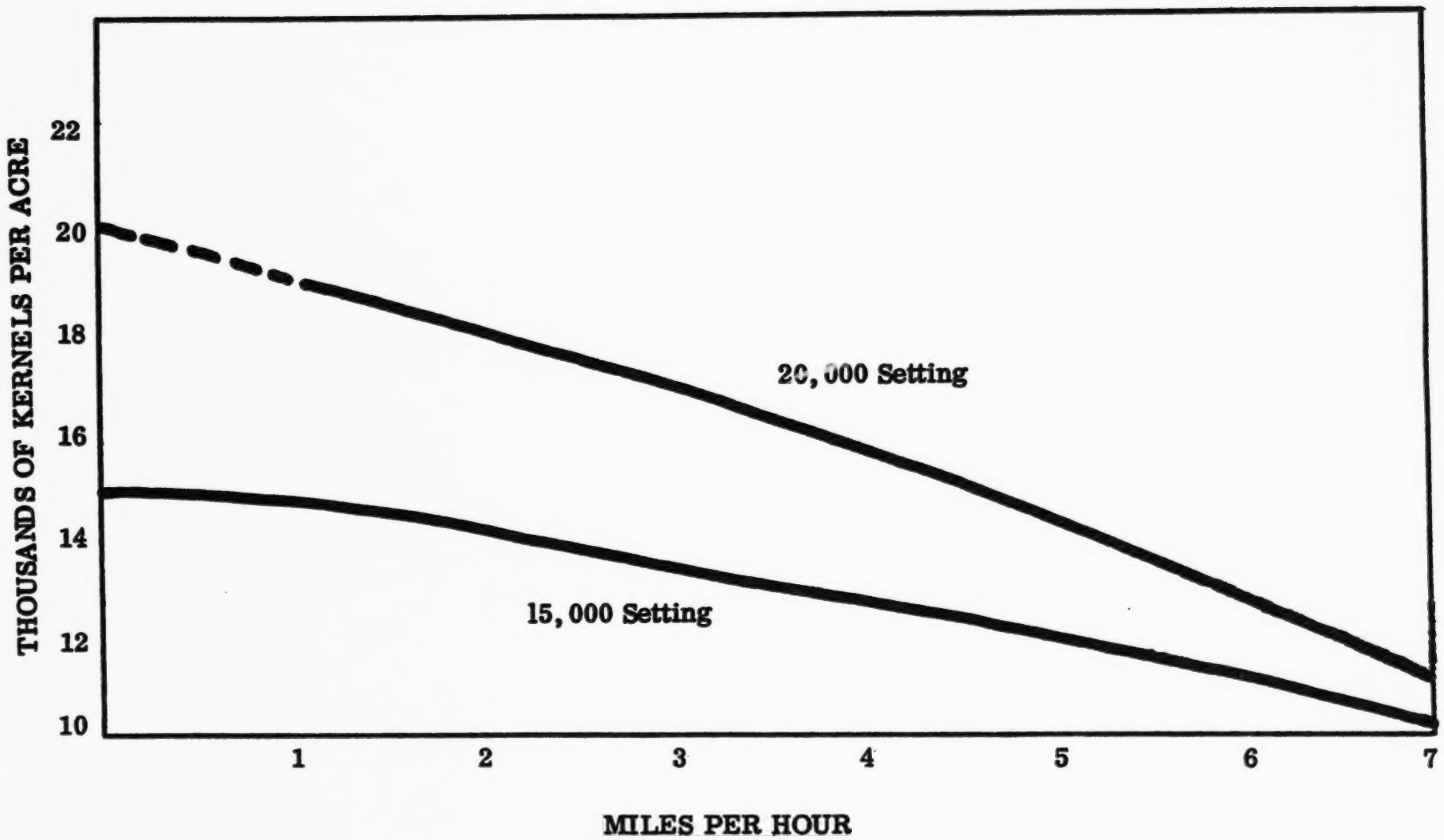
      (4) The plate holder or false plate has a groove 2/64" or 4/64" deep on one side and is flat on the other side.

      If kernels are wide the groove side of the seed plate holder should be up to take care of extra kernel width. Seed box grading will occur if the groove is not turned up.

CORN PLANTING SPEED AND ITS EFFECT ON SEED DROP

Planter setting: 15,000 and 20,000 seed drop

Seed plate: $\frac{36}{64}$" length seed cell



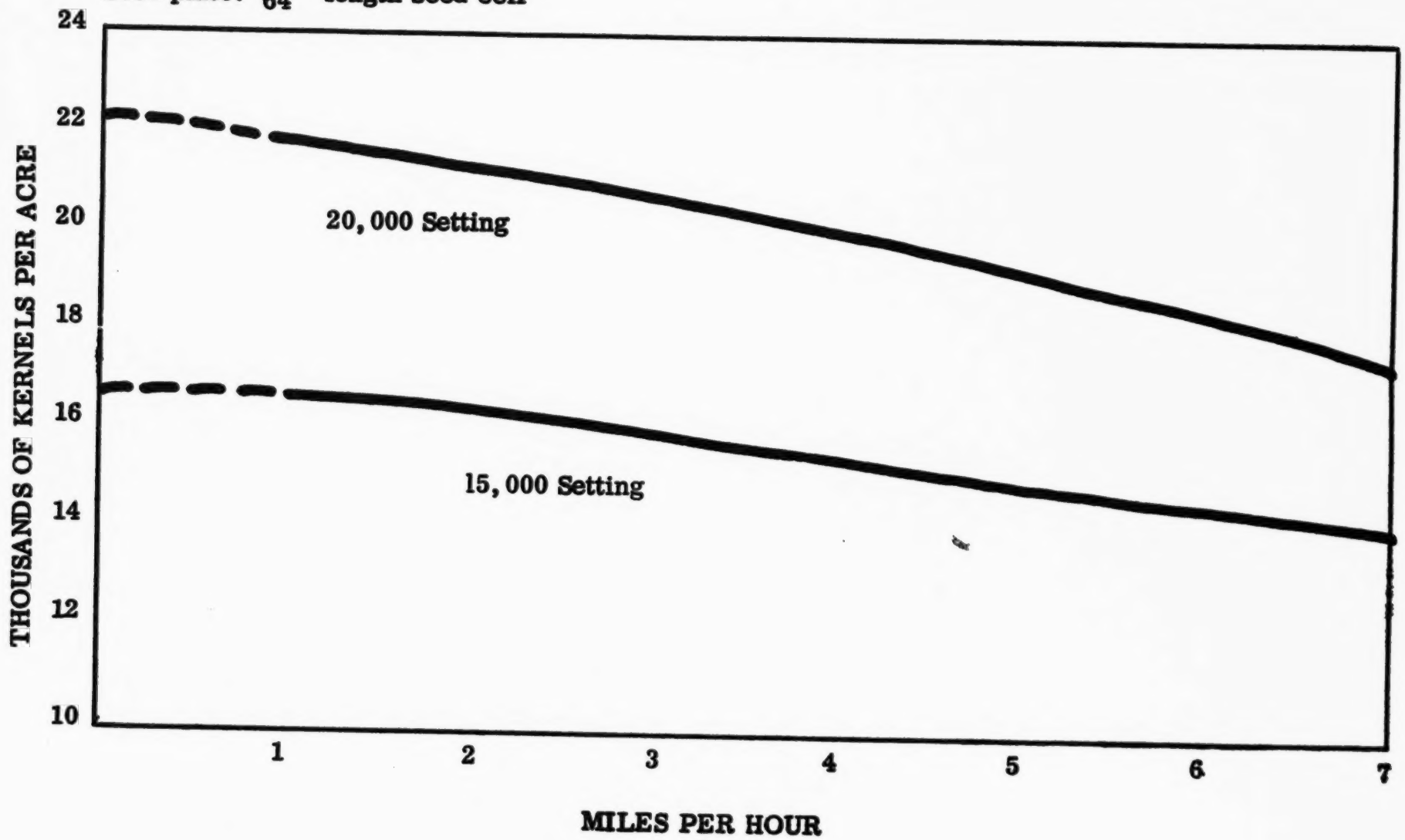
High Speed Planting Cuts Corn Yields, PLANT FOOD REVIEW, by Gordon Ryder

CHART 8

CORN PLANTING SPEED AND ITS EFFECT ON SEED DROP

Planter setting: 15,000 and 20,000 seed drop

Seed plate: $\frac{40}{64}$" length seed cell



High Speed Planting Cuts Corn Yields, PLANT FOOD REVIEW, by Gordon Ryder

CHART 9

Fig. 2 Seed Box Grading

Seed Plate Cell Length	% Drop At Start With Full Box	% Drop After 1/2 Bu. Had Been Planted
32/64"	99	92
36/64"	100	97

"Corn Planter Problems" G. J. Ryder and W. E. Gill, 24th annual Seed Growers School, Ohio Seed Improvement Association.

There may be seed box grading as the smaller kernels are selected and planted while the longer and/or wider kernels are rejected. A good rule is to empty and keep separate the lower 1/4 of the seed in the box after 4 fillings. A new plate selection may be needed to plant this corn.

IV. Corn Planter Calibration

Reference: Corn Planter Calibration for Highest Yields, AGDEX 111/742
Circular 840, University of Illinois, Urbana, price 10¢
Operator's Manual for planter being calibrated.

Steps	Procedure
1. Check planter parts.	Thoroughly inspect, clean and service planter well ahead of planting time. Look at bottom of hopper. Check the hopper ring, cut off pawl, and knock out pawl. Check the power train from ground drive wheels to the seed plate. Loose or worn parts can affect accuracy.
2. Select proper plant population for fertility level.	(See part I, Table 1 this outline)
3. Read the operator's manual carefully.	The owners manual tells how to adjust the planter for proper operation. Do not exceed recommended speed of operation. (See part 1, Table 1 this outline) Check tire pressure if pneumatic tires are used.
4. Match grade of seed to seed plate cell size.	For best results and to avoid damage to seed as it passes through the hopper mechanism the cell fill should be between 100 to 105%. Seed plate r. p. m. will also affect cell size selection. (See part III section B, 4 this outline.)
5. Adjust planter for desired planting rate.	Use the operator's manual and adjust the planter for the planting rate desired. (See part 1, Table 1 this outline.)
6. Calibrate in barn lot or roadway before planting	Calibration should be done at planting speed. Leave planter in raised position and engage the seed plate drive with a wire or string. The following table shows the distances to measure for 1/200 A at different row widths and the number of kernels that should be dropped for the different rates of planting. (No. kernels x 200 = kernels per acre.)

Table 4

Row spacing inches	Distance to Drive feet	Kernels to count for planting rates per A of 12,000	14,000	16,000	18,000	20,000	22,000
36	72	60	70	80	90	100	110
38	69	60	70	80	90	100	110
40	66	60	70	80	90	100	110
42	63	60	70	80	90	100	110

University of Illinois Circular 840

1. Stake out the calibrating distance.
2. Engage seed plate drive.
3. Start in advance of first stake and drive past 2nd stake at planting speed.
4. Collect and count all kernels from each row. Check against the desired rate and make adjustments if needed. (See part III this outline.)

The different planting assemblies on the same planter may not plant at the same rate. This probably can not be corrected.

Allow a few hundred kernels extra when calibrating since field planting rate will be below calibration rate.

7. Make a field check

Dig out several kernels along the row and estimate the average kernel spacing (Part I, Table 1). Make any adjustments necessary.

The practice of placing fertilizer or insecticides in the ground requires that extra pressure be applied to those units. This pressure may raise the drive wheels and cause wheel slippage which will in turn reduce the rate of planting.

8. Count Emerged Plants and Final Harvest Population

These counts will help determine whether the correct plant population for maximum yields is being planted. The following table will serve as an aid in estimating the stand of corn.

Table 5 How to Check Corn Stands Quickly

To estimate thousands of stalks per acre:

1. Measure the length of row equal to 1/1000 acre as shown in table below.
2. Count the number of stalks and multiply by 1000 to determine the estimated stand per acre. Check several sections of row and take the average.

Row Width inches	Length of Row for 1/1000 A. feet and inches
36"	14' - 6"
38"	13' - 9"
40"	13' - 1"
42"	12' - 5"

American Potash Institute, Inc.

Table 6 How to Determine Field Speed

In planting corn it is important to know how fast you are driving, especially if you are applying granular or liquid chemicals at the same time. You can determine your field speed as follows:

1. Carefully mark off a distance of 176 feet in the field.

2. As you plant, check the number of seconds required to drive between the markers with a stop watch or watch with a sweep second hand.

3. Divide the time in seconds into 120 for speed in miles per hour.

Time to drive 176 feet	Speed - Miles per hour
120	1
60	2
40	3
30	4
24	5
20	6
17	7

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AN AID TO THE IDENTIFICATION OF 60 OHIO PLANTS, Agdex 100/40. Revised 1966, 23 pages. A brief description and illustration of the plants included in the Ohio agronomy and horticulture contests. It is written for student use. Price $.50.

SOME COMMON CROP AND WEED PLANTS, Agdex 100/40, 1966. A series of 79 color slides with script to accompany the publication " An aid to the identification of 60 Ohio Plants". The series includes overall views of plants as well as close ups of important details. Price $12.00

FUNDAMENTALS OF PLANT IDENTIFICATION, Student work sheets. Agdex 100/40, 1967, 10 pages. A set of student work sheets designed to familiarize students with the important identifying characteristics of plants. The work sheets should be used with the slide series of the same name and become a part of the student's notebook. Price$.15

FUNDAMENTALS OF PLANT IDENTIFICATION, Agdex 100/40, 1966. A series of 18 color slides and script which illustrate, by means of sketches, the important identifying characteristics of plants. The student work sheets of the same name should be used with the series. Price $3.00.

SOME IDENTIFYING CHARACTERISTICS OF 52 OHIO SEEDS, Agdex 100/40, 1965, 16 pages. A brief description and illustration of the seeds included in the Ohio agronomy contest. The publication is designed for student use. Price $.80.

SOME COMMON CROP AND WEED SEEDS, Agdex 100/40, 1966, A series of 52 color slides and script to accompany the publication, "Some Identifying Characteristics of 52 Ohio Seeds". The series includes close up views of the crop and weed seeds included in the Ohio agronomy contest. Price $8.00.

SEED PRODUCTION OF SOME COMMON FIELD CROPS, Agdex 100/40, 1966, 65 pages. A student study manual which considers the importance of the seed industry, losses from using poor seed, how plants produce seeds, crop varieties, production of certified seed, and seed laws. Price $1.75.

SEED PRODUCTION EXAMINATION, Agdex 100/40, 1966. A suggested examination consisting of 48 objective questions that may be used with the publication "Seed Production of Some Common Field Crops". Price $.10.

RATE OF PLANTING CORN, A Laboratory Exercise, Agdex 111/32, 1963, 31 pages. A laboratory exercise designed to be used with a corn planting unit in the shop to check plate selection and accuracy of drop at different speeds of operation. Information concerning the most effective rate to plant corn is included. Nine full page charts that may be made into transparencies are included. Price $.50.

CORN ROOT DEVELOPMENT, Agdex 111/20, 1964, a series of 21 color slides with script, developed by Dr. Henry D. Foth, Department of Soil and Dr. Raymond Clark, Department of Agricultural Education, Michigan State University. The slides show the extent of corn root development at different stages of plant growth from the seedling stage to maturity. The soil has been carefully pulled away from the roots and the root pattern photographed. The corn was grown on medium textured soil and yielded well over 100 bushels per acre. Price $5.50.

MAIZE DWARF MOSAIC, Agdex 111/630, 1965. A series of 24 color slides and script. The slides and script were prepared by Dr. Lansing Williams of the Ohio Agricultural Research and Development Center. The series shows how to identify the disease, how it spreads and the available control measures. A copy of the Ohio Bulletin 460 "Maize Dwarf Mosaic" should be used as an additional reference source by the teacher. Price $4.80.

HORTICULTURE Agdex 200

LANDSCAPING YOUR HOME - A Teachers' Guide, Agdex 271, 1964, 72 pages. This is a guide to teachers who are starting to teach in a relatively unfamiliar field. The unit includes suggestions to teachers as to methods as well as to the major technical areas to be included. A number of suggested tests and student exercises are incorporated. Price $1.00.

ESTABLISHMENT AND MAINTENANCE OF LAWNS-A Teachers Guide, Agdex 273, 1965, 59 pages. This unit has been prepared as a guide to teachers. Technical information has been divided into logical areas for teaching. The establishment of new lawns and the maintenance of established lawns is included. Price $1.00.

CARE AND MANAGEMENT OF LAWNS, Agdex 273, 1965. A series of 41 color slides with script. May be used with the teachers guide "Establishment and Maintenance of Lawns". The series was developed by Dr. Robert W. Miller, Assistant Professor of Agronomy, The Ohio State University. It deals with the following areas of lawn management: Seed selection,seeding, fertilizing, mowing, weed control, disease control, watering, and thatch control. Price $6.00.

WHAT IS HORTICULTURE? Agdex 200, 1966. A series of 40 color slides and script. The major subject matter offerings in horticulture are described. Student school activities and job opportunities are considered. May be used with groups considering offering horticulture in their school or with beginning students. Price $6.00.

PRUNING FOR GARDEN BEAUTY, Agdex 275/24, 1966. A series of 21 color slides and script. Prepared by D.B. Lacey, Rutgers. Provides hints for pruning evergreens, flowering shrubs, roses, and trees. Price $3.25.

FLORICULTURAL CROPS, Agdex 280, 1966. A series of 60 color slides and script. The objective of this slide series is to introduce vocational horticulture students to the major floriculture crops produced in the United States today. Individual crops are discussed briefly as to types and varieties available, some of the specific cultural requirements, and the uses of the plants by the ultimate consumer. Price $9.50.

FLOWERS FOR GARDEN COLOR, Agdex 280, 1966. A series of 29 color slides and script. Prepared by D.B. Lacey and M.R. Harrison, Rutgers University. Describes how many common flowers may be used to their best advantage in landscape planning. Price $4.25.

ANIMAL SCIENCE Agdex 400

LIVESTOCK MARKETING, Agdex 400/840, 1966. A packet containing a 128 page manual and about 25 pamphlets and materials order forms. The manual presents a thirty point lesson outline and supplemental references. The pamphlets in the packet provide additional reference materials. Price $3.65.

DAIRY CATTLE STERILITY, Agdex 410/30, 1965. A series of 45 color slides and script. The slides illustrate both normal and abnormal conditions in the male and female reproductive tracts. The series has been organized into lessons that correspond to the lessons in the Hoard's Dairyman book "Dairy Cattle Sterility". Script prepared by Dr. Harry Barr, Dairy Science, O.S.U. Slides provided by Dr. Barr and Michigan State University Animal Reproduction Laboratory. Price $6.50.

STEER MANAGEMENT, Resource Unit, Agdex 420, 1964, 81 pages. The unit structures the subject matter for teaching, suggests approved practices, and supplies related information. Price $.75.

GESTATION LACTATION PERIOD MANAGEMENT of Sows and Gilts, Agdex 440/10, 1966. A series of 23 color slides and script. The slides and script were made available by Dr. R.F. Wilson, Animal Science, O.S.U. The series considers both feeding and management suggestions. It might be used to introduce the unit. Local or other research information may be added as needed. Both animated drawings and actual pictures are used. Price $3.75.

THE OHIO PORK IMPROVEMENT PROGRAM, Agdex 440/40. Revised 1966. A series of 18 color slides and script. Mr. Wilbur Bruner, Swine Extension Specialist O.S.U. provided the slides and edited the script. The major findings of the Swine Testing Station are presented in the series. Price $3.50.

HOW MUCH FEED IN REQUIRED TO PRODUCE A POUND OF PORK, Agdex 440/53, 1964, 10 pages. Information gathered from Iowa and Illinois research data. These are seven full page charts suitable for use with the overhead or opague projector. Price $.20.

SOILS Agdex 500

CORN FERTILITY PRACTICES IN OHIO (Agronomy Series # 1) Agdex 540, 1962. A series of 49 color slides and script. The slides were provided by the O.S.U. Department of Agronomy Extension Service. The recommended fertility practices for corn are illustrated by the slides. The script provides a brief description of the slides. Price $7.35.

CORN PRODUCTION PRACTICES (Agronomy Series # 2) Agdex 510, 1962. A Series of 17 color slides and script. The slides were provided by the O.S.U. Department of Agronomy Extension Service. The series briefly covers minimum tillage and rate of planting. The script provides an extensive description of each slide. Price $2.55

INTERPRETING SOIL TESTS (Agronomy series # 3) Agdex 530, 1962. A series of 65 color slides and script. The slides were provided by the O.S.U. Department of Agronomy, Extension Service. The series discusses the extent of soil testing, liming, sampling, testing, recommendations, and fertility status. The script is brief as many slides are self explanatory. Price $9.75.

AGRICULTURAL ENGINEERING Agdex 700

CONCRETE MASONRY, Agdex 715, 1962. A series of 55 color slides and script. The series deals with the selection and handling of concrete blocks, preparing mortar, laying blocks, construction practices to insure durable walls, and cement painting. The series was prepared by the Ohio Vo-Ag. Service and the Portland Cement Association. Price $8.25.

MR. QUALITY CONCRETE, Agdex 715, 1965. A series of 40 color slides. The slides are self explanatory thus no script is provided. The slide series is designed to accompany the Portland Cement Association's "Concrete Technology" instructors guide available from the Portland Cement Association, 33 West Grand Avenue, Chicago, Illinois 60610. Copies have been distributed to Ohio teachers. The slide series is only available through the Ohio Vo-Ag. Instructional Materials Service. Price $6.00.

COMBINES AND COMBINING, Agdex 745, 1965, 82 pages. A manual structured for student use. It is extensively illustrated by means of line drawings, charts, graphs, and pictures. The subject matter is divided into the following areas. 1. What is the value of doing a good job of combining? 2. The basic design of the combine; 3. The operation of the combine, and 4. The economics of owning a combine. Price $0.75.

COMBINES AND COMBINING, EXAMINATION, Agdex 745, 1965. A suggested examination consisting of 50 objective questions that may be used with the publication Combines and Combining. Price $0.10.

COMBINES AND COMBINING, Agdex 745, 1965. A series of 30 color slides and script. The slide series is designed to accompany the manual Combines and Combining listed above. The slides have been selected from several hundred provided by the Allis Chalmers, J.I. Case, and International Harvester Companies. The design of the combine and how adjustments are made is illustrated. Price $4.50.

EFFICIENT MACHINE HARVESTING, Agdex 745, 1965. A series of 21 color slides. A series of slides developed by Dr. D.M. Byg, Extension Agricultural Engineer in connection with his corn harvesting loss surveys. The results are shown in graphic form on the slides. The Ohio Extension Service publication MM 268 Machine Losses-Corn should be available for teacher reference. This publication has been distributed to Ohio teachers. Price $3.50.

"MOWERS", Agdex 745, 1966, 58 pages. A student workbook designed to assist students in understanding the principles of cutterbar operation and in applying the knowledge to the operation and repair of the mower. An excellent reference for use with the workbook is "Field Mowers" produced by the American Association for Agricultural Engineering and Vocational Agriculture, Agricultural Engineering Building, Athens, Georgia, 30601. Price $0.75.

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FARMING PROGRAMS Agdex .40

BUDGET FACTS, Agdex .40/22, 1966, 40 pages. The purpose of this publication is to assist students and teachers in developing meaningful budgets for livestock and crop projects. Price $.40.

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VAS

Catalog of TEACHING MATERIALS

Vocational Agriculture Service
434 Mumford Hall
Urbana, Illinois 61801

University of Illinois College of Agriculture

VT021175

Vocational Agriculture Service is a division of the College of Agriculture at the University of Illinois. Its primary function is to produce and distribute subject-matter teaching materials for use in agriculture classes at the secondary and post-secondary level.

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ANIMAL AND DAIRY SCIENCE MATERIALS

SUBJECT-MATTER UNITS

Subject-matter units are prepared for student text and reference material. They are printed, 8½" x 11", illustrated, and punched for standard 3-ring notebook. Each unit carries a VAS number, as 1001. Units that have been revised have a letter following the number, as 1001a. Date of issue or revision is coded in letters on the last page. E-FG, for example, is 5-67 (May 1967).

Unit Number	Title	Price per Copy
1001a	Caring for the Sheep Breeding Flock, 8 pages	$ .10
1002a	Artificial Insemination of Livestock, 8 p.	.10
1003	Selecting and Purchasing Sheep, 8 p.	.10
1004	Diseases of Sheep, 12 p.	.15
1005	Internal Parasites of Sheep, 8 p.	.10
1006	External Parasites of Sheep, 8 p.	.10
1007	Capons and Caponizing, 8p.	.10
1008a	Making the Butterfat Test, 8 p.	.10
1009	Improving Animals Through Breeding, 16 p.	.20
1010	Producing Beef Cattle from a Beef Breeding Herd, 8 p.	.10
1011	The Ewe and Her Lamb, 8 p.	.10
1012	Buying and Feeding Beef Cattle, 12 p.	.15
1013	General Facts on Livestock Feeding, 8 p.	.10
1014	Poultry Lice and Mites, 8 p.	.10
1015	Internal Parasites of Poultry, 8 p.	.10
1016	Baby Chicks, 8 p.	.10
1017	Culling the Laying Flock, 8 p.	.10
1018	Minerals for Livestock, 8 p.	.10
1019	Judging Livestock, 24 p.	.30
1020	Feeding Dairy Cows, 12 p.	.15
1021	Raising Dairy Calves, 8 p.	.10
1022	Raising Dairy Heifers and Bulls, 8 p.	.10
1023	Classes and Grades of Livestock, 12 p.	.15
1024	Beef Cattle Breeds, 12 p.	.15
1025	The Cow's Udder and How it Functions, 12 p.	.15
1026	Digestion in Animals, 8 p.	.10
1027	Feeding Lambs, 8 p.	.10
1028	Managing the Dry Dairy Cow, 4 p.	.05
1029	The Swine Enterprise, 8 p.	.10
1030	Keeping and Usine Swine Records, 8 p.	.10
1031	The Sheep Enterprise, 4 p.	.05
1032	Castrating, Docking, and Dehorning, 8 p.	.10
1033	Selecting and Purchasing Hogs, 8 p.	.10
1034	Caring for the Swine Herd During Breeding and Gestation, 4p.	.05
1035	Cattle Grubs, 4 p.	.05
1036	Feeds and Feeding Swine, 12 p.	.15
1037	Caring for the Sow and Litter at Farrowing Time, 8 p.	.10
1038	Feed Additives, 8 p.	.10
1039	Systems of Swine Breeding, 8 p.	.10
1040	Selecting, Feeding, and Caring for Light Horses, 16 p.	.20
1041	Caring for the Brood Mare and Foal, 8 p.	.10

Use SUBJECT-MATTER UNIT order form

ANIMAL AND DAIRY SCIENCE MATERIALS (continued)

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Slidefilms are 35 mm. single-frame, for use with a standard filmstrip projector. No separate syllabus is required as all of the text is included on the frames. Those that are in color are so marked on the list below. Unmarked slidefilms are in black and white. Slidefilms are available on a sale basis only.

Use SLIDEFILM order form

Film Number	Title	Price Each
100	Selecting Beef Breeding Animals	$1.70
164-61	Breeds of Swine	1.50
166-64	Selecting Breeding Hogs	1.50
181-65	Identification of Kinds of Meat (color)	2.30
182-65	Identification of Pork Cuts (color)	3.00
*182-65	(Supp.) Practice Set for Identification of Pork Cuts (color)	2.70
183-65	Identification of Beef Cuts (color)	3.15
*183-65	(Supp.) Practice Set for Identification of Beef Cuts (color)	2.85
185-65	Identification of Lamb Cuts (color)	2.45
*185-65	(Supp.) Practice Set for Identification of Lamb Cuts and Variety Cuts (color)	2.55
206-65	Testing Milk for Butterfat	1.15
208	The Cow's Udder and How it Functions	1.15

*Practice sets consist of series of pictures shown in the companion slidefilms for use in practice work in teaching students to identify cuts. They are intended only as supplements to the identification films.

PROGRAMMED INSTRUCTION SERIES

These are sets of multiple-choice questions based, for the most part, on VAS units or other subject-matter materials. They are designed for use with the Rapid Rater (see Miscellaneous Materials), although they may be used by marking in a conventional way. Each set is in a package of 20 identical copies, all on the same subject.

Use PROGRAMMED INSTRUCTION MATERIALS order form

Item		Price per Package
101	Selecting and Purchasing Hogs	$ .25
102	Caring for Sheep Breeding Flock	.25
103	Artificial Insemination of Livestock	.25
104	Cattle Grubs	.25
105	Feeds and Feeding Swine, Part 1	.25
106	Feeds and Feeding Swine, Part 2	.25
107	Making the Butterfat Test	.25
108	Caring for the Sow and Litter at Farrowing Time	.25
109	Feed Additives	.25
110	Systems of Swine Breeding	.25

ANIMAL AND DAIRY SCIENCE MATERIALS (continued)

SCRAMBLED BOOKS

Scrambled books are programmed like a teaching machine. The student reads some information, reacts to a statement, and is directed to a certain page if he considers the statement true or to another page if he thinks the statement false. If his choice is correct, he is directed on; if incorrect, he is sent back. Scrambled books are based on VAS units or other subject-matter materials and are normally used only as supplementary teaching material.

Item	Price Each
101 Digestion in Animals	$ .15
102 Improving Animals Through Breeding	.15
103 General Facts on Livestock Feeding	.20
104 Minerals for Livestock	.20
105 Making the Butterfat Test	.15

Use PROGRAMMED INSTRUCTION MATERIALS order form

OTHER MATERIALS

Approved Practices for Swine. This is a 5-page publication which lists specific practices successful swine producers follow. It may be most useful to students in planning and carrying out their supervised farming programs where swine are involved. Price $.05 per copy.

Meat Judging and Grading. This 32-page, 8½" x 11" publication discusses beef, pork, and lamb judging and carcass grading. It describes the retail cuts listed in the National Contest Rules. The score cards used in the national and state contests are shown in the back. Price $.30 per copy.

Judging Milk, Sediment Discs, and Milker Unit Heads. This 8-page, 8½" x 11" publication discusses quality in milk, the steps in judging it, and how to score sediment discs and milker unit heads. Score cards used in the state and national contests are shown in the back. Price $.15 per copy.

Use MISCELLANEOU MATERIALS order form

Visuals. These are 8½" x 11" instructional illustrations printed on heavy paper. They are for making transparencies for overhead projection, for use with an opaque projector, or for direct viewing. Each set is contained in a manila pocket folder with the title of the series stamped on the flap. Available sets are:

Beef Visuals - (Set of 5) Price $.25
Dairy Visuals - (Set of 5) Price $.25
Meat Visuals - (Set of 19) Price $.60
Sheep Visuals - (Set of 7) Price $.30
Swine Visuals - (Set of 11) Price $.40

AGRICULTURAL ECONOMICS MATERIALS

SUBJECT-MATTER UNITS

Subject-matter units are prepared for student text and reference material. They are printed, 8½" x 11", illustrated, and punched for standard 3-ring notebook. Each unit carries a VAS number, as 2001. Units that have been revised have a letter following the number, as 2001a. Date of issue or revision is coded in letters on the last page. E-FG, for example, is 5-67 (May 1967).

Unit Number	Title	Price per Copy
2001a	Planning the Farm Business for Profit, 4 pages	$ .05
2002a	Inventory Your Resources for Farm Planning, 12 p.	.15
2003a	Planning for Sound Land-Use, 12 p.	.15
2004a	Field Arrangement Principles, 8 p.	.10
2005a	Developing the Land-Use Plan and Field Layout, 8 p.	.10
2006a	Choosing Specific Crops to Grow, 12 p.	.15
2007a	Making Estimates of Crop Production and Its Value, 8 p.	.10
2008a	Record Keeping on the Farm, 8 p.	.10
2010a	The Soil Fertility Program--Economic Considerations, Build-Up and Removal, 16 p.	.20
2011	Choosing a System of Farming, 8 p.	.10
2012a	Fitting Livestock to the Farm, 12 p.	.15
2013	Planning for Adequate Size Business, 8 p.	.10
2014a	Choosing the Livestock System, 8 p.	.10
2015	Completing the Soil Fertility Plans, 8 p.	.10
2016	Marketing Farm Products, 8 p.	.10
2017	Mechanics of Land Transfer, 12 p.	.15
2018	Legal Problems of the Farmer, 20 p.	.25
2019	Getting Started in Farming is Hard, 8 p.	.10
2020	The Rural Community and Its Development, 8 p.	.10
2021	What Factors Affect Prices of Farm Products, 12 p.	.15
2022	Taxation and the Farmer, 12 p.	.15
2023	Marketing Dairy Products, 8 p.	.10
2024	Use of Credit to Increase Farm Earnings, 8 p.	.10
2025	Credit Needs on the Farm, 12 p.	.15
2026	Farmer Jones' Plans for Repayment of Loans, 8 p.	.10
2027	Sources of Farm Credit, 12 p.	.15
2028	Factors Involved in the Borrowing Process, 8 p.	.10
2029	Types of Hog Markets in Illinois, 12 p.	.15
2030	Four Common Ways of Doing Business, 8 p.	.10
2031	Integration in the Livestock Industry, 8 p.	.10
2032	How Prices of Meat Animals Are Established, 12 p.	.15
2033	Using Farm Real Estate Loans, 8 p.	.10
2034	Credit Instruments, 12 p.	.15
2035	Balancing the Labor Supply and the Farm Business, 8 p.	.10
2036	Simplifying Farm Work, 16 p.	.20
2037	Setting Up Farm Records to Provide for Analysis, 8 p.	.10
2038	Capitalism, Socialism and Communism, 12 p.	.15
2039	Fitting Machinery and Equipment to the Farm, 20 p.	.25

Use SUBJECT-MATTER UNIT order form

AGRICULTURAL ECONOMICS MATERIALS (continued)

SLIDEFILMS

Slidefilms are 35 mm. single-frame, for use with a standard filmstrip projector. No separate syllabus is required as all of the text is included on the frames. Those that are in color are so marked on the list below. Unmarked slidefilms are in black and white. Slidefilms are available on a sale basis only.

Use **SLIDEFILM** *order form*

Film Number	Title	Price Each
330-60	Farm Appraisal	$2.15
340-65	The Illinois Crop-Share Cash Farm Lease	1.40
350	Starting to Keep Records (color)	3.25
351	Keeping Records Up-to-Date (color)	3.35
352	Summarizing and Analyzing Records (color)	3.80
353	Increasing Earnings Through Farm Records (color)	3.35
357	What Records Tell About This Farm (color)	3.50
370-65	Inventory Your Resources	1.20
371-65	Plan the Land-Use Program and Estimate Crop Production	1.05
380	Insurance in the Farm Business (color)	3.00†

†This film available to Illinois Vo-Ag Departments at $.25 postpaid.

PROGRAMMED INSTRUCTION SERIES

These are sets of multiple-choice questions based, for the most part, on VAS units or other subject-matter materials. They are designed for use with the Rapid Rater (see Miscellaneous Materials), although they may be used by marking in a conventional way. Each set is in a package of 20 identical copies, all on the same subject.

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	Item	Price per Package
201	Summarizing and Analyzing Records	$.25
202	Starting to Keep Records	.25
203	Increasing Earnings Through Farm Records	.25
204	Keeping Records Up to Date	.25
205	How Prices of Meat Animals are Determined	.20
206	Credit Instruments	.25
207	Using Real Estate Loans	.20
208	Choosing the Specific Crops to Grow, Part 1	.25
209	Choosing the Specific Crops to Grow, Part 2	.25
210	Making Estimates of Crop Production and Its Value	.25
211	Record Keeping on the Farm, Part 1	.25
212	Record Keeping on the Farm, Part 2	.25
213	Balancing the Labor Supply and the Farm Business	.25
214	Simplifying Farm Work	.25
215	Setting Up Farm Records to Provide for Analysis	.25
216	Inventory Your Resources for Farm Planning	.25
217	Planning for Sound Land Use	.25
218	Developing the Land-Use Plan and Field Layout	.25
219	The Soil Fertility Program--Economic Considerations, Buildup and Removal	.25
220	Capitalism, Socialism and Communism	.25
221	Field Arrangement Principles	.25
222	Fitting Livestock to the Farm	.25
223	Fitting Machinery and Equipment to the Farm	.25
224	Federal Income Tax (40 questions)	.50

AGRICULTURAL ECONOMICS MATERIALS (continued)

OTHER MATERIALS

Analysis Charts and Tabulation Sheets. The charts are used for comparing students' productive enterprise results with class averages. The tabulation sheets provide a convenient means for computing these averages. Each package contains analysis charts sufficient for 10 students with crop and 10 with livestock enterprises, 5 sample charts filled in for a swine enterprise, and 5 tabulation sheets each for crops and livestock. Price $.35 per package.

Farm Lease Reports

Livestock-Share Tenant's Farm Report to Landlord. This is a pad of 25 blank forms, in duplicate, that can be submitted monthly or for periods longer than a month. Price $1.25 per pad.

Crop-Share Tenant's Farm Report to Landlord. This is a pad of 15 blank forms, in duplicate, considered to be a three-year supply for a crop-share tenant. Price $1.25 per pad.

Farm Management Manual and Related Materials

Farm Management Manual. This 24-page publication provides budgeting information for use in a short-cut procedure for comparing alternate crop and livestock systems in determining which ones are the most profitable. Price $.30 per copy.

Income Possibilities on Your Farm. This is a form for use by students or adult farmers in comparing alternate crop and livestock systems to determine the best long-time system for a farm. Price $.30 per pack of 10 forms.

The Use of the "Income Possibilities" Form. This is an illustration on how to use the Income Possibilities form. It illustrates how to use it for three different crop and livestock plans for a given farm situation. Price $.60 per pack of 10.

Use FARM MANAGEMENT MATERIALS order form

Farm Record Materials

Illinois Farm Record Book, Parts I and II. This is a two-part record book developed by the department of Agricultural Economics for widespread use by Illinois farmers. Part I contains receipts and expenses, inventories, and farm business analysis information. Part II contains depreciation and net worth forms. Parts I and II are sold together. Price $1.25.

Problem for Use with Illinois Farm Record Book. This is a set of transactions for a farm for student use with the Illinois Farm Record Book. After records have been entered and summarized, students can make an analysis of the farm business. Price $.60 for a pack of 10 problems.

Key for Farm Record Problem. This is essentially a reproduction of parts of the Record Book filled in with information from the problem. It also shows results for the analysis measures provided by the Record Book. The key is normally for teacher use although some use keys in quantities for adult classes. Price $.50 per copy.

AGRICULTURAL ECONOMICS MATERIALS (continued)

OTHER MATERIALS (continued)

Financial Planning Materials

Farm and Family Financial Budget Form. This form is also known as a "cash flow budget." It provides space for anticipated cash income and expenses for each month, both for farm business and family living items. Price $.30 per pack of 10 forms.

Farm and Family Financial Planning Problem. This problem provides information on monthly cash receipts and expenses for a 430-acre farm with steers and hogs as the main livestock enterprises. These figures are used for filling out the financial budget form. Price $.15 for pack of 10.

Your Net Worth Statement. This form provides space for recording net worth information for five years. Price $.30 for pack of 10.

Set of Budget Sheets. This 5-page set of budget sheets provides space for completing an annual operating budget -- crop production and crop costs, crop usage and feed requirements, livestock, and inventory-repair-replacement and improvement. Price $.50 for pack of 10.

Mechanics of Farm Budgeting. This is a 28-page manual that explains and illustrates the use of all of the above forms. It also contains a key for the financial planning problem. Price $.30 per copy.

Machine Costs. This 2-page item helps in determining machine charges in connection with crop enterprises in students' farming programs, or in other problems involving machinery costs. The material is mostly based on detailed cost data from Farm-Bureau Farm-Management farms. Price $.15 for pack of 10.

Use FARM MANAGEMENT MATERIALS order form

Partial Budget Materials

Partial Budgets and Break-Even Problems. This 8-page item provides information and practice problems for preparing four partial budgets for adding livestock or machinery to the farm business. The break-even problems help determine the number of acres at which machine ownership is more economical than hiring custom work. A key is included which shows completed budgets and problem results. Price $.80 for pack of 10 problems and 1 key.

Budget Forms. This 4-page set of 4 blank forms is for use in working the problems. They can also be used with VAS 2036, Simplifying Farm Work, or VAS 2039, Fitting Machinery and Equipment to the Farm. Price $.40 for 40 forms (10 sets of 4 forms each).

Planning Your Farm Business. This 28-page booklet provides a method of working out plans for a farm and making income and cost estimates. It can be used separately or in conjunction with VAS units 2001-2007 and 2010-2015. Space is provided for drawing soil maps and providing related information. The book is suitable for students or adult farmers. Price $.30 per copy.

Standards for Measures of Efficiency. This 6-page item is prepared in December each year, based on results obtained by about 6,500 farmers in the Illinois Farm-Bureau Farm-Management Service. Physical measures from previous years are used and dollar values are assigned according to current prices. Teachers can use these standards for comparing students' results or those of adult farmers enrolled in classes on record keeping. Price $.60 per pack of 10.

AGRICULTURAL MECHANICS MATERIALS

SUBJECT-MATTER UNITS

Subject-matter units are prepared for student text and reference material. They are printed, 8½" x 11", illustrated, and punched for standard 3-ring notebook. Each unit carries a VAS number, as 3001. Units that have been revised have a letter following the number, as 3003a. Date of issue or revision is coded in letters on the last page. E-FG, for example, is 5-67 (May 1967).

Unit Number	Title	Price per Copy
3001	Using the Oxy-Acetylene Flame in Farm Construction and Repair, 24 pages	$ .30
3002	Farm Metal Work, 24 p.	.30
3003a	Electrical Wiring--Fundamentals and Planning, 24 p.	.30
3004	Arc Welding, 40 p.	.50
3005	Sharpening Hand Tools, 16 p.	.20
3006	Selecting Lumber and Other Building Materials, 12 p.	.15
3007	Making and Using Concrete on the Farm, 16 p.	.20
3008	Farm Tractor Tune-Up, 12 p.	.15
3009	Use of the Square in Farm Construction, 20 p.	.25
3010	Farm Surveying, 16 p.	.20
3011	Lightning and Lightning Protection on the Farm, 12 p.	.15
3012	Electrical Hazards on the Farm, 12 p.	.15
3013	Handling and Using Gasoline and LP-Gas Safely, 8 p.	.10
3014	Small Engines--Principles of Operation, Trouble Shooting and Tune-Up, 16 p.	.20
3015	Spray Painting, 28 p.	.35
3016	Electrical Wiring--Procedures and Exercises, 32 p.	.40
3017	Farm Building Appraisal, 24 p.	.30
3018	Air Compressors, 20 p.	.25
3019	Small Engines--Repair and Overhaul, 20 p.	.25
3020	The Two-Cycle Engine, 20 p.	.25
3021	The Planter - Selection, Adjustment, Maintenance, and Use, 40 p.	.50
3022	Safety in the Agricultural Mechanics Shop, 24 p.	.30
3023	Micrometers and Related Measuring Tools, 8 p.	.10

Use SUBJECT-MATTER UNIT order form

SLIDEFILMS

Slidefilms are 35 mm. single-frame, for use with a standard filmstrip projector. No separate syllabus is required as all of the text is included on the frames. Those that are in color are so marked on the list below. Unmarked slidefilms are in black and white. Slidefilms are available on a sale basis only.

Film Number	Title	Price Each
401-65	Diagramming Electrical Wiring Circuits	$1.30
404-64	Unpacking, Checking, and Identifying Electrical Items	1.45
412	Electric Motors Part 1. Magnetism and the DC Motor	.95
413	Electric Motors Part 2. Induction and the AC Motor	.95
414	Electric Motors Part 3. Testing and Identifying Leads; Connecting and Reversing	1.00
415	Electric Motors Part 4. Trouble Shooting	1.35
423	Selection and Application of Galvanized Roofing and Siding	1.25
432	The Use of Welded Wire Fabric on the Farm	1.15

Use SLIDEFILM order form

AGRICULTURAL MECHANICS MATERIALS (continued)

SLIDEFILMS (continued)

Film Number	Title	Price Each
433	Planning and Preparing for Concrete Masonry Construction	$1.35
434	Laying Concrete Masonry Units	1.25
435	Special Concrete Masonry Problems	1.25
436	Using the Steel Tape in Surveying	.90
437	Recording Field Notes in Surveying	.90
438	Using the Level in Farm Surveying	1.25
439	Using the Level to Stake Out a Building Site	.85
441	Care, Operation, and Adjustment of Mowers	1.35
454	Oxyacetylene - Assembling, Testing, Lighting Blowpipe	1.35
455	Oxyacetylene - Cutting, Bronze Welding	1.15
456	Oxyacetylene - Fusion Welding, Hard Surfacing, etc.	1.40
450-64	Arc Welding - Process, Equipment, and Safety (color)	Set of 3 - 5.00
451-64	Arc Welding - Flat Position Welding (color)	
452-64	Arc Welding - Vertical, Horizontal and Overhead Position Welding (color)	
457	Welding Cast Iron with the Arc Welder	1.15
458	Hardsurfacing Farm Equipment with the Arc Welder	1.00
459	Heating, Brazing, Soldering, and Cutting with Arc Welding Equipment	1.05
460	The Jointer--How to Use It Safely (color)	2.65
461	Drill Press--How to Use It Safely (color)	3.05
462	The Circular Saw--How to Use It Safely (color)	3.35
463	The Power Grinder--How to Use It Safely (color)	3.05
464	The Radial Arm Saw--How to Use It Safely (color)	3.45
465	The Portable Electric Saw--How to Use It Safely (color)	3.35
480	Identification of Pipe and Fittings	1.50
495	Part 1. Building a Woven Wire Fence	1.50
496	Part 2. Special Fencing Problems	1.25
497	The Safe Use and Care of Ladders	1.10
498	Using Power Lawn Mowers Safely (color)	4.00

Use SLIDEFILM order form

PROGRAMMED INSTRUCTION SERIES

These are sets of multiple-choice questions based, for the most part, on VAS units or other subject-matter materials. They are designed for use with the Rapid Rater (see Miscellaneous Materials), although they may be used by marking in a conventional way. Each set is in a package of 20 identical copies, all on the same subject.

Item	Price per Package
301 Small Engines, Part 1	$ .25
302 Small Engines, Part 2	.25
303 Farm Surveying, Part 1	.25
304 Farm Surveying, Part 2	.25
305 Electrical Wiring, Part 1	.25
306 Oxyacetylene Welding, Part 1	.25
307 Oxyacetylene Welding, Part 2	.25
308 Farm Building Appraisal	.25
309 Air Compressors, No. 1	.25
310 Air Compressors, No. 2	.25
311 Small Engines - Repair and Overhaul	.25

Use PROGRAMMED INSTRUCTION MATERIALS order form

AGRICULTURAL MECHANICS MATERIALS (continued)

OTHER MATERIALS

Electrical Materials

Applying Electrical Controls in Farm Production. This 10-page publication contains the basic subject-matter material for student use with the electrical controls kit. Principles of various types of manual and automatic control devices are explained and illustrated. Price $.10

Student Exercises. A total of 17 exercises for student use with the electrical controls kit are stapled together. Questions are asked with space provided for answers. Directions and wiring diagrams are given which guide the student in assembling and testing the various exercises. Price $.25.

Electric Motors for Farm Use. This 30-page, 8½" x 11" publication was prepared as a text and laboratory guide to accompany the electric motor kits. Some of the illustrations are in color. It explains the principles of electric motors, their selection, use, maintenance, testing, connecting and reversing. Price $.45.

National Electrical Code, 1965 edition. This 433-page book, published by the National Fire Protection Association, is the standard for safety in electrical wiring. It is a valuable reference for use in teaching the various phases of electricity. Price $1.00.

Field Notes for Surveying. This is a student field book for use in recording student notes in surveying. Price $.15.

Use AGRICULTURAL MECHANICS MATERIALS *order form*

Plans

Plans for bolt rack, tool cabinet, and revolving device. This is a set of 3 drawings on 11" x 17" paper. They are for use in constructing these three items of shop equipment. Price for set of 3 is $.20.

Welding Plans. This is a set of 39 plans, each on 8½" x 11" paper, stapled together, for welding projects. Most are for items of shop equipment and were submitted by teachers as useful projects for students to make. Price $.40.

Safety Materials

Charts on Safety Rules for Power Tools. These are printed in two colors on 8½" x 11" heavy paper, plastic laminated on both sides, and punched for hanging near the power tool to which they apply. Each chart lists 10 important safety rules for students to observe in using the particular tool. Separate charts are available for each of the following: Arc Welder, Band Saw, Drill Press, Grinder, Jointer, Oxyacetylene Welder, Portable Electric Saw, Radial Arm Saw, and Tilting Arbor Saw. Price $.25 each.

Safety Glasses. Two types of shop safety eye-protection devices are available. The spectacle type is of approved safety glass with side shields. The plastic face mask type is of soft, clear plastic with a replaceable lens. Prices: spectacle type, $3.75; plastic face mask type, $1.50; replacement lens for plastic face mask, $.65.

AGRICULTURAL MECHANICS MATERIALS (continued)

OTHER MATERIALS (continued)

Student Tests on Shop Safety. This is a set of 20 student tests of 10 questions each based on VAS 3022, Safety in the Agricultural Mechanics Shop. Each test deals with a specific machine or tool. There is also a sheet of suggestions to the teacher and a page for the student to sign that he has received instruction in shop safety and that he has passed a written test on each machine that he uses. Price per package of 10 sets (for 10 students), $1.25.

Small Engine Tools These are special small engine repair tools that are difficult to obtain. The complete set contains five tools, as follows:

Magnetic key inserter - for use in removing and replacing valve spring pins or other keepers. Price $2.30.

Piston ring compressor - for use in replacing the piston in a small engine. Price $2.25.

Piston ring expander - for use in removing the rings from a piston and in replacing them. Price $3.00.

Hand valve grinder - for use in lapping valves with grinding compound. Price $3.50.

Valve lifter and spring compressor - for use in removing and replacing valves in a small engine. Price $5.45.

Price of the entire set of tools is the sum of the above figures, or $16.50.

Use **AGRICULTURAL MECHANICS MATERIALS** *order form*

Tool Holders. These are gripper type clamps that can be used to hold most small tools in a cabinet or on a tool panel. They are available in two sizes. Prices: small $.07 each; large $.08 each.

Visuals These are $8\frac{1}{2}$" x 11" instructional illustrations printed on heavy paper. They are for making transparencies for overhead projection, for use with an opaque projector, or for direct viewing. Supplementary information for use by the teacher as he projects the drawing are contained on the back of each visual. Each set is contained in a manila pocket folder with the title of the series stamped on the flap. Available sets are:

Small Engine Visuals	- (Set of 98)	Price $2.65
Oxyacetylene Welding Visuals	- (Set of 73)	Price $2.00
Spray Painting Visuals	- (Set of 50)	Price $1.35

CROP AND SOIL SCIENCE MATERIALS

SUBJECT-MATTER UNITS

Subject-matter units are prepared for student text and reference material. They are printed, 8½" x 11", illustrated, and punched for standard 3-ring notebook. Each unit carries a VAS number, as 4001. Units that have been revised have a letter following the number, as 4002a. Date of issue or revision is coded in letters on the last page. E-FG, for example, is 5-67 (May 1967).

Unit Number	Title	Price per Copy
4001	Collecting and Preparing Soil Samples for Testing, 4 pages	$ .05
4002a	pH Test for Soil Acidity, 8 p.	.10
4003a	P_1 and P_2 Soil Tests for Phosphorus, 8 p.	.10
4004a	Testing Soils for Potassium, 12 p.	.15
4005	Nature of Soil Acidity and Major Plant Nutrients, 4 p.	.05
4006a	Soil Liming--A Key to Better Farming, 8 p.	.10
4007	Using Phosphorus Fertilizers, 4 p.	.05
4008a	Recommended Potassium Fertilizers, 8 p.	.10
4009	Using Nitrogen Fertilizers, 8 p.	.10
4010a	Planning a Fertilizer Program, 8 p.	.10
4011	Hunger Signs--A Guide to Soil Improvement, 10 p.	.15
4012	Maintaining Organic Matter in the Soil, 8 p.	.10
4013	Animal Manures on the Farm, 8 p.	.10
4014	Improving Permanent Pastures, 8 p.	.10
4015	Growing Red Clover, 12 p.	.15
4016	Growing Ladino Clover, 8 p.	.10
4017	Growing Sweet Clover, 12 p.	.15
4018	Farmstead Windbreaks, 8 p.	.10
4019	Seed Treatments, 4 p.	.05
4020	Plants Poisonous to Livestock, 16 p.	.20
4021	Grass Waterways, 8 p.	.10
4022	Inoculation of Legumes, 4 p.	.05
4023a	Producing Oats, 12 p.	.15
4024	Planting and Care of Farm Forests, 16 p.	.20
4025	Controlling Diseases of Vegetable Crops, 12 p.	.15
4026	Growing Barley, 8 p.	.10
4027	Growing Winter Wheat, 16 p.	.20
4028	Soil Structure, 8 p.	.10
4029	Soil Color, 8 p.	.10
4030	Soil Texture, 8 p.	.10
4031	Treating Fence Posts, 8 p.	.10
4032a	Producing High Alfalfa Yields, 20 p.	.25
4033	Growing Soybeans, 8 p.	.10
4034	Controlling Pests of Home Fruits, 4 p.	.05
4035	Selecting and Preparing Soybeans for Seeding, 8 p.	.10
4036	Contouring, 8 p.	.10
4037	Controlling Giant Foxtail, 4 p.	.05
4038	Terracing, 16 p.	.20
4039a	Producing High Corn Yields, 12 p.	.15
4040	Corn Insects, 12 p.	.15

Use SUBJECT-MATTER UNIT *order form*

CROP AND SOIL SCIENCE MATERIALS (continued)

SUBJECT-MATTER UNITS (continued)

Use SUBJECT-MATTER UNIT order form

Unit Number	Title	Price per Copy
4041	Minimum Tillage, 8 p.	$ .10
4042	Controlling Weeds, 12 p.	.15
4043	Pruning Fruit Trees, 8 p.	.10
4044	Storing and Drying Corn, 12 p.	.15
4045	Handling and Using Agricultural Chemicals, 12 p.	.15
4046	Growing and Selling Christmas Trees, 12 p.	.15
4047	Controlling Insects of Vegetable Crops, 20 p.	.25
4048	Pruning and Training Bramble Fruits and Highbush Blueberries, 8 p.	.10
4049	Maize Dwarf Mosaic of Corn, 8 p.	.10

SLIDEFILMS

Slidefilms are 35 mm. single-frame, for use with a standard filmstrip projector. No separate syllabus is required as all of the text is included on the frames. Those that are in color are so marked on the list below. Unmarked slidefilms are in black and white. Slidefilms are available on a sale basis only.

Use SLIDEFILM order form

Film Number	Title	Price Each
501	The Farmstead Windbreak	$1.95
504	Identifying Coniferous Trees (color)	3.40
703-64	Collecting and Preparing Soil Samples for Testing	.95
704-63	Using the pH Meter in Testing Soils for Acidity	1.10
708	Soil Color (color)	3.00
**T710	Soil Moisture	.70
712	Soil Structure	1.45
713	Soil Texture	1.70
731	Planting Corn	1.25
732	Corn Diseases in Illinois (color)	3.05
790	Preparing and Using Soil Monoliths	1.40
791	Identification of Weeds, Part I (color)	2.80
792	Identification of Weeds, Part II (color)	2.35
794	Controlling Giant Foxtail (color)	2.70
795	Control of Aquatic Weeds (color)	2.90
796	Seed Quality--A Major Factor in Crop Yields (color)	2.75
797	Using Pre-emergence Herbicides (color)	2.95

**T - For use with tape recording of same title, $3.50.

CROP AND SOIL SCIENCE MATERIALS (continued)

PROGRAMMED INSTRUCTION SERIES

These are sets of multiple-choice questions based, for the most part, on VAS units or other subject-matter materials. They are designed for use with the Rapid Rater (see Miscellaneous Materials), although they may be used by marking in a conventional way. Each set is in a package of 20 identical copies, all on the same subject.

Item	Price per Package
401 Storing and Drying Corn	$ .25
402 Corn Insects	.25
403a Understanding Soils, Part 1	.25
404 Understanding Soils, Part 2	.25
405 Recommended Potassium Fertilizers	.25
406 Handling and Using Agricultural Chemicals	.25
407 Growing and Selling Christmas Trees	.25
408 Producing Oats	.25
409 Controlling Insects of Vegetable Crops	.25
410 Planning a Fertilizer Program	.25
411 Pruning and Training Brambles	.25
412 Maize Dwarf Mosaic of Corn	.25

Use PROGRAMMED INSTRUCTION MATERIALS order form

SCRAMBLED BOOKS

Scrambled books are programmed like a teaching machine. The student reads some information, reacts to a statement, and is directed to a certain page if he considers the statement true or to another page if he thinks the statement false. If his choice is correct, he is directed on; if incorrect, he is sent back. Scrambled books are based on VAS units or other subject-matter materials and are normally used only as supplementary teaching material.

Item	Price Each
401 Corn Production--As a Part of Your Farming Program	$.20
402 Producing Oats	.15

OTHER MATERIALS

Approved Practices These are 4-page publications which list specific practices followed by successful crop producers. They are useful to students in planning and carrying out their supervised farming programs involving crops. They are available for the following crops:

Approved Practices for Alfalfa - Price $.05 per copy
Approved Practices for Corn - Price $.05 per copy
Approved Practices for Oats - Price $.05 per copy
Approved Practices for Soybeans - Price $.05 per copy
Approved Practices for Wheat - Price $.05 per copy

Use CROPS, SO & FERTILIZ MATERIA order for

CROP AND SOIL SCIENCE MATERIALS (continued)

OTHER MATERIALS (continued)

Demonstrations on Weed Control This is a series of demonstrations for student use to show the effect of herbicides on weed control. All except Number 4 contain the essential items needed to set up the demonstration. Each one provides full directions for carrying out the demonstration and observing the results. They are as follows:

1. The Effect of Pre-Emergence Herbicide on Weed Growth - Price $.25 ea.
2. The Effect of Post-Emergence Herbicide on Weed Growth- Price $.25 ea.
3. The Effect of 2-4D on Broad Leaved Plants in Lawns - Price $.25 ea.
4. Checking and Calibrating Farm Sprayers - Price $.05 ea.

Land-Use Selection Cards. These are $5\frac{1}{2}$" x 8" cards, printed on both sides, for use in Land-Use Selection contests. The information on them is based on Ill. Circular 758, "Understanding Soils." Land-use selection cards are available in packages of 25 cards (five boys on a team to judge five holes). Price $.30 per package.

Munsell Color Book. This set of standard color charts in a soft, black loose-leaf binder is used to determine soil colors. It is available in two forms:

Kit Form. This includes the color charts, color chips to be glued on, and the notebook cover. Price $5.25 each.

Assembled Book. This Munsell Color Book is completely assembled, ready to use. Price $6.95 each.

pH Kit. The complete kit includes $\frac{1}{4}$ pound of pH powder, plastic wash bottle, instruction sheet, color chart, 1-gram measuring spoon, 2 vial racks containing 24 vials, and a metal carrying case. It can be used for making indicator pH tests of soils in the laboratory or in the field when soil is not too wet to plow. Price $8.00 each.

Replacement pH Powder. In $\frac{1}{4}$ pound lots, sufficient to make about 100 tests. Price $2.50 per $\frac{1}{4}$ pound.

Soil-Testing Spoons. These are copper spoons, double end, 1 and $2\frac{1}{2}$ grams. Price $.65 each.

Soil-Test Report Forms. This is a set of 6 forms for use in testing soil, recording results, and interpreting soil tests. The set includes one each of the following: Soil Test Form A; Soil Test Form B; D-1 Soil Test Report; D-2 Using the Results of Your Soil Acidity Test for Lime; D-3 Phosphorus--Maps and Interpretations; D-4 Potassium--Maps and Interpretations. Price $.10 per set of 6 forms.

Subject-Matter Packet -- Corn Production. This is a collection of more than 30 publications on Corn Production, assembled in a manila pocket folder. This material may be handed out as it is discussed, and should make an extensive library on corn for a student or adult farmer. A teacher's guide is included with each order. Price $2.50 per packet.

Visuals These are $8\frac{1}{2}$" x 11" instructional illustrations printed on heavy paper. They are for making transparencies for overhead projection, for use with an opaque projector, or for direct viewing. Supplementary information for use by the teacher as he projects the drawing are contained on the back of each visual. Each set is contained in a manila pocket folder with the title of the series stamped on the flap. Available sets are:

Weed Control Visuals - (Set of 36) Price $1.00
Weed Identification Visuals - (Set of 33) Price $.95

Use CROPS, SOILS & FERTILIZER MATERIALS order form

MISCELLANEOUS MATERIALS

Calendar of Events. This is a set of 8½" x 11" monthly calendars, printed on heavy paper, punched for easy hanging. Space is provided at each date for recording events. There is a sheet for each month, September through August. Price $.20 per set.

Careers

Tape Recordings on Careers in Agriculture. These are 1200 ft. tapes for a standard tape recorder. The subjects and other information about each are as follows:

Careers in Agriculture, 25 minutes, 7½ ips.
Choosing a Career in Agronomy, 25 minutes, 7½ ips.
Choosing a Career in Ornamental Horticulture, 25 minutes, 7½ ips.
Junior College Programs in Agriculture in Illinois, 35 minutes, 3 3/4 ips.

The price of each tape is $4.50 on a new tape; or $2.00 if you send in your own tape for dubbing.

Use MISCELLANEOUS MATERIALS order form

Programmed Instruction Series. This is a set of multiple-choice questions on the importance of agriculture and careers in this field. The questions are designed for use with the Rapid Rater (see Miscellaneous Materials), although they may be used by marking in a conventional way.

No. 501 Let's Look at Agriculture - Price $.25 per package of 20 copies.

Use PROGRAMMED INSTRUCTION MATERIALS order form

Cumulative Record Books for Foundation Awards These record books were developed by the Illinois Foundation FFA for members to use in their improvement project programs. Completed books are submitted as official entries in the Foundation Award Fields listed below:

Agricultural Electrification - Price $.12 per copy
Agricultural Mechanics - Price $.12 per copy
Beautification - Price $.12 per copy
Safety - Price $.12 per copy
Soil and Water Management - Price $.12 per copy

Flannel Board Materials

Flocked Paper. This is a high-quality material that can be cut and attached to items you wish to use on a flannel board. It has a pressure-sensitive side for attaching to the display item and a rough texture that clings well to flannel. It is available in lots of two sheets, each 15" x 20". Price $1.70.

Suede Paper. This is an economical material for making flannel board items. One side of the paper is rough and will adhere to the flannel surface. The other side is white and will accept ink, chalk, gummed letters or felt pen. It is available in 27" width and any length desired. Price $.30 per yard.

Use MISCELLANEOUS MATERIALS order form

Judging Materials

Illinois Scoring System Cards. This set of three 7" x 10" cards may be used to score any 4-place judging ring. The bottom card gives scores, divided into columns according to spacing between pairs. The top cards are "window" or "cut-out" cards, divided into columns according to placings, one card by numbers 1-2-3-4, and the other by letters A-B-C-D. To use the system, you match the top card and bottom card together according to correct placing and official spacing between pairs, and read off the scores directly on a basis of 100 points possible. Price $.20 per set.

Use JUDGING CARDS & MATERIALS order form

MISCELLANEOUS MATERIALS (continued)

Use **JUDGING CARDS & MATERIALS** *order form*

Hormel Computing Slide. The 4" x 6" plastic holder and nine inserts may be used for scoring any 4-place judging ring. By selecting the proper insert cards and assembling them correctly, the scores of all possible placings show through. This computing slide differs from most other systems by considering the closeness of the whole ring as well as placing and spacing between pairs. Scores are on a basis of 50 points possible. Price $2.75 ea.

Judging Cards and Supplies. Placing, grading, and identification IBM cards are available for judging contests, classroom or practice work in 7 colors -- salmon, green, yellow, pink, blue, manila, and brown. Registration forms, scoring cards, judges placing cards, summary sheets, are furnished without charge with a judging contest card order. Price of cards is $3.00 per 1,000.

Parliamentary Practice Materials

Use **MISCELLANEOUS MATERIALS** *order form*

Guide to Parliamentary Practices. This is a 58-page, $5\frac{1}{2}$" x $8\frac{1}{2}$" publication which is essentially a condensed version of Robert's Rules of Order. It was prepared to assist FFA officers and as basic text material in preparing parliamentary procedure contest teams. Price $.30 per copy.

Beginning Steps in Parliamentary Procedure. This 13-page multilith is supplementary to "A Guide to Parliamentary Practices." It is essentially an outline of "steps up the ladder" for each main type of parliamentary action, with blanks for students to fill and questions to answer. A key to the correct answers is given on the last page. Price $.10 per copy.

Scrambled Books on Parliamentary Procedure. Scrambled books are programmed like a teaching machine. The student reads some information, reacts to a statement, and is directed to a certain page if he considers the statement true or to another page if he thinks the statement false. If his choice is correct, he is directed on; if incorrect, he is sent back. These scrambled books are based on "A Guide to Parliamentary Practices."

Use **PROGRAMMED INSTRUCTION MATERIALS** *order form*

No. 501	Parliamentary Procedure--Presenting and Voting Motions	- Price $.15 ea.
No. 502	Subsidiary Motions	- Price $.20 ea.
No. 503	Incidental Motions	- Price $.15 ea.
No. 504	Privileged and Unclassified Motions	- Price $.15 ea.

Rapid Rater. This is a punch-board device for use with the Programmed Instruction Series questions or any set of multiple choice questions with not more than 4 choices. The device can be used with up to 80 questions, coded to 8 different orders of correct answers. The student knows when he has answered each question correctly and a paper insert records the number of wrong efforts he makes in arriving at the correct answer.. Price $4.00 each.

Insert sheets for Rapid Rater. These are available in packages of 25, cut to correct size with space to identify student name and subject. Price $.06 per package.

Replacement templates for Rapid Rater. These are not needed until original templates are lost or damaged. Complete set is a pair -- Coded 1-4, and 5-8. Price $.35 each or $.70 per pair.

Use **MISCELLANEOUS MATERIALS** *order form*

Pressboard Covers. These are 9" x $11\frac{1}{2}$" binders for use with $8\frac{1}{2}$" x 11" punched materials. Each binder has a metal fastener and a blank label. Price $.30 each.

Slidefilm Containers. These are the green plastic cans with removable cover in which new slidefilms are delivered. They can be used as replacements or to store 35 mm. negatives, etc. Price $.05 each.

Sets of order forms are available on request from

VOCATIONAL AGRICULTURE SERVICE
434 Mumford Hall
Urbana, Illinois 61801

Instructional Materials
Trade and Industrial Education
Indiana State University
Terre Haute, Indiana

/ Available Instructional Materials. - Tentative Revision 5/2/67

ED013339

Administrative Handbook, Basic Philosophy - Teacher education materials. Excerps from the administrative handbook which apply to vocational education are cited and commented upon.

Practical Nursing Job Analysis - (one sheet) chart form job analysis for practical nursing.

Opportunities in Off-Farm Agricultural Occupations - a brochure designed for counselors, parents, and prospective students in the area.

Electricians Fabrication Process and Technology, Revised - a series of assignment sheets and other instructional materials including some job sheets which deal with general sheet metal practices as applied to chassis construction and sheet metal work in electronics fabrication.

Basic Mathematics for Electronics - this is a course outline which includes both the instructors materials and the student assignment sheets.

Basic Vacuum Tube and Transistor Theory for Electronics - a third level course in a series of electricity electronics courses. It includes an instructional outline and student assignment sheets which structure the course.

Basic Vacuum Tube and Transistor Application for Electronics - this is a companion outline to the theory presentation. The theory is applied by a series of laboratory assignment sheets.

Basic AC-DC for Electronics - this instructors outline and compilation of student assignment sheets outline a basic course in electronics. It preceeds the basic vacuum tube and transistor theory and application courses.

Laboratory Jobs for Electricians - assignment sheets for lab work.

Blueprint Reading for Metal Trades - a series of assignment sheets for related materials in the machine trades.

VT 021176

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Carpentry, Building Trades Area - a rather complete instructional outline incompassing a curriculum guide, instructional sheets and other materials sufficient for day trade classes. The materials can also be used in apprenticeship training programs as related instructional materials.

Drafting Transparencies - a series of transparency masters which are intended to be selected by the instructor and used wherever applicable in a drafting class. There are no assignment sheets and the masters are not structured in any way, suggesting that they are used as supplementary or reference materials.

Check into Distributive Education - a brochure intended to describe the program and attract students. Basically for counselors, parents, supervisors, and other interested persons.

Career in Vocational Practical Nursing for High School Students - a brochure describing the practical nursing program - for use with counselors, parents, and students.

Cooperative Office Education - brochure describing the program. For counselors, students and parents.

Electronics Symbols - this is a series of sheets duplicated for teachers who wish to make schematic diagrams by scissors and paste technique.

Pipefitter Maintenance, Related Instruction for Apprentice - adapted from the University of the State of New York materials. A schedule of apprentice training.

Related Bench and Machine Operations - a series of assignment sheets and questions keyed to several textbooks to be used for machine shop training related instruction.

Metal Trades Technical Math - a rather comprehensive treatment of the related math necessary for machine shop training from common fractions through right angle trig.

Arc Welding - assignment sheets covering technical information related to arc welding.

Metallurgy and Heat Treating - a series of individual assignment sheets covering assigned reading and reference materials.

Welding, Blueprint Reading for Welders - a series of assignment sheets concerned with the symbols and typical notations on drawings containing welded assemblies.

Oxy-Acetylene Welding - a series of assignment sheets covering the related technical information for gas welding.

Precision Measurement - a comprehensive instruction manual including technical information, assignment sheets, and exercises for precision measurement. To be used in conjunction with machine shop training programs.

Machine Drafting, Geometric Tolerancing - a series of plates and technical information pertaining to dimensioning and tolerancing in machine drafting.

Power Mechanics in Industrial Arts - a teachers guide outlining the technical content and teaching student activities concerned with this course. Text references, audiovisial materials and other teaching aids are also part of the outline.

Pipefitter Related Instruction - adapted from the University of the State of New York. This is an apprenticeship schedule of related instruction for pipefitters. (5 - year program)

Optical Lens Grinder Apprentice - Related Instruction - materials obtained from the University of the State of New York which outline an apprenticeship schedule for a 4-year training program.

Coordinator's Manual for General Related Study Guides - this is a teachers manual for DCE. They are stocked in quantity as a standard item.

General Related Study Guide, DCE - a student manual for the DCE program. Stocked in quantity.

Indiana Vocational Acts - this is an historic treatment of the vocational acts, their significance with the various amendments. It does not include recent legislation. Primarily for teacher education.

Manpower Development Training Program - Evansville, Indiana - this is a statement of policy position, responsibilities, and so forth having to do with a specific program at Evansville. For Reference Center use only.

Projects Exchange Material - Made especially for day trade vocational machine shop program. A series of projects (prints) for use in machine shop program. A standing committee reviews and revises the material.

Shop Details for Proposed Area Schools, 1964 - this is a compilation of shop layout for area schools as of this date.

1960 Report, Leadership Development Conference
1961 Report, Leadership Development Conference - workshop bulletins designed to accompany a special presentation designed to extend some of the benefits of the national leadership development conference to local personnel. Of reference value only.

Baker Apprentice Related Instruction - A schedule of the related instruction for baker apprentice representing the required 144 hours per year for a 4-year period.

Machine Trades Grinding and Heat Treating - this is a compilation of related technical information. The publication also contains some suggested projects. The prints of data instruction for the manipulative part of the course.

Industrial Technical Mathematics I and II - This is a series of assignment sheets and instructor information for the topic noted.

Organizing and Conducting Programs in Agricultural Sales and Service Occupations - This is directive type publication from the state office personnel indicating the trends and desirable direction of programs in the agricultural field.

Distributive Education, Cooperative Study and On-the-Job Training Program for In-School use Designed to Attract and Prepare Young People for Careers in Merchandising, Marketing, and Management in Distributive Occupations - this is also a directive manual prepared by the state office personnel, distributed to teachers in Indiana as guidelines and direction for establishing programs in distributive education.

Basic Hydraulics - a course outline consisting of 11 sessions. The material is adapted from those produced by Racine Hydraulics and Machinery, Inc., Racing, Wisconsin.

"How It Operates" - a brochure describing DCE

Introduction to Fluid Power - a course outline for an introduction to fluid power with educational materials list. Materials reproduced from the National Fluid Power Association.

Instrument Making - A proposed course of study for a three year program.

Shop Trigonometry - Basic trigonometry course presented by means of students assignment sheets.

Progress Report - DCE in Indiana 1960 - Of historic and reference value only.

Related Technical Information: Turret Lathe
Shaper
Drill Press
Milling Machine
Grinders
Technology

Analyzing the Instructor's Job - Job instruction manual written by Dr. Yoho.

Leather Technology and Shoe Repair - A complete course outline and course materials for the service trade associated with shoe repair.

Film Bibliography for Printing - Note: This has not been brought up to date.

Tape Controlled Machines - Technical information for the Pratt & Whitney Co. Model A, Tape-o-matic Numerically Controlled Drill.

Manpower Projections & Training needs Forcast to 1975 for the Terre Haute Area - An RCU Report.

Business and Office Education - A directive statement from the State Office of Education which outlines business and office education training and designing an intensive lab.

Indiana State Plan for Vocational & Technical Education

Machine Trades Individual Progress Records Analysis Charts

Legislation for Vocational Education - Does not include recent legislation; revision planned.

Electrician's Blueprint Reading and Sketching - Assignment sheets for blueprint reading in electricity.

Basic Electronic Science - A series of lesson outlines for electronics which could be applied to electronics servicing or electronic-technical programs.

Carpenter Apprentice - Related Instruction
Pressman Apprentice - Related Instruction
Painter & Decorator Apprentice - Related Instruction
Electro-Plater Apprentice - Related Instruction
Oil Burner Mechanic Apprentice - Related Instruction
Electrical Lineman Apprentice - Related Instruction

Job Analysis Cards - Trade, Operation, Information, Guidance, Evaluation

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INSTRUCTIONAL MATERIALS FROM MISSOURI
CURRICULUM MATERIALS LABORATORY

Available through
Department of Industrial Education
University of Missouri
Columbia, Missouri
February 1, 1967

SECTION I. INSTRUCTIONAL MATERIALS FOR COOPERATIVE CLASSES

Description: The GENERAL RELATED STUDY GUIDE (student's manual) includes instructional materials common to and essential in the occupational adjustment of all young workers, organized into assignments for individual and group study. It is intended that each student in the class should have a copy of this manual. The COORDINATOR'S MANUAL for the General Related Study Guide includes a list of references needed, suggested extra assignments for advanced students, lists of visual aids for use in teaching the various units, and an objective test, with key, covering each assignment outlined in the student's manual.

Each STUDY GUIDE FOR SPECIFIC OCCUPATIONS (student's manuals) includes an analysis showing what the worker must know and be able to do, and the personality traits essential for success in the occupation, with assignment sheets containing learning activities, references, and objective type questions for individual study. The teacher's keys for these specific occupational materials include answers to questions in the student's manual and page numbers where answers are found in the references assigned. They are intended to enable the coordinator to check accurately and quickly the student's work in the classroom.

Note: Order all materials by full title shown (Specify if key is desired) SEE HOW TO ORDER--LAST PAGE

	Title	Publication Date	Price of Student's Manual*	Price of Teacher's Key*
1.	GENERAL RELATED STUDY GUIDE	Aug. 60	$1.50	--
2.	GENERAL RELATED STUDY GUIDE--COORDINATOR'S MANUAL	Aug. 60	--	$1.50
	Study Guides for Specific Occupations:			
3.	Auto Body Repair	Mar. 65	1.50	.50
**4.	Auto Mechanics Individual Study	July 66	1.50	.50
5.	Cabinetmaking	Jan. 65	1.50	.50
6.	Carpentry	Sept. 62	1.75	.50
7.	Chef	Jan. 64	1.50	.50
8.	Cleaning and Pressing	Sept. 58	1.50	.50
9.	Dental Assistant	Apr. 61	1.50	.50
10.	Dental Laboratory Technology	Nov. 60	1.50	.50
**11.	Electrical Appliance Servicing Individual Study	Aug. 66	1.50	.50

* Includes regular postage in continental U. S.
** See Section II for Study Guides designed for Group Instruction in Preparatory Classes.

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Title	Publication Date	Price of Student's Manual*	Price of Teacher's Key*
12. Electrical Construction (Interior Wiring)	Jan. 67	$1.50	.50
13. Floristry	Feb. 67	1.50	.50
14. Food Service	Jan. 63	1.50	.50
15. Food Service Supervisor (Institutional)	Aug. 63	1.50	.50
16. Frozen Food Locker Plant Operation	1949	1.25	(key out of print)
17. Furniture Retailing	June 51	(temporarily out of print)	
18. General Mechanics (Small gas engines, lawnmowers, bicycles, keys)	Aug. 63	1.50	.50
19. Grocery Store, Retail	(temporarily out of print)		
20. Hardware Retailing	Oct. 65	1.75	.50
21. Hotel Management	1949	1.25	(key out of print)
22. Jewelry Making and Repair	Dec. 56	1.50	.50
23. Machine Shop	Nov. 62	1.50	.50
24.** Management Individual Study	(Available March 67)		
25. Meat Cutting	Apr. 65	1.50	.50
26. Medical Assistant	July 64	1.50	.50
27. Medical Record Technology	Aug. 64	1.50	.50
28. Merchandising Individual Study	Nov. 65	1.50	.50
29. Nursing Assistant	Jan. 67	1.50	.50
30. Offset Lithography	Apr. 64	1.50	.50
31. Painting and Decorating	May 66	1.50	.50
32. Printing	May 63	1.50	.50
33. Projectionist, Motion Picture	Sept. 60	1.50	.50
34. Radio and TV Servicing	Feb. 67	1.75	.50
35. Salesmanship Individual Study	Feb. 66	1.50	.50
36. Sheet Metal	Jan. 67	1.50	.50
37. Shoe Retailing	1952	1.25	.50
38. Tile Setting	Sept. 57	1.50	.50
39. Upholstery	Oct. 64	1.50	.50
40. Variety Store Merchandising	(temporarily out of print)		

SECTION II. INSTRUCTIONAL MATERIALS FOR PREPARATORY CLASSES (Student Manuals and Instructor's Guides)

Description: The following materials are designed for group instruction in day and evening classes in vocational-technical education. The Student's Manuals are designed to be issued to the individual student as a study guide for technical and related information. The Instructor's Guides are designed with a source of reference for the discussion questions, suggested instructional aids and other helpful instructional devices (some include unit tests).

Where Group Instruction is designated it is intended that such study guides should be used with a large group or class in guiding class

discussion. There is a corresponding study guide in Section I which is correlated with the Group Instruction study guide that may be used for providing an objective type examination covering the identical content of each respective assignment.

Note: Order by full title as shown. (Specify if Instructor's guide is desired)

Title	Publication Date	Price of Student's Manual*	Price of Instructor's Guide*
***41. Auto Mechanics Group Instruction	1966	$1.50	$1.50
42. Building Trades	1963	1.50	.50
***43. Electrical Appliance Servicing Group Instruction	1966	1.50	.50
***44. Management Group Instruction	(Available March 67)		
45. Merchandising Group Instruction	1966	1.50	.50
***46. Salesmanship Group Instruction	1966	1.50	.50

SECTION III. COMPREHENSIVE COURSES OF STUDY
(For Instructors' Use Only)

Description: Unless otherwise stated, the following courses of study are designed as teachers' guides and include a detailed analysis of instructional units texts and references keyed to assignment sheets, suggested evaluation procedures and sample tests, suggested facility, equipment lists, instructional aids and devices, films and supplementary references. These are intended to be used in preparatory and in-service classes in industrial education.

Title	Publication Date	Price
47. Applied Electricity	1964	$2.00
48. Design Drafting (for title III G.B. technical classes)	1966	2.00
49. Electronics Technology (for title III G.B. technical classes)	(Available Fall 1967)	
50. Materials Testing (course outline only--for title III G.B.)	1963	(limited copies free)
51. Water and Sewage Treatment	1963	2.00

How to Order:

Orders should be sent to the DEPARTMENT OF INDUSTRIAL EDUCATION, UNIVERSITY OF MISSOURI, COLUMBIA, MISSOURI. Send an official order stating full title (specify if key or Instructor's guide is desired), and the instructional materials will be forwarded. A statement for such material is sent to you at the time the material is shipped, for which prompt remittance is expected. Such remittance should be returned directly to the University Cashier's Office, 123 Jesse Hall, Columbia, Missouri.

*** See Section I for study guides designed for individual instruction or for objective tests corresponding to the "Group Instruction Material."

AGRICULTURAL

• EDUCATION •

VOCATIONAL AGRICULTURE SERVICES

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(18)

Agricultural Education
Teaching Materials Center
College Station, Texas

ORDER BLANK

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Courses of Study For Cooperative Training:	Price Each	Number	Total Price
Greenhouse Worker	4.50		
Nursery Worker	4.50		
Garden Center Employee	4.50		
Assistant Groundskeeper	3.50		
Parks and Landscape Employee	3.50		
Feed Sales and Serviceman	2.50		
Fertilizer Sales and Serviceman	2.50		
Agricultural Machinery Mechanics Helper, Partsman, and Service Supervisor - Units 910-I-XIII	4.00		
Agricultural Machinery Repairman, Set-Up & Delivery Man, Partsman, and Service Supervisor - Units 910-XIV-XX	4.00		
Veterinary Assistant	4.50		
Sets of 2 X 2 Slides			
Judging Steers (with script)(25 slides)	6.25		
Lamb Grading (30 slides)	7.50		
Judging Swine (with script)(61 slides)	15.25		
Carcasses and Cuts of Meat (23 slides)	5.75		
Teaching Plans, Guides or References			
Electrical Applications in the Greenhouse	1.00		
Erecting and Managing the Greenhouse	.50		
Teaching Small Gas Engines	.50		
Required References in Stock			
For Veterinary Assistant Occupation:			
Restraint of Animals by Leahy and Barrow	3.75		
		Total	

(Complete Sales Tax Exemption Certificate OR include 2% sales tax)

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Agricultural Education
Teaching Materials Center
College Station, Texas

ORDER BLANK

Please send teaching materials to:

Name _____

School _____

Street _____

City _____ State _____

Send Invoice to:

_____

_____

_____

_____
Signature and title of person placing order.

Sales Tax Exemption Certificate

The undersigned hereby claims an exemption from payment of taxes under Chapter 20, Title 122A, Revised Civil Statutes of Texas, for the purchase of the tangible personal property described below or on attached order or invoice, which is made a part hereof, and will be purchased from the Teaching Materials Center The reason that said purchaser is claiming this exemption is: The purchase is for school use. The purchaser will be liable for payment of the Limited Sales and Use Tax if the purchaser uses the tangible personal property in some other manner or for some other use other than reason listed above, and shall pay the tax based on the description of tangible personal property. Description of tangible personal property to be purchased: Instructional Materials.

Executed this the _____ day of _____ 19 _____

Purchaser: _____

Agency Purchased for: (School) _____

_____

Address: _____

State of New Jersey
Department of Education
Vocational Division

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CURRICULUM MATERIALS

VT 021179

Vocational - Technical
Curriculum Laboratory
Rutgers - The State University
10 Seminary Place
New Brunswick, New Jersey

Curriculum Laboratory
Department of Vocational-Technical Education
Graduate School of Education
Rutgers University
10 Seminary Place
New Brunswick, New Jersey 08903

January, 1967

Academic Studies

Installment Buying (School for the Deaf)	.50
The Dictionary (School for the Deaf)	.50
The Newspaper (School for the Deaf)	.50
Time (School for the Deaf)	.50

Agriculture

Rural Electrification - 1	.50
Rural Electrification - 2	.75
Rural Electrification - 3 & 4	.75
Biology for Agriculture - 1	2.00
Biology for Agriculture - 2	2.00
Program for Vocational Agriculture	.50

Apprentice Training

Major New Jersey Trades - Skill Outlines	2.00
Major New Jersey Trades Related Outlines Vol. 1	1.50
Major New Jersey Trades Related Outlines Vol. 2	1.50
Major New Jersey Trades Related Outlines Vol. 3	1.50
Major New Jersey Trades Related Outlines Vol. 4	1.50
Major New Jersey Trades Related Outlines Vol. 5	1.50

Auto Mechanics and Auto Body Repair

Auto Body Repair - Mathematics 1	1.50
Auto Body Repair - Mathematics 2	1.50
Auto Body Repair - 1 (School for the Deaf)	1.50
Basic Automotive Repair - 1	2.00
Internal Combustion Engine	1.50
Physics & Chemistry for Auto Mechanics	2.00

Baking

Related Science and Trade Information	2.00

Beauty Culture

Beauty Culture - Related Theory	2.00

Business Education

Office Machines (School for the Deaf)	2.00
Data Processing (Course of Study)	1.50

Carpentry and Wood Working

Applied Geometry (Carpentry)	2.00
Carpentry 1 - House Framing	1.50
The Framing Square	1.50

Drafting

Basic Drawing	1.50
Drafting - 1	2.00
Machine Drafting - 1	1.50
Practical Architectural Drawing	1.50

Electricity

Projects in Electricity - 1	2.00
Experiments in Electricity - 2	1.50
D.C. Principles and Projects - 3	1.50
Alternating Current Projects - 4	2.00
Basic Electricity - Theory and Practice	2.00
Direct Current Generators, Motors & Controllers	2.00
Physics for Electrical Construction & Maintenance	2.00

Electronics

Electronics - Laboratory Experiments - 1	1.50

English

Vocational English I (Boys) - Globe Book Co.	
Vocational English II(Boys) - Globe Book Co.	
Better Communications	1.50
English Refresher Course	1.50

Foods

Commercial Foods - Mathematics 1	1.50
Food Science	2.00
Cooks - A Suggested Guide for a Training Course	1.00

Glassblowing

Scientific Glassblowing - 1	1.50

General - Vocational

Applied Chemistry	1.25
Algebra - 1 Fundamentals	1.00
General Mathematics - 9	2.00
General Mathematics - 10	1.50
Shop Mathematics (General)	1.50
Mathematical Essentials for Business and Industry	2.00
Industrial Trigonometry	1.50

Guidance

Projects for Group Guidance	2.00

Health and Physical Education

Driver Education	1.25
First Aid - School, Shop, & Home	1.25
Health-Personal Hygiene	1.25

Home Economics

Our First Foods Book (For the Deaf)	1.50
Our Second Foods Book (For the Deaf)	2.00
Our Third Foods Book (Meat, Poultry, Fish) (For Deaf)	3.00
FHA Resource Guide	1.50
Homemaking in the Elementary Schools	3.00
Resource Materials for the Playschool	1.00

Industrial Arts

Teaching Guide for Elementary Grades	1.00
Guide for Teaching the Lapidary Arts	1.00
Guide to Teaching Art Metal	1.50
Plastics	1.50
Resource Book on Ceramic Materials	3.00
Silk Screen Process Printing	1.50
Photography	1.50
Welding Projects	2.00

Industrial Chemistry

CHEMICAL & NUCLEAR TECHNOLOGY

Basic Analysis - Area 1 - Visual Communication

Unit 1	- Common Laboratory Items	1.50
Unit 2	- Laboratory Aids	3.00
Unit 3	- Chemical Instruments	3.00
Unit 4	- Nuclear Instruments..Part 1	3.00
	Nuclear Instruments..Part 2	3.00

Basic Analysis - Area 3 - Identity Test

Unit 1	- Preliminary Data	
Unit 2	- Functional Groups	2.00
Unit 3	- Survey of Cation Precipitation Reactions	
Unit 4	- Comparative Identity Systems	2.00

Algebra 1 - Industrial Chemists	.75

Ironwork

Applied Mathematics-Ironworker	2.00

Machine Shop

Strength of Materials - Machinists	2.00
Precision Inspection Manual - 1	2.00
Precision Inspection Manual - 2	2.00
Mathematics 1 - Machine Shop	1.50
Machine Tool Operations - 1	2.00
Machine Tool Operations - 2	2.00
Algebra - Machinists	.75

Masonry

Basic Estimating for Masons	1.75
Blueprint Reading for Masons	1.50
Masonry 1, Related Information-Concrete	2.00
Mathematics 1 - Masons	1.50

Medical Assisting

Medical Terminology for Medical Assistants (Shorthand)	2.00

Metallurgy

Basic Metallurgy	2.00
Basic Metal Science - Shop and Laboratory Projects	2.00
Experiments in Ferrous Metallurgy - American Technical Society	

Needle Trades

Industrial Needle Trades	2.50
Mathematics 1 - Needle Trades	2.00
Pattern Making & Design - 1	2.00
Power Sewing (School for the Deaf)	2.00
Related Art for Dress Design	1.50

Painting and Decorating

Art and Design for Painters - 1	1.50
Art and Design for Painters - 2	1.50
Art and Design for Painters - 3	1.50
Art and Design for Painters - 4	1.50
Related Information for Painters - 1	1.50
Related Information for Painters - 2	1.50

Plumbing

Related Information for Plumbers - 1	Delmar Book Company
Related Information for Plumbers - 2	Delmar Book Company

Practical Nursing

Practical Nursing Procedures	Delmar Book Company
Nutrition & Meal Preparation for P. N.	Delmar Book Company

Printing

Layout and Design for Printers - 1	1.50
English for Printers	1.50
Linecasting Keyboard Operation-1 (School for the Deaf)	1.50
Photo-Offset Printing & Commercial Photography	2.50
Related Information for Printers	1.50

Refrigeration

Refrigeration - 1	2.00

Sheet Metal

Layout-1 for Sheet Metal Mechanics	1.00
Sheet Metal-Precision Layout	1.50

Social Studies

Bergen County-Past, Present, Future	1.25
Civics 9-Part 1 - New Jersey, The State & Its Gov't	1.75
Civics 9-Part 2 - The National Government	1.75
Problems for Americans	1.75
Survey of Economic and Political Development	1.50
The Worker in Modern Society	2.00

Teacher Training

Administration & Supervision of Vocational and Practical Arts Education	2.50

Technical

Air Conditioning & Heating Technology - 2	2.00
Mechanics of Liquids-Part 1	1.50
Mechanics of Liquids-Part 2	1.50
Calculus for Technicians	2.00
Mechanics of Structures-Part 1	1.50
Mechanics of Structures-Part 2	1.50
Mechanics of Structures-Part 3	1.50
Technical Writing	1.50
Electronics Laboratory Manual - Electron Tubes and Basic Curcuits	1.00

Upholstery

Sketching and Design for Upholsterers - 1	2.00
Sketching and Design for Upholsterers - 2	1.50
Sketching and Design for Upholsterers - 3	1.25
Science for Upholsterers	1.75

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PUBLICATIONS PREPARED BY

BUREAU OF INDUSTRIAL EDUCATION

Published by California State Department of Education

PRICES EFFECTIVE SEPTEMBER 1, 1966

Orders for publications should be addressed to:

California State Department of Education
Sacramento, California 95814

Purchase orders without remittance will be accepted only from public agencies. However, in billing for such orders, the California State Department of Education can use only its own invoice forms; it cannot fill out special invoices or voucher forms from the ordering agency. All other orders, including those from student book stores, must be accompanied by remittance. Books cannot be returned for refund or exchange.

The sales tax of 4 percent must be added to the prices quoted here on all orders to California locations, except orders for resale, which should be marked "For Resale" and should show the resale permit number.

The courses of instruction for the various apprenticeable trades are planned so as to require that each apprentice have both a workbook and testbook plus a reasonable number of reference books. Therefore, an equal number of workbooks and testbooks should be ordered at the same time.

Orders for examinations will be accepted only from schools or from authorized agencies, and must be on official purchase order or stationery.

The following publications designed for apprentice training programs are available free of charge to schools using California instructional materials. Requests for these should be addressed to Instructional Materials, State Department of Education, Sacramento, California 95814.

1. Answer sheets for both testbooks and final examinations. These should be requested on official request forms supplied by Instructional Materials or official school stationery. Either should be signed by the school official responsible for the apprentice training program.

2. A publication entitled Introduction to the Teaching of Classes for Apprentices, which explains in detail how the instructional material is to be used.

VT 02180

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APPRENTICE TRAINING*

Course in Auto Mechanics		Price
Part 1 (Rev. 1964)		
Workbook, Testbook	ea.	$2.00
Examination		.25
Part 2 (Rev. 1962)		
Workbook, Testbook	ea.	1.75
Examination		.25
Part 3 (Rev. 1963)		
Workbook, Testbook	ea.	1.75
Examination		.25
Part 4 (Rev. 1965)		
Workbook, Testbook	ea.	2.00
Examination		.25

Course for the Auto Parts Man		
Workbook, Testbook	ea.	2.00
Examination		.25

Course in Automobile-Body Repair		
Workbook, Testbook	ea.	2.25
Examination		.25

Course in Cabinetmaking and Millwork		
Part 1 (1st yr.; Rev. 1962)		
Workbook, Testbook	ea.	2.00
Examination		.25
Part 2 (2nd yr.; Rev. 1964)		
Workbook, Testbook	ea.	2.00
Examination		.25
Part 3		
Workbook, Testbook	ea.	2.00
Examination		.25

Course in Carpentry		
Part 1 (Rev. 1959)		
Workbook, Testbook	ea.	2.00
Examination, Form A or B		.25
Part 2 (Rev. 1961)		
Workbook, Testbook	ea.	2.00
Examination, Form A or B		.25
Part 3 (Rev. 1957)		
Workbook, Testbook	ea.	2.00
Examination, Form A or B		.25
Part 4 (Rev. 1959)		
Workbook, Testbook	ea.	2.00
Examination, Form A Only		.25

Course for Cement Masons		
Workbook, Testbook	ea.	2.25
Examination		.25

Course in Commercial Baking		Price
Workbook, Testbook	ea.	$2.00
Examination		.25

Course in Commercial Cooking		
Workbook, Testbook	ea.	2.00
Examination		.25

Course for Dental Technicians		
Workbook, Testbook	ea.	$2.00
Examination		.25

Course in Drywall Construction		
Part 1 (1965)		
Workbook, Testbook	ea.	2.00
Examination		.25
Part 2 (1964)		
Workbook, Testbook	ea.	2.00
Examination		.25

Course for Electric Lineman		
Workbook, Testbook	ea.	2.00
Examination		.25

Course in Electric Motor Repair		
Parts 1, 2, 3, 4		
Workbook, Testbook (each part)	ea.	1.75
Examination (each part)		.25

Course in Electrical Wiring		
Part 1 (1st yr.; Rev. 1963)		
Workbook, Testbook	ea.	2.00
Examination		.25
Part 2 (2nd yr.; Rev. 1964)		
Workbook, Testbook	ea.	2.00
Examination		.25
Part 3 (3rd yr.; Rev. 1965)		
Workbook, Testbook	ea.	2.00
Examination		.25
Part 4 (4th yr.; Rev. 1965)		
Workbook, Testbook	ea.	2.00
Examination		.25

Course in Floor Covering		
Part 1 (Resilient)		
Workbook, Testbook	ea.	2.25
Examination		.25
Part 2 (Carpet)		
Workbook, Testbook	ea.	2.25
Examination		.25

Course in Furniture Upholstering		
Workbook, Testbook	ea.	2.00
Examination		.25

*All prices subject to change without notice

Course in Glazing (1961)
Workbook, Testbook ..... ea. $2.50
Examination ..... .25

Introduction to Apprenticeship
Workbook, Testbook ..... ea. 2.25
Examination ..... .25

Course in Lathing
Workbook, Testbook ..... ea. 2.25
Examination ..... .25

Course in Machine Shop
Part 1 (Rev. 1964)
Workbook, Testbook ..... ea. 2.00
Examination ..... .25
Part 2 (Rev. 1959)
Workbook, Testbook ..... ea. 2.00
Examination ..... .25
Part 3 (Rev. 1962)
Workbook, Testbook ..... ea. 2.00
Examination ..... .25
Part 4
Workbook, Testbook ..... ea. 1.50
Examination ..... .25

Course in Meatcutting
Part 1 (Rev. 1963)
Workbook, Testbook ..... ea. 2.25
Examination ..... .25
Part 2 (Rev. 1964)
Workbook, Testbook ..... ea. 2.25
Examination ..... .25

Course in Molding and Coremaking
Parts 1, 2, 3
Workbook, Testbook (each part) ea. 2.00
Examination (each part) ..... .25

Course in Operating Engineers
Part 1 (First Course in Apprenticeship)
Workbook 1.50
Testbook ..... .50
Part 2 (First Course in Apprenticeship)
Workbook 1.50
Testbook ..... .50

Course in Operating Engineers
Part 1 (Heavy Duty Equipment)
Workbook 1.50
Testbook ..... .50
Part 2 (Heavy Duty Equipment)
Workbook 1.50
Testbook ..... .50

Course in Operating Engineers — **Price**
Part 2 (Heavy Equipment and Its Uses)
Workbook $1.50
Testbook ..... .50

Course in Operating Engineers
(Special Systems)
Workbook 1.50
Testbook ..... .50

Course for Optical Technicians
Workbook, Testbook ..... ea. 2.00
Examination ..... .25

Course in Painting and Decorating
Part 1 (Rev. 1962)
Workbook, Testbook ..... ea. 1.75
Examination ..... .25
Part 2 (Rev. 1960)
Workbook, Testbook ..... ea. 1.75
Examination ..... .25
Part 3 (Rev. 1961)
Workbook, Testbook ..... ea. 1.75
Examination ..... .25

Course in Plastering
Parts 1, 2
Workbook, Testbook (each part) ea. 2.00
Examination (each part) ..... .25

Course in Plumbing and Pipefitting
(No revision of this course in process)
Part 1
Workbook, Testbook ..... ea. 2.00
Examination ..... .25
Parts 2, 3, 4
Workbook, Testbook (each part) ea. 1.75
Examination (each part) ..... .25
Part 5
Workbook, Testbook ..... ea. 2.00
Examination ..... .25

Course in Radio Services
Parts 1, 2, 3, 4
Workbook, Testbook (each part) ea. 2.00
Examination (each part) ..... .25

Course in Roofing
Part 1 (Rev. 1964)
Workbook 2.00
Testbook 1.00
Examination ..... .25
Part 2
Workbook, Testbook ..... ea. 2.25
Examination ..... .25

Course in Sheet Metal		Price
Part 1 (Rev. 1965)		
Workbook, Testbook	ea.	$2.25
Examination		.25
Part 2 (Rev. 1960)		
Workbook, Testbook	ea.	2.00
Examination		.25
Part 3 (Rev. 1962)		
Workbook, Testbook	ea.	2.00
Examination		.25
Part 4 (Rev. 1964)		
Workbook, Testbook	ea.	2.00
Examination		.25
Course in Surveying		
Part 3		
Workbook, Testbook	ea.	2.00
Examination		.25
Part 4		
Workbook, Testbook	ea.	2.00
Examination		.25
Course in Television Repair and Service		
Workbook, Testbook	ea.	2.25
Examination		.25
Course in Tilesetting (Rev. 1964)		
Workbook, Testbook	ea.	2.50
Examination		.25
Course in Tool and Die Making		
Workbook, Testbook	ea.	2.00
Examination		.25

****

TECHNICAL EDUCATION	Price
A Guide to Technical Illustration, 1963	$1.00
Apprenticeship Handbook for Educators, California State Department of Education, 1964 Edition	$1.00
Technical Education Curriculum Development Series	
Automatic Controls - Number 6	$1.00
Selected Modern Metallurgical Techniques - Number 7	$1.00
Fundamentals of Servomechanism Components - Number 8	$2.00
TEACHER TRAINING	
A Syllabus for Training of Part-time Trade and Technical Teachers, California State Department of Education, Bureau of Industrial Education. Order directly from U.C.L.A. Students Bookstore, 308 Westwood Boulevard, Los Angeles, California 90024	$1.50

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STATE OF TENNESSEE
DEPARTMENT OF EDUCATION
Division of Vocational-Technical Education

List of Instructional Materials

March 1, 1967

Agriculture

003-00001	Farm Motors	$ 1.00
003-00002	Farm Credit in Vocational Agriculture	3.00

Health Occupations

	Hospital Housekeeping Aide	1.50
	Medical Nursing	3.00
	Surgical Nursing	2.00
	Pharmacology	2.50
	Behavior and Working Relations	2.00
	Nutrition and Diet in Disease	3.00
006-00001	Nursing the Aged	2.00
006-00002	Mental Nursing	2.00
006-00003	Body Structure and Function	2.00
006-00004	Unit Tests, Practical Nurse Education	4.00
006-00005	Answer Book, Unit Tests	.25
006-00006	Course Outline, Dental Assistant	2.00
006-00008	Mother and Infant Care	3.00
006-00009	Lesson Plans, Nursing of Children	3.00
006-00010	Course Outline, Operating Room Technician	2.00

Distributive Education

005-00001	Public Speaking for Beginners	.25
005-00002	Course of Study for Marketing I (Punched-unbound)	5.00
005-00003	Course of Study for Marketing II (Punched-unbound)	5.00

VT 02223

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OFFICE OF EDUCATION

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Manpower Development and Training

Guide for Course of Study for:

012-00001	Power Saw Man	1.25
012-00003	Woodworking Machine Operator (Entry)	2.00
012-00004	Millman (Woodworking)	2.00
012-00005	Electronic Mechanic	1.50
012-00006	Welder, Combination	2.00
012-00007	Upholsterer	2.50
012-00008	Machinist II, Machine Shop, Machine Operator	2.00
012-00009	Automobile Mechanic	3.00
012-00012	Handbook for MDT Guidance Personnel	2.50
012-00014	Farmer General	3.00

Trade and Industrial Education

	Teacher's Handbook, Evening School	2.00
	Shop Instructor's Handbook	3.50
	Cooperative Coordinator's Handbook	3.50
	Schedule of Processes and Assignment Sheets for:	
008-00020	Auto Mechanics	2.50
008-00021	Sheet Metal	1.00
008-00024	Nurse Aide	1.50
008-00035	Meatcutting	2.50

Note: Some of the above publications are available in single copies only. For Additional information write:

Vocational Curriculum Laboratory
Box 1114
Murfreesboro, Tennessee 37130

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CURRICULUM MATERIALS LABORATORY
DEPARTMENT OF INDUSTRIAL EDUCATION
MISSISSIPPI STATE UNIVERSITY
Box NU
State College, Mississippi 39762

STUDY GUIDES FOR USE IN PART-TIME COOPERATIVE TRAINING

Answer Keys are not available

Title	Publication Date	Price	Number Ordered
Auto Mechanics	1962	$2.50	_____
Auto Parts Selling	1956	1.00	_____
Basic Retail Selling	1959	1.00	_____
Department Store Selling	1959	1.00	_____
Floristry	1958	1.50	_____
Grocery Store Salesmanship	1956	1.00	_____
Ladies' Apparel Selling	1960	2.50	_____
Machine Tool Operation	1956	2.50	_____
Meat Cutting and Selling	1956	2.25	_____
Men's Apparel Selling	1959	1.50	_____
Merchandising Stockman	1956	1.50	_____
Mortician, The	1956	1.25	_____
Service Station Management	1956	1.50	_____
Typewriter Mechanics	1957	2.00	_____

INSTRUCTOR'S GUIDES FOR VOCATIONAL TRAINING

Title	Publication Date	Price	Number Ordered
Sawmill Trades (Hardwood Inspection, Millwright, Saw Filer, Sawyer, Southern Pine Grading)	1964	$4.00	_____
* Vocational Automotive Mechanics	1966	2.00	_____
* Vocational Industrial Electricity	1966	2.00	_____
* Vocational Machine Shop	1966	2.00	_____
* Vocational Refrigeration and Air Conditioning	1967	2.00	_____
* Vocational Welding (Combination)	1967	2.00	_____

* Preliminary Draft -- has not had industrial evaluation and authentication.

VT002224

BASIC PLANS FOR THE ORGANIZATION AND MANAGEMENT OF INSTRUCTION

Title	Publication Date	Price	Number Ordered
* Vocational Diesel Engine Mechanics	1967	$1.00	_____
* Vocational Metal Trades	1967	1.00	_____
* Vocational Radio & Television	1967	1.00	_____
* Vocational Sheet Metal	1967	1.00	_____
* Vocational Tool and Die	1967	1.00	_____

INSTRUCTOR'S GUIDES FOR TECHNICAL TRAINING

Title	Publication Date	Price	Number Ordered
Drafting & Design Technology	1965	$4.00	_____
Electronics Technology	1964	4.25	_____
Mechanical Technology	1966	4.00	_____

PROFESSIONAL HANDBOOKS & MANUALS

Title	Publication Date	Price	Number Ordered
Community Surveys for Educational Purposes	1953	$1.00	_____
Handbook for Coordinators	1964	4.00	_____
School and Community Relationships	1955	1.25	_____
Suggested Club Projects and Ideas	1964	2.00	_____

* Preliminary Draft -- has not had industrial evaluation and authentication.

NAME _____

SCHOOL _____

ADDRESS _____

(5-67)

ED013339

1967

INSTRUCTIONAL MATERIALS

FOR

TRADE INDUSTRIAL AND TECHNICAL OCCUPATIONS

OHIO TRADE AND INDUSTRIAL EDUCATION SERVICE

VT 003 227

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

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1967

INSTRUCTIONAL MATERIALS

FOR

TRADE INDUSTRIAL AND TECHNICAL OCCUPATIONS

VT 022 427

OHIO TRADE AND INDUSTRIAL EDUCATION SERVICE

Edited and distributed by the
Instructional Materials Laboratory
Trade and Industrial Education
The Ohio State University
College of Education
Columbus, Ohio 43210

THE INSTRUCTIONAL MATERIALS PUBLICATIONS

Contains Descriptions - of instructional materials developed by the Instructional Materials Laboratory, Trade and Industrial Education Service, College of Education, The Ohio State University, Columbus, Ohio.

Type Of Materials - The materials contained in this booklet have been designed to aid both the instructor and learner. They consist mainly of lesson plans or informative materials for the instructor and assignment sheets for the learner. Also included are two complete text books.

Using The Materials - In general, the organization of the class will govern how these materials will be used. In cases where enrollment is enough to warrant individual classes, and group instruction methods can advantageously be used, the Instructor's Manual becomes an indispensable aid. It should, however, be kept in mind that all classes will be made up of persons who possess varied individual differences and it is, therefore, poor teaching to rely entirely upon group instruction methods. For this reason, each member of the class should be supplied with a Learner's Manual so as to assist with individual learning.

When the class is composed of several years or levels of training, the instruction should be taught mainly on an individual basis and the old "country school house" method should be used. For such instruction, the Learner's Manual becomes the important aid. This does not imply that there is no place for using group instruction techniques. On the contrary, the class should be brought together as a group for points of common and general interest. For this purpose, the Instructor's Manual will undoubtedly be found to be of great value.

Order Information

ORDERS SHOULD BE PLACED WITH:

Instructional Materials Laboratory
1885 Neil Avenue
The Ohio State University
Columbus, Ohio -- 43210

Remittance should accompany all individual orders.

CHECKS OR MONEY ORDERS SHOULD BE MADE TO:

THE INSTRUCTIONAL MATERIALS LABORATORY

Shipping directions should be given indicating whether material is to be sent parcel post, express, or freight.

ALL CURRENCY SENT BY MAIL AT SENDER'S RISK

Order forms are included in the last pages of this catalog.

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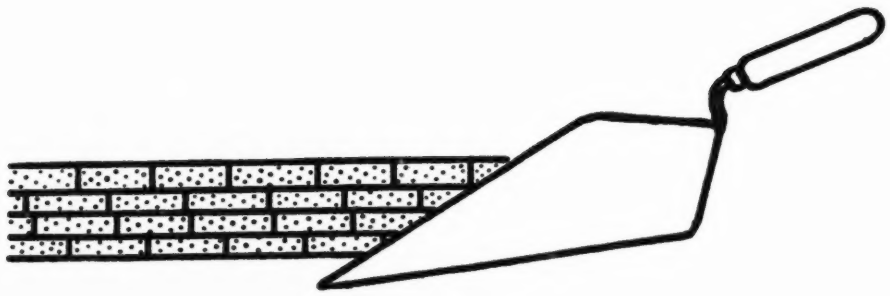
INDUSTRIAL OCCUPATIONS

Bricklaying



BRICKLAYING - Learner's Manual - BRLM-1
(49 individual assignments and reviews,
approximately 1st and 2nd years work)

This manual has been designed to assist the instructor with the teaching of related technical knowledge for the bricklaying trade. It has been especially constructed for related apprenticeship training and includes the first two years of related instruction. It will be of assistance when using group instruction methods, and of even greater value when using individual instruction procedures.

Comprehensive objective reviews or tests are spaced periodically throughout the manual to provide a "check" on individual progress and ability.

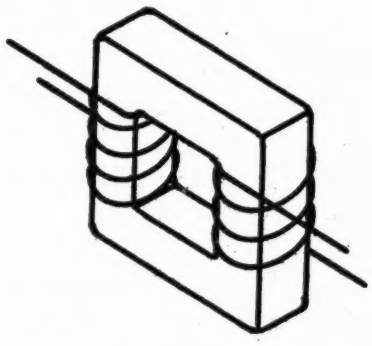
The manual contains such assignments as: Apprenticeship; Safety; The Story of Brick; Fundamentals of Brickwork; Properties of Mortar and Mortar Joints; Layout; Bricklaying Trade Terms; Foundation Walls; Freehand Drawing; Bonding; Tile; Block; Cornices; Cleaning Brickwork; Blueprint Reading; Mathematics; etc.

BRICKLAYING II - Learner's Manual - BRLM-2
(39 individual assignments and reviews,
approximately 3rd and 4th years work)

The Learner's Manual is designed to cover approximately the 3rd and 4th years of apprenticeship instruction. There are numerous reproductions and drawings and photographs intended to help the student.

This manual contains such assignments as: Stonework; Cornices; Efflorescence; Moisture Proof Walls; Steps; Principles of Brick Fireplaces; Chimneys; Spiral Columns; The Ellipse; Glass Block; Masonry; Art in Brickwork; Brick Veneer; Rolok Courses; Arches; Blueprint Reading; Mathematics; etc.

BRICKLAYING - Answers - BRA-1
BRICKLAYING - Answers - BRA-2



Electricity

BASIC ELECTRICITY - Instructor's Manual - ELIM-1
(38 separate related lessons, 12 individual jobs, approximately 60 hour course)

A complete course in the form of lesson plans designed to aid both the related and shop instructor in the presentation of the principles of basic electricity. Each lesson is complete in itself and incorporates the introduction, presentation, application, and follow-up steps of good teaching. Basic experiments for group or individual demonstration are used throughout. This manual is an invaluable aid when teaching in-school, trade extension, or apprenticeship groups. Course covers only the necessary basic principles needed.

BASIC ELECTRICITY - Learner's Workbook - ELLM-1
(38 individual assignment sheets and 12 job sheets)

Individual assignments designed to give the learner a thorough understanding of basic electricity. The material is so organized that it can be used in conjunction with the instructor's manual for group instruction or it can be used by itself for individual instruction. It contains such assignments as: The Complete Circuit; Paths For The Electric Current; Sources of Electrical Energy; Frictional Or Static Electricity; Resistance In Conductors; Ohm's Law; Controlling Current By Resistance; Heating Effect Of Current; Safeguarding The Circuit; The Simple Cell; The Dry Cell; Connecting Cells; Magnets And Magnetic Fields; Electromagnets; etc.

BASIC ELECTRICITY - Experiment Manual - ELEX-1

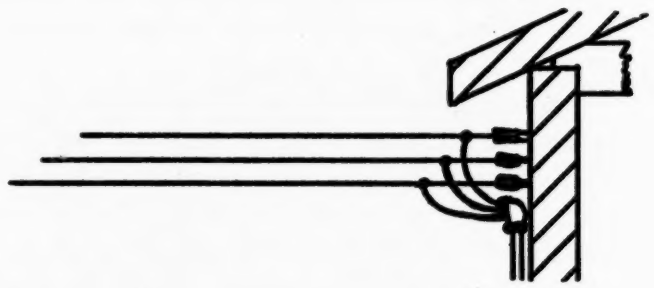
A series of simple but highly important experiments designed to accompany the basic electricity course. These experiments can be utilized to give either individual or group demonstrations. A list of needed equipment, none of which is difficult to obtain, is contained at the start of the manual. Each experiment is correlated with the lesson plans or the learner's manual so as to assure a thorough understanding of the subject.

Electricity
(Continued)

BASIC INSTRUCTIONAL UNITS FOR THE ELECTRICAL TRADE - ETIM-2

This manual contains a suggested course outline for basic electricity and basic electronics. It is designed to aid the instructor in developing a more complete course of study in these areas. In addition to the course outline it contains suggested jobs and problems which should be supplemented by additional and alternate jobs designed to meet local needs.

Residential Wiring



RESIDENTIAL WIRING - Learner's Manual - ELLM-7
(37 individual assignments, including 5 reviews
and a general review)

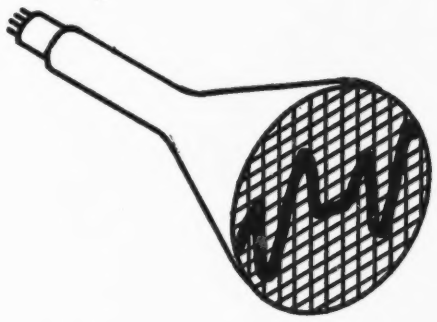
This manual is a part of a series of instructional materials which has been developed in the field of electricity and electronics. The series consists of materials which will aid both the instructor and the learner in the presentation and mastery of related technical information.

The assignments cover the following subjects: Safety; History of Electricity; Apprenticeship Standards and Electrical Standards; Basic Principles and Measurements; Overcurrent Devices; Wiring Branch Circuits and Service Entrances; Adequate Wiring, Lighting, and Motors; Exercises embracing various types of Installations; House Wiring and Farm Wiring. A number of Review Sections are provided at various appropriate points during the course and the last assignment provides a final review.

This book is recommended for related instruction for the training of apprentices as well as for a unit of work for the in-school electrical trade program.

RESIDENTIAL WIRING - Answers - ELA-7

This answer book has been compiled for use with the Residential Wiring Learner's Manual. Answers to all assignment questions are contained in this publication. The assignment sheets in the answer book are numbered to correspond to the assignment sheets in the Learner's Manual.

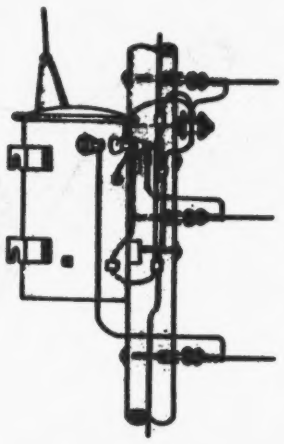


Electronics

ELECTRONICS - Learner's Manual - ELLM-14

A learner's manual for the teaching of basic electronics including assignment and work sheets. It is based on the well-known text Industrial Electricity, by Nadon and Gelmine, published by the D. Van Nostrand Book Company. It is desirable that learners have a knowledge of basic electricity before taking this course. Basic Electricity, Learner's, Instructor's, and Experiment Manuals, Ohio Trade and Industrial Instructional Materials Laboratory, are recommended.

Electric Lineman



ELECTRIC LINEMAN TRAINING

A series of printed, plastic bound manuals developed cooperatively by Ohio Electrification personnel and Rural Electrification Job Training and Safety Instructors throughout the nation. The manuals were edited by a Committee consisting of past presidents of the National Rural Electrification Job Safety and Training Conference.

ELECTRIC LINEMAN TRAINING, SERIES 100 - Learner's Manual - ELTL-8

The Series 100 Manual includes forty-five basic job training procedures and fifty-four assignment sheets. Emphasis is placed on safe working procedures.

ELECTRIC LINEMAN TRAINING, SERIES 200 - Learner's Manual - ELTL-9

The 200 Series Manual includes fifty-five job training procedures and fifty-six assignment sheets. Safety is stressed throughout the manual.

ELECTRIC LINEMAN TRAINING, SERIES 300, Learner's Manual - ELTL-10

The 300 Series Manual includes twenty-one job training procedures and twenty-nine assignment sheets. This manual is designed to cover the more advanced jobs and technology of the line craft.

ELECTRIC LINEMAN TRAINING, SERIES 400 - Learner's Manual - ELTL-11

The 400 Series Manual includes thirty job training procedures and forty-one assignment sheets on line craft skills, essential technical information and safe working practices in order to qualify for a lineman first class and for a foreman to effectively supervise line craft work.

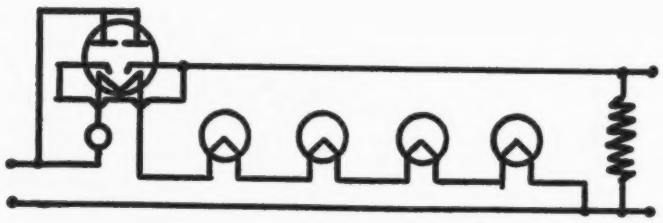
Answer books are made available for each series as they are published.

ELECTRIC LINEMAN TRAINING, SERIES 100 - Answer Book - ELTA-8

ELECTRIC LINEMAN TRAINING, SERIES 200 - Answer Book - ELTA-9

ELECTRIC LINEMAN TRAINING, SERIES 300 - Answer Book - ELTA-10

ELECTRIC LINEMAN TRAINING, SERIES 400 - Answer Book - ELTA-11



UNDERSTANDING RADIO - Instructor's Manual - ELIM-5
(25 units of instruction)

A manual to give the instructor an abbreviated lesson plan when using group instruction methods for the teaching of a course in radio. The lessons are correlated with the assignment sheets found in the Learner's Manual, and a combination of both will greatly aid in the teaching of both shop and related information for the radio trade. The manual includes a list of reference reading for each lesson. A series of "guide posts" for effective presentation calls attention to visual aids and models, and lists the assignment sheets which will aid in the mastery of each lesson. A valuable aid when using the group instruction methods of teaching in-school or trade extension or apprentice groups.

UNDERSTANDING RADIO - Learner's Manual - ELLM-5

This manual consists of 60 individual assignments which make up a beginning course in radio. Each assignment covers a fundamental, easily understandable lesson and is correlated with the Instructor's Manual. The material is excellent for individual as well as group instruction use. It will be found of value when instructing school, trade extension, or apprenticeship groups.

Hydraulics

BASIC HYDRAULICS - Learner's Manual - HYLM-1

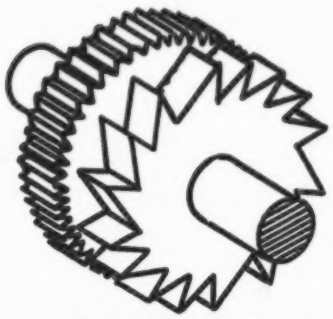
Basic Hydraulics, Learner's Manual, has been developed to meet an expressed need for basic training materials for the training of maintenance personnel and others involved with the use of hydraulics. The need for such a manual was made known by a number of industries through the Statewide Instructional Materials Advisory Committee.

A Statewide Hydraulics Curriculum Committee was organized to study the need further and to plan an approach. As a first step, an outline was developed of the recommended topics to be covered in a basic hydraulics course. All available training materials were then collected and reviewed by the committee in light of the outline. After thorough study of available materials, the committee decided that a course could be organized around the three basic texts listed in the manual.

The manual contains nearly 100 pages and has twenty-five assignments based on available text materials. It also contains hydraulic symbols and a glossary of terms.

BASIC HYDRAULICS - Answer Book - HYLA-1

The Basic Hydraulics Answer Booklet has been fabricated for use with the Basic Hydraulics Learner's Manual. The answers to all assignment questions found in the Learner's Manual are contained in this booklet and assignment sheets are numbered to correspond with those in the Basic Hydraulics Learner's Manual.



Machine Trades

The following machine trades learner's manuals are designed so as to aid either group or individual instruction. They consist of a series of assignment sheets which take the student in easy, progressive steps from the simple to the complex. Each assignment lists several up-to-date texts as reference material, anyone of which will satisfactorily supply the required information for completion of the questions.

These manuals are excellent for in-school related work, apprenticeship and trade extension type training.

MACHINE TRADES I - Learner's Manual - MTLM-1 Revised 1965

This manual covers the following trades: Bench Work; Drilling Machine Work; Engine Lathe Work; Turret Lathe Work; and Power Saw Work.

Numerous reproductions of drawings and photographs are provided to help the student, in the belief that "one picture is worth a thousand words."

A comprehensive objective review, or test, follows each unit to provide a "check" on individual progress and ability.

MACHINE TRADES II - Learner's Manual, Second Edition - MTLM-2
(153 assignments)

This manual is a companion volume to Machine Trades I. The Learner's Manual MTLM-2 contains the following trade areas: Shaper Work; Milling Machine Work; Planer Work; Grinder Work; Metallurgy; Heat Treating; and Gears and Gearing.

MACHINE TRADES - Answer Book - MTA-1
MACHINE TRADES - Answer Book, Second Edition - MTA-2

These answer books have been compiled for use with the Machine Trades I and Machine Trades II Learner's Manuals. Answers to all assignment questions are contained in these publications. The assignment sheets in the answer books are numbered to correspond to the assignment sheets in the Learner's Manuals.

JIGS AND FIXTURES - Learner's Manual - MTLM-3
(29 assignments)

This manual covers elementary design as it applies to the designing of simple jigs and fixtures. Plates are furnished for the learner's drawing of each assigned jig or fixture. This manual is recommended for both group and individual instruction methods.

Machine Trades

(Continued)

BASIC INSTRUCTIONAL UNITS FOR THE MACHINE TRADES - MTIM-4

This course outline has been produced as an instructional aid for adult and in-school instructors to be used in conjunction with MACHINE TRADES I & II, LEARNER'S MANUALS. The manual contains titles of preparatory steps; basic and supplementary operations for manipulative work; titles of assignment sheets for basic and supplementary items of trade technology; and suggested progress chart headings for manipulative work.

MACHINE TRADES JOBS AND JOB SHEETS

The following 100-Series and 200-Series jobs progress from the simple to the complex and cover the complete range of basic operations in the machine trade. The material consists of drawings for the job and job sheets which provide detailed information about the job. The drawings are printed on a vellum type paper so that blue prints can be made for shop use.

This material is an excellent aid for the teacher in the manipulative phase of the vocational machine trade course. Jobs may be purchased individually in the 100-Series and 200-Series or in bound sets.

100- Series - Machine Trades Jobs and Job Sheets.

A bound set of twenty-four Series 100 jobs - MJJS - 100.

These jobs are selected for first year students in the vocational machine trade course. Bound copies are recommended for instructor use only and the drawings should not be removed from the bound copies due to difficulty in replacing them. Order individual copies for student use, or for purposes of reproduction for student use.

MJ-101 Drill Point Gage
MJ-102 Center Gage
MJ-103 Tool Bit Gage
MJ-104 Scriber, Double Pointed
MJ-105 Parallels
MJ-106 Clamp Strap
MJ-107 U-Clamp Strap
* MJ-108 Step Block
MJ-109 Drill Press Vise
● MJ-110 Drill Press Vise, 3"
* MJ-111 V-Block, 4"
MJ-112 C-Clamp
MJ-113 C-Clamp, Heavy Service
● MJ-114 Angle Clamp V-Block
●▶ MJ-115 C-Clamp (Cast iron frame)
MJ-116 Parallel Clamp
MJ-117 Bench Block
MJ-118 Trammel Points
MJ-119 Fly-Cutting Adapter
MJ-120 Standard Lathe Mandrel
●▶ MJ-121 Drill Press Vise, 2"
●▶ MJ-122 Angle Plate, 3 3/8"
●▶ MJ-123 Surface Plate, 3 3/4" x 5 3/4"
●▶ MJ-124 Surface Plate, 8" x 10"

* Job requires round or square casting, but our supplier cannot furnish. These can be secured through your local foundry.

● Information regarding castings for these jobs may be secured by writing the Instructional Materials Laboratory.

▶ Prints are available for these jobs, but job sheets are not included.

200-Series - Machine Trades Jobs and Job Sheets.

A bound set of twenty-six Series 200 jobs - MJJS - 200

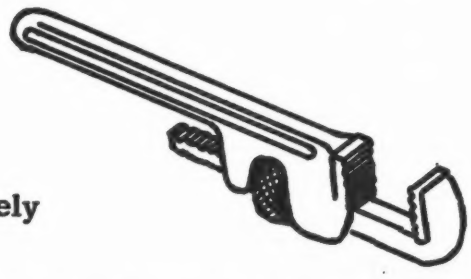
The Series 200 Jobs consist of 26 advanced machine trade jobs suitable for second year students in the vocational machine trade course. Bound copies are recommended for instructor use only and the drawings should not be removed from the bound copies due to difficulty in replacing them. Order individual copies for student use, or for purposes of reproduction for student use.

MJ-201 Boring Bar Holder
MJ-202 T-Tap Wrench
MJ-203 T-Tap Wrench
MJ-204 Tap Wrench
MJ-205 Adjustable Boring Head
MJ-206 Die Stock
MJ-207 Center Drill Chuck
MJ-208 Gear puller
MJ-209 Hand Knurling Tool
MJ-210 Planer Jack
● MJ-211 Machine Screw Jack
●► MJ-212 Grinder, Ball Bearing
● MJ-213 Screw Jack
MJ-214 Screw Jack
● MJ-215 8" Wood Lathe
● MJ-216 Grinding and Polishing Arbor
MJ-217 Milling Machine Jack
● MJ-218 4" Machinist Vise, Round Beam
MJ-219 5" Sine Bar
MJ-220 Live Center, Ball Bearing
● MJ-221 Utility Vise
MJ-222 Surface Gage
MJ-223 Step Block
●► MJ-224 2-1/2" Machine Vise, Round Beam
●► MJ-225 Woodworking Vise, 10"
●► MJ-226 4" Machinist Vise, Square Beam

● Information regarding castings for these jobs may be secured by writing the Instructional Materials Laboratory. These make excellent advance production type jobs.

► Prints are available for these jobs, but job sheets are not included.

Plumbing



PLUMBING I - Learner's Manual - PLLM-1
(59 individual assignments, approximately
1st, 2nd, and 3rd years' work)

The purpose of this manual is to aid the instructor and learner in the teaching of related information for the plumbing trade. It is so designed as to enable instruction to be given on an individual or group basis, depending upon the make-up of the class. There is no instructor;s manual to accompany this material, however, the assignment sheets themselves can be used as the instructor's guide when group instruction methods are used.

The manual contains such assignments as: Laws and Regulations Governing Apprenticeship Training; Trade Safety; Municipal and Private Sewage Disposal; Sewer and Pipe Materials; Joints in Clay and Iron Pipe; House Sewers and Drains; Wiping Joints and Lead Work; Kinds and Uses of Soil and Waste Pipe; Traps Used in Plumbing Systems; Code; Ventilation of Plumbing Systems; Blueprint Reading; Mathematics; etc.

PLUMBING I - Answers - PLA-1

PLUMBING II - Learner's Manual - PLLM-2
(51 individual assignments, approximately
4th and 5th years' work)

A continuation of Part I with the emphasis placed on blueprint reading, shop work, and residential hot water heating.

Contains such assignments as: Taking Off Quantities; Wiping Joints and Lead Work; Sketching; Using Specifications; Practical Problems; Boilers, Steam Radiator and Coils; Vapor Heating; Vacuum Systems; Pumps; Valves; Unit Heaters; Hot Water Heating Systems; Forced Hot Water Systems; Radiant Heating; etc.

TENTATIVE OUTLINE OF A COURSE OF STUDY IN PLUMBING
SHOP PRACTICE - PLCO-1

This course of study was prepared as resource material for instructors of plumbing apprentices in the building trade. It is intended for indentured apprentices engaged in the plumbing trade and working for a recognized plumbing contractor. It cannot be considered as final and complete and is always subject to change.

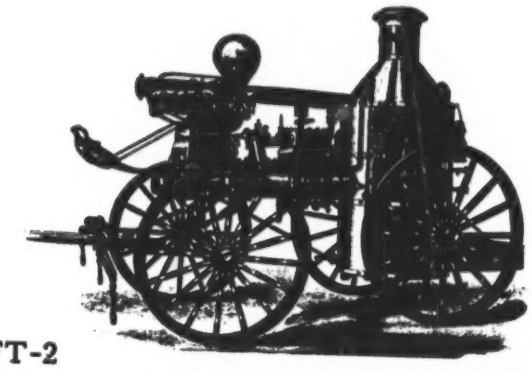
TENTATIVE OUTLINE OF A COURSE OF STUDY IN
PLUMBING TECHNOLOGY - PLCO-2

The specific objectives of this course are as follows: (1) to develop an understanding of the principles related to the operation of pumps, levers, pulleys, machines, forces, etc.; (2) to develop the ability to solve the technical, mathematical, and science problems of the trade; (3) to develop the ability to interpret the plumbing regulations and to apply the provisions of the code in a practical way when put on the job.

SERVICE

OCCUPATIONS

Fire Service Training



FIRE SERVICE TRAINING - Textbook - FT-2

This is a textbook designed to give necessary information for the training of competent volunteer and paid fire fighters. There are over four hundred pages with over 500 illustrations and charts showing and explaining proper fire fighting tactics, procedures and evolutions. This book is designed and used as the text for the statewide thirty-six hour basic and the advanced fire service training course. However, it will be found to be a valuable reference book for anyone who deals with the fighting of fires, and is used by many for self-study and improvement.

The contents of this manual include: Community Fire Defense; Chemistry of Fire; Classification and Use of Fire Extinguishers; Water as Used in Fire Fighting; Fire Hydrants; Standpipe and Hose Systems, Sprinkler Equipment and Automatic Alarms; Fire Pumps; Fire Hose; Tools and Equipment; Rope in the Fire Service; Ladders; Gas Masks; Advance Information, the Alarm; Size-Up; Forcible Entry; Rescue; Exposures and Confinement; Fire Extinguishment; Ventilation; Salvage; Overhaul and Pick-up; Care of Apparatus, Driving Suggestions, the Run; Post-Mortem Conference; Fire Detection and Arson Investigations; Radiation Hazards; Inspections.

FIRE SERVICE TRAINING - Instructor's Manual - Basic Course - FTIM-2

Contains twenty-six detailed teaching guides for the basic course and is keyed to the Fire Service Training textbook. These teaching guides will serve as a plan for the instructor when utilizing the group instruction method. This manual is an indispensable instructional aid to both the experienced and new instructor and is correlated with the above mentioned textbook.

FIRE SERVICE TRAINING - Learner's Workbook - Basic Course - FTLM-2
(26 assignments)

These 26 assignments break the Fire Service Training textbook down into easily understandable lessons. an excellent aid for individual or group study, as well as preparing for promotional exams, for this specialized subject. Each of the assignments may be thought of as a "digestible" part of learning easily comprehended by the average person. Excellent for DEPARTMENT and BRIGADE basic training, class study, of self-study and improvement when used with the above mentioned textbook in the basic training course.

Emergency Victim Care And Rescue Training

EMERGENCY VICTIM CARE AND RESCUE TRAINING - Textbook - EVCR
Revised 1965

A major revision of a previous publication, this text reflects the most recent medical findings about closed heart compression, artificial respiration, maneuvering auto accident victims onto backboards, and other new materials. This edition is over 300 pages with 404 illustrations. Medical aspects were thoroughly reviewed by physicians who are experts in their various specialties. Many emergency rescue procedures have been added, and materials which appeared in the original edition have been amplified.

Chapter titles for the revised manual are as follows: Emergency and Rescue Vehicles; Equipment; Personnel; Operations; Safe Driving Practices; Controlling the Situation; Childbirth; Common Squad Emergencies; The Mentally Disturbed Patient; Resuscitation; Oxygen Therapy; Closed-Chest Heart Compression; Use of Backboards; Rescue Carries and Drags; Aerial Ladder Rescue Procedures; Forcible Entry; Gas Masks; Electrical Emergencies; Cutting Torches; Rope and Rigging; Shoring and Tunneling; Waterfront Operations; Unusual Situations; Records and Reports; Post Mortem Conferences: Legal Aspects.

Custodial Training

CUSTODIAL TRAINING - Learner's Manual - CTLM-1

The Custodial Training Learner's Manual has been designed to give building custodians a better understanding of many of the problems involved in providing adequate building services. It brings together, in an organized program, many ideas, practices, and suggestions which have been used with success in various parts of the country. These have been collected from numerous magazine articles, conference reports, proceedings of professional organizations, professional literature, and from reported experiences of qualified people in this field.

The materials contained in this manual will serve as an up-to-date source of information covering the practices and techniques of building care. The content of this manual is adaptable for the training of custodians in any type of building, whether it be an office, school, industrial establishment, institution, hotel or public building.

This manual contains 165 pages, including a bibliography. The chapter on Work Schedules covers the routine jobs and the frequency each of the 15 major areas should be cleaned. Sample work schedules covering the 15 areas are included. Fifteen blank work schedule handouts are bound into the back of each manual to be used as work sheets by the custodian trainee in planning his own work schedule.

Law Enforcement Officer Training

LAW ENFORCEMENT OFFICER TRAINING, BASIC COURSE - UNIT I,
Learner's Manual - LELM - 1

This manual is designed for use in the Law Enforcement Training Program of the Ohio Trade and Industrial Education Services which is to provide the law enforcement officer with the skills and technical knowledge essential in carrying out his duties. It provides the necessary learner instructional material which will serve as an up-to-date and comprehensive source of information, covering the practices and techniques of the following procedures: Acquiring and Maintaining Uniform; Patrolling On Foot - Daytime - Nighttime; Patrolling In An Automobile - Daytime - Nighttime; Handling Misdemeanors Witnessed By Officer; Handling Misdemeanors Not Witnessed By Officer; Handling Felonies; Handling Traffic Violations; Handling Traffic Accidents; Arresting; and Testifying in Court. The manual contains practices which have proven successful in organized training programs in various sections of the country.

LAW ENFORCEMENT OFFICER TRAINING, BASIC COURSE - UNIT I,
Instructor's Manual - LEIM-1

This instructor's manual contains the teaching guides for each of the training procedures contained in the Learner's Manual, Basic Course - Unit I, and also the training procedures. The teaching guides have been developed to serve as a teaching plan and to provide additional aids and methods for instructing the course. This manual is an indispensable aid to the new instructor and of great help to the experienced instructor in guiding the instruction.

LAW ENFORCEMENT OFFICER TRAINING, BASIC COURSE - UNIT II,
Instructor's Manual - LEIM - II

This manual contains the teaching guides for each of the training procedures contained in the Learner's Manual, Basic Course, Unit II.

LAW ENFORCEMENT OFFICER TRAINING, BASIC COURSE - UNIT II,
Learner's Manual - LELM - II

This manual is designed for advanced training in the areas covered by Basic Course, Unit I.

School Bus Driver Training

SCHOOL BUS DRIVING - Learner's Manual - SBLM-1

This School Bus Driving manual has been designed to give drivers a better understanding of the many responsibilities involved in providing safe and economical pupil transportation services. It brings together, in an organized program, many ideas, practices, and suggestions, which are being used in other parts of the country. Numerous manuals, conference reports, and professional literature, were reviewed for ideas and discussions were held with many experienced people in the field of pupil transportation.

The intent of this manual is to provide the necessary instructional material, which will serve as an up-to-date source of driver information and proper procedures necessary for driving a school bus.

HEALTH

OCCUPATIONS

Health Occupations

NURSING PROCEDURES FOR THE PRACTICAL NURSE - Learner's Manual - NPPN-1

Nursing Procedures For The Practical Nurse is a learner's manual designed to assist in the teaching of those principles of nursing which are normally the responsibility of the practical nurse. It has been developed by a representative committee of coordinators and instructors of practical nurse programs, who are experienced in formulating efficient methods of nursing education

With over 100 illustrations, this 497-page manual contains 81 procedures and 68 assignment sheets. Each assignment sheet serves as a study guide covering the corresponding procedure(s) and the most essential information in the assigned references. The manual is organized to provide effective instruction in the pre-clinical and clincial phases. It will also be very useful for reference and review by the practical nurse after she is employed and for use in refresher courses. An individual progress record sheet provides an aid in keeping an accurate record of each student's assignment sheet progress.

This manual is an invaluable aid and timesaver for the instructor, and will improve the program of instruction in the training of practical nurses.

NURSING PROCEDURES FOR THE PRACTICAL NURSE - Answer Book - NPA-1

NURSING ARTS PRACTICE - NALM-1 (64 topics)

A manual of basic nursing procedures for students in nurse's aide training programs. Each procedure sheet gives: purpose, equipment needed. a step by step breakdown of the procedure, and important points to remember. These procedure sheets have been developed over a period of years by the Cleveland Public Schools Practical Nurse Staff and the Cleveland Hospital Council. Manuals are printed and plastic bound.

HOSPITAL HOUSEKEEPING INSTRUCTOR'S GUIDE - HHIG-1

This is a manual of procedures for developing an organized training program for hospital housekeeping personnel. It is equally adaptable for establishing training programs in housekeeping in any type of institution or organization. It contains 43 job breakdowns relating to housekeeping, sections on setting up an instructional program, general instructions and sample forms and reports to be used in the training program. The guide can be used for individual or group instruction. In addition to training new personnel, this guide will prove valuable in raising the proficiency level of an existing staff of housekeepers

HOSPITAL HOUSEKEEPING TRAINING PACKET - HHTP-2

As an aid for instruction, sample reports and forms in the Hospital Housekeeping Instructor's Guide are available in blank form A packet of these consists of 10 copies each of the Skill Inventory and Classroom Record, and 50 copies of the Individual Employee Record, an adequate supply for a staff of fifty.

RESEARCH AND PROGRAM EVALUATION

FACILITIES AND EQUIPMENT FOR TRADE AND INDUSTRIAL PROGRAMS - 1966 - MIS-19

This manual provides boards of education, school administrators, vocational directors and supervisors of Trade and Industrial Education and others responsible for the initial planning of trade and industrial facilities, with authoritative information as a guide to shop planning. Sound suggestions are offered from the important stage of planning to the physical layout in terms of size, with recommendations concerning height of ceilings, size of entrances, lighting and storage requirements, etc. A suggested equipment list for each area is also included. There are 132 pages of modern guide lines for those school systems planning new or revised facilities.

USING TELEVISION FOR INDUSTRIAL SUPERVISORY DEVELOPMENT - MIS-12

A report on Using Television for Industrial Supervisory Development is a booklet outlining the methods and results of using the television screen as a teaching medium.

Through the combined efforts of the Ohio Trade and Industrial Education Service, the Foremen's Club of Columbus, the Columbus Public Schools, The Ohio State University Television Station WOSU-TV, and a number of individuals who were interested in the total program of producing more competent leadership in industry, an attempt was made several years ago to open new horizons of supervisory development through television.

This brochure serves as a permanent record of the study made at that time and should act as an aid to others who wish to use television as a device to teach.

(Continued)

OHIO CAN MEET THE EDUCATIONAL CHALLENGE OF THE 60'S - RESEARCH BULLETIN #1 - MIS-14

This bulletin is based on a doctoral research study by Carl J. Schaefer, entitled "A Study to Determine a Master Plan for Post Secondary Vocational-Technical Education for the State of Ohio." 1959.

This bulletin summarizes this research which proposes to assure all Ohio residents, rural and urban, the opportunity to prepare themselves for entrance into the state's expanding industrial empire. The main features of this study consist of: (1) the development of a set of criteria to guide in the establishment of post-secondary vocational-technical institutions, (2) the creation of a firm basis for the best possible statewide program of vocational-technical education, and (3) the presentation of a concrete plan including geographic regions, curricula, facilities, financing, and legislation for vocational-technical institutes in the great state of Ohio.

TRADE AND INDUSTRIAL EDUCATION
PROGRAM ANALYSIS QUESTIONNAIRE
MIS-13

This is an analysis questionnaire for analyzing a local trade and industrial education program. It is a series of evaluative questions, the answers to which tend to analyze one phase of the program. Following each evaluative question is a series of checklist questions, the markings of which are intended to provide the factual basis for the choice of an answer to the evaluative question.

LET'S FIND OUT THROUGH A TRADE AND INDUSTRIAL EDUCATION COMMUNITY SURVEY - MIS-3

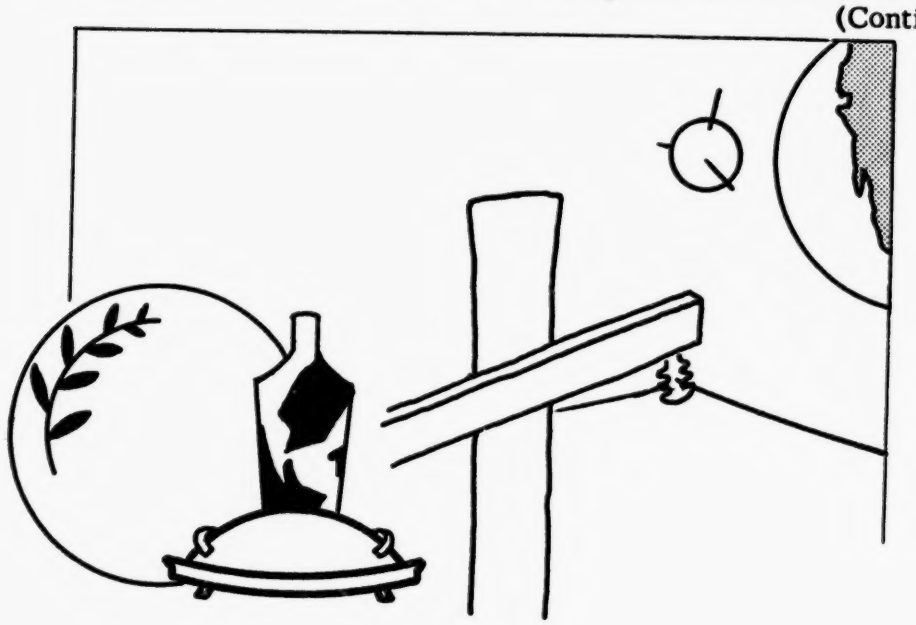
This booklet is an outline of a method of determining, by survey, whether or not a vocational trade and education program should be established in a community.

It was developed as a result of notable increases in requests for trade and industrial programs from smaller and less industrialized communities. As a result, a more efficient community survey procedure had to be found. The procedure which is described in this brochure was developed by members of the state supervisory staff at a two-day conference in Granville, Ohio. Revisions were made in the procedure as surveys were conducted, resulting in this outline in its present form.

PRACTICAL NURSE EDUCATION IN OHIO
RESEARCH BULLETIN #3 - MIS-16

This bulletin is based on a doctoral research study by Gordon G. McMahon, entitled "Comparison of Work Assignments With Training in Ohio Public Schools of Practical Nursing." Western Reserve University, 1963.

The bulletin summarizes a study which was made to determine whether schools are offering training which prepares the graduate to perform the duties assigned in her daily work.



CERAMIC TECHNOLOGY
RESEARCH BULLETIN #2 - MIS-15

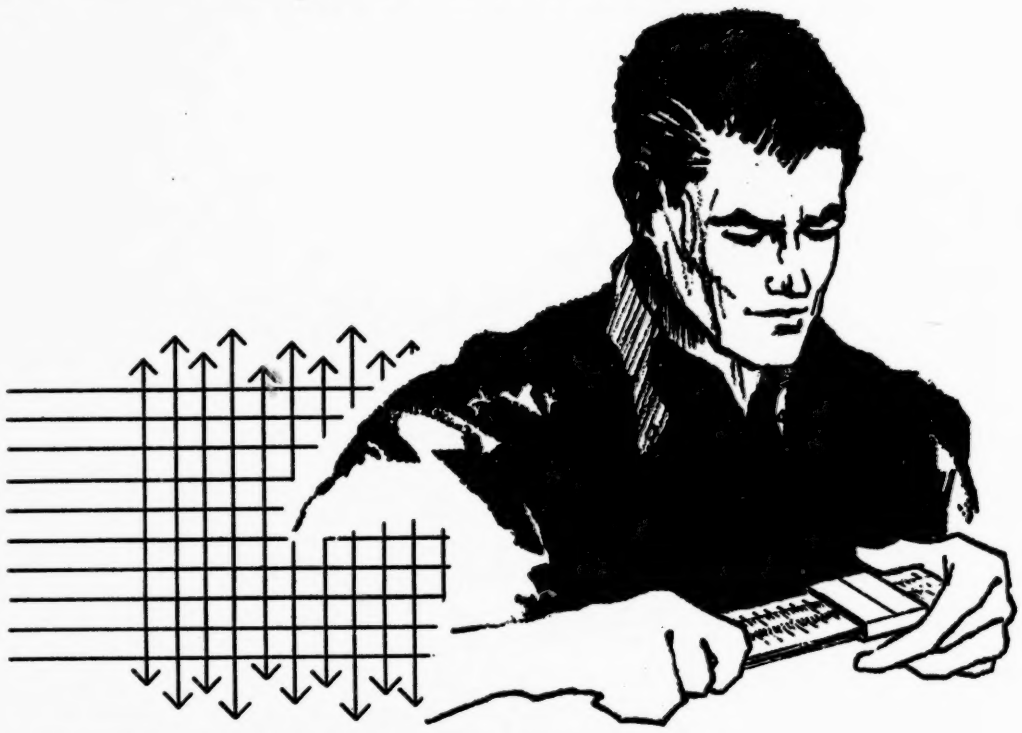
This bulletin is based on a doctoral research study by Robert Charles Fritz, Ohio State University, 1960.

It provides an overview of a comprehensive research study in the field of Ceramic Technology within the United States. The major purpose of the study was to provide a basis for the development of a curriculum in any one of the several industrial areas of instruction. This may be at the secondary Industrial Arts (general education) level or the high school and post high school skilled occupation and technician level of vocational instruction.

The detailed sections on Composition and Preparation of Ceramic Materials, Processing Methods and Testing Procedures will be particularly useful to a teacher in planning for instruction in ceramics.

Personnel of industry who find a need for a detailed analysis of the ceramics field will also find this bulletin useful.

Research and Program Evaluation



FACTORS CONTRIBUTING TO STUDENT ACHIEVEMENT IN TRADE AND INDUSTRIAL EDUCATION - MIS-18

This study was developed in an attempt to discover: (1) who is teaching in Ohio Trade and Industrial Secondary Education (2) what is his or her background and preparation (3) if there is any relationship between the amount of money spent per student and quality programs (4) if local supervisors' ratings describe quality programs (5) what are the behavior characteristics of Trade and Industrial Education teachers (6) what differences exist between specific areas of the many Trade and Industrial programs, and (7) what factors appear to be significant in quality programs.

Findings are presented in a 121 page attractively bound report which discloses many characteristics of the Trade and Industrial Education teachers. Traits indicated by an Opinion, Attitude and Interest Survey are reported for teachers in sixteen trades. Eleven traits including Achiever Personality, Intellectual Quality, Creative Personality, Social Adjustment, Emotional Adjustment, Masculine Orientation, Business Interest, Humanities Interest, Social Science Interest, Physical Science Interest and Biological Science Interest were used in forming a profile for these teachers.

The conclusions and recommendations will be of special interest to individuals responsible for selection of teaching personnel.

SUPERVISORY TRAINING

Instructor Training

INSTRUCTOR TRAINING - Leader's Manual - STIM-1
(12 units of instruction, to be covered
in approximately 15 clock hours)

The course outlined here has two basic objectives. First, to provide the future tradesman-instructor with an approved method of instruction based on the laws of learning which will enable him to teach others the related technology or the manipulative skills of his trade.

Second, to build a corps of qualified, trained instructors for trade, public service, and industrial occupations in the adult training field.

A series of charts accompany the instruction plans and are to be used by the instructor-trainer as teaching aids in presenting his course of instruction.

The appendix contains hints and suggestions to the instructor trainer for the improvement of the instructor training course and handouts to aid in conducting the course.

INSTRUCTOR TRAINING - Handouts - STLM-1

A portfolio of 19 handout sheets designed to be used in conjunction with the Instructor Training Course (STIM-1). Each sheet "points up" some highly important information contained in the course.

HUMAN RELATIONS TRAINING - Leader's Manual - STIM-2
(10 hours, 5 - 2 hour sessions)

The development of this course is based on the belief that the fundamental principles of good supervisor-employee relations can be analyzed and expressed in concrete, workable elements which simplify and clarify the complicated subject of human reactions. The material presented has been drawn from the work experience of successful supervisors who have recognized and practiced the principles of good human relations. A step-by-step lesson break-down of each session. A complete leader's guide which assures a good job of instruction from the start.

HUMAN RELATIONS - Handout Sheets - STLM-2
(15 sheets in series)

A visual tie-in with the Leader's Manual. These sheets are designed to emphasize important points in presenting the course and will stimulate the interest and motivation of the group.

HUMAN RELATIONS - Flannel Board Cards - STFC-2

A set of 42 cards to be used by the leader in the presentation of the human relations training program. Each card is keyed for use with the manual.

HUMAN RELATIONS - Tape Recordings - STTR-2

Recordings of the cases which are to be presented by the leader may be procured on tape or records.

Conference Leadership

LEADERSHIP IN DISCUSSION TECHNIQUES - Leader's Manual - STIM-6

This manual has been prepared as an aid to the prospective conference leader who will be engaged in leading conferences in his own or other organizations. The procedures and techniques described are based upon the findings of those who have had experience as conference leaders, and they are methods which have been used with a considerable amount of sucess. The ideas and suggestions presented here are valuable aids for those who wish to make their conference leading more successful.

LEADERSHIP IN DISCUSSION TECHNIQUES - Handout Sheets - STLM-6

A portfolio of 35 handout sheets designed to be given out to the learner during the conference leadership course. Each sheet emphasizes some important information which is presented in the course.

LEADERSHIP IN DISCUSSION TECHNIQUES - Flannel Board Cards - STFC-6

A set of flannel board cards for the leader's use in presentation of the course. Each card is keyed for use with the manual.

Effective Speaking

EFFECTIVE SPEAKING - Leader's Manual - STIM-4

A complete 12-15 hour course designed to improve the ability of supervisory personnel to express themselves. A participation type course which emphasizes "learning by doing." Each lesson is broken down into the Purpose, Materials Needed, Presentation and Application steps. Excellent material for the training of supervisors.

EFFECTIVE SPEAKING - Handout Sheets - STLM-4

A portfolio consisting of a series of 20 handout sheets. These sheets are correlated with the leader's manual and each emphasizes an important part of the course. Each sheet is handed out as the point is covered -- a technique that has proven most effective.

EFFECTIVE SPEAKING - Flannel Board Cutouts - STFC-4

A series of flannel board cuts designed to accompany the leader's manual. Each cutout is on heavy poster board and has been produced in two colors with flock already on the back. Each cutout portrays some important phase of the course and tends to hold the interest of the group and motivates group participation. For information on how to make a flannel board on which to display these cutouts, write your Instructional Materials Laboratory.

Job Methods

JOB METHODS - Leader's Manual - STIM-5

An outlined text on procedures in training personnel to seek and initiate improvements in their daily work by means of finding more efficient ways of completing their tasks. Competence in improving methods of accomplishing work is one of the basic skills needed by every successful supervisor. This job methods training program has been designed as a practical and effective way to help supervisors develop their ideas and put them into use. This skill, like other basic supervisory skills, can be acquired and is necessary in our industrial society which demands efficiency with high productivity.

JOB METHODS - Handout Sheets - STLM-5

A portfolio of handout sheets essential to students to illustrate important points. There are 15 sheets and each sheet is keyed for use in the Leader's Manual, and should be given to learners and participants at the appropriate time.

JOB METHODS - Flannel Board Cards - STFC-5

A set of cards keyed for visual use to enable effective presentation of the course. Each card is designed to stimulate and hold interest, plus the emphasizing of key points in the course.

JOB METHODS - Demonstration Kit - STDK-5

This demonstration kit is used in Session One for performing the Demonstration Job by the proposed or improved method. The kit consists of a fixture with two staplers, two jigs, one stamp pad, one hand stamp, and the necessary cards representing the brass and copper sheets required for the job.

TEACHER IMPROVEMENT

Teacher Improvement

STUDY GUIDE 1, INTRODUCTION TO VOCATIONAL TRADE AND INDUSTRIAL TEACHING (PRE-SERVICE) - TISG-1

This study guide was prepared with the idea of improving teaching and evaluation technique in trade and industrial education. It provides study outlines and references designed to assist the instructor in the vocational education program. Covering only one phase of teacher improvement work, this guide is not intended to be an exhaustive treatment of the area represented by the title of the unit. It should be sufficiently comprehensive, however, to be really helpful to the vocational instructor during his early years of teaching.

STUDY GUIDE 2, INTRODUCTION TO VOCATIONAL TRADE AND INDUSTRIAL TEACHING (IN-SERVICE) - TISG-2

This study guide was prepared with the idea of improving teaching and evaluation techniques in trade and industrial education. It provides study outlines and references designed to assist the instructor in the vocational education program. Since it covers only one phase of teacher improvement work, this guide is not intended to be an exhaustive treatment of the area represented by the title of the unit. It is sufficiently comprehensive, however, to be really helpful to the vocational instructor during his first year of teaching.

HANDBOOK FOR TRADE AND INDUSTRIAL TEACHERS - TISG 1 & 2

Contains the preceding two study guides in a single bound volume.

STUDY GUIDE 3, RELATIONSHIP OF THE VOCATIONAL INSTRUCTOR TO THE COMMUNITY - TISG-3

This study guide will assist the trade teacher in becoming acquainted with duties and responsibilities outside of the shop or classroom by which the community in which he teaches will judge him and his school. It will assist in understanding the problems involved in working out satisfactory solutions.

STUDY GUIDE 13, TECHNIQUES OF DEVELOPING TRADE SKILLS IN STUDENTS TISG-13

The primary purpose of this study guide is to provide practical suggestions for instructors who are interested in imporving the methods they use in developing trade skills in their pupils. Since the demonstration shop lesson is the foundation of any successful method, it has been reviewed in some detail in this material. In this regard, recommendations have been made based on experiment and actual practice in a number of shops in Ohio.

STUDY GUIDE 16, INSTRUCTION SHEET WRITING - TISG-16

The purpose of this guide on instruction sheet writing is to present the correct techniques of writing instructional materials to the beginning vocational instructor and to motivate him to write the various types of sheets he needs.

STUDY GUIDE 18, COLLECTING AND CLASSIFYING INSTRUCTIONAL MATERIALS - TISG-18

This study guide is designed to help vocational instructors obtain valuable teaching aids from many sources and to suggest ways and means of classifying the aids obtained so that they can be easily identified and located for use when needed.

STUDY GUIDE 22, ORGANIZING AND OPERATING TOOL OR STORAGE ROOMS TISG-22

This unit will be most useful to those vocational teachers who need help in planning or reorganizing their tool and storage facilities. When the teacher-trainer discovers such a need, the material included herein will provide an excellent source of information.

STUDY GUIDE 23, ORGANIZING AND USING SHOP PERSONNEL SYSTEMS TISG-23

This study guide is intended to acquaint the vocational instructor with the (1) benefits to be derived from the use of student personnel systems, (2) fields or areas to be supervised by students, (3) duties to be delegated to student supervisors, and (4) details of operating a personnel organization.

STUDY GUIDE 25, ORGANIZING AND CONTROLLING STUDENT GROUPS TISG-25

This guide is intended to help vocational instructors improve themselves and their techniques as leaders which is essential to the successful organizing and controlling of student groups. It also suggests sources of information to which beginning instructors may go for help in their organization problems.

STUDY GUIDE 29, INSTRUCTOR'S RESPONSIBILITY FOR COORDINATION TISG-29

Some of the matters discussed in this guide are (1) basic aims of trade and industrial education, (2) adapting instruction to industrial needs, and (3) instructor's responsibility for coordination. This guide will be an asset to teachers who wish to improve their programs of coordination.

STUDY GUIDE 31, METHODS OF EVALUATING AND RECORDING STUDENTS' PROGRESS - TISG-31

The specific purpose of this study guide is to help the vocational instructor to develop and properly utilize concrete devices to evaluate and record student progress. Two phases of the problem, rating scales and progress charts, are included in this unit.

Teacher Improvement

STUDY GUIDE 32, DEVELOPING AND USING OBJECTIVE TESTS - TISG-32

This course is intended to give shop and classroom instructors a simple and practical presentation of the basic principles of educational measurements as applied to vocational teaching. The plan of treatment provides the vocational instructor with a guide for his individual study and research.

STUDY GUIDE 33, INDIVIDUAL DIFFERENCES - TISG-33

This study guide deals with the individual differences which are inherent in all persons and which are so readily apparent in student groups. The purpose of the discussion in this unit is to bring to the attention of the instructor the existence of these differences, their implications in relation to the preparation of instructional material, and the methods he may use in offsetting them.

STUDY GUIDE 34, RELATION OF STANDARDIZED TESTS TO THE VOCATIONAL PROGRAM - TISG-34

This unit treats the material relating to testing from the standpoint of the vocational instructor who has not had an opportunity to study tests and measurements in a formal class. This material relates largely to the use of standardized tests, especially those which will provide a better picture of the vocational students'abilities and limitations.

STUDY GUIDE 39, EQUIPMENT SELECTION, SHOP DESIGN, AND LAYOUT TISG-39

This study guide is intended to be used so that each member of the class will be working on his own problem, thus he may work singly or as a member of a group interested in a particular problem in shop design, layout or equipment selection. The material presented here suggests the areas that must be investigated before and during the planning and laying out of a successful vocational school or department, its shops, and all related facilities.

STUDY GUIDE 40, EQUIPMENT SELECTION, TRADE TECHNOLOGY, LABORATORY DESIGN AND LAYOUT - TISG-40

Vocational teachers who will benefit most from this unit of study are of two categories:

1. Those who contemplate changing their methods of teaching trade technology from old segregated subject matter areas to laboratory procedures.
2. Those who anticipate building changes or new school construction which will require the planning and equipping of a new laboratory for teaching trade technology.

In accepting this assignment, you are undertaking study in an area where little help can be obtained from published material and each situation requires the analysis and solution of specific problems.

STUDY GUIDE 42, CONFERENCE LEADERSHIP TRAINING - TISG-42

This manual has been prepared as an aid to the prospective conference leader who will be engaged in leading conferences in his own or other organizations. The procedures and techniques described are based upon the findings of those who have had experience as conference leaders, and they are methods which have been used with a considerable amount of success. The ideas and suggestions presented here are valuable for those who wish to make their conference leading more successful.

STUDY GUIDE 43, APPROVED SUPPLEMENTAL WORK EXPERIENCE TISG-43

This unit has been prepared for the vocational instructor as a guide in acquiring added trade experience or special schooling. Provisions have been made for overcoming any deficiencies in trade background. To realize the goals set forth in this unit, it is necessary for the instructor and the teacher trainer to discuss frankly any existing weaknesses.

STUDY GUIDE 44, METHODS OF KEEPING UP-TO-DATE IN THE TRADE TISG-44

This guide, plus the actual supplemental work experience, will be of value primarily to instructors in two different classifications; first, to the instructor who has had no direct contact with the trade for several years and who now desires to acquaint himself with current manipulative practices and the technology; second, to the instructor who has had recent contact with the trade, but who is interested in extending his trade skill and knowledge.

UNIT C - TEACHING METHODS AND TECHNIQUES IN TRADE AND INDUSTRIAL EDUCATION

Study Guide C-1 - Questioning Techniques

This study guide has been designed to encourage the instructor to read some of the text materials on oral questioning techniques and enable him to understand and appreciate that the ability to ask oral questions effectively is an art calling for keen insight and a willingness to practice. It also offers the instructor an opportunity to practice asking questions during lessons under the observation of the teacher educator, using the controlled situations as the basis for discussions. Finally, this guide points out that oral questions during lessons have definite purposes.

Study Guide C-2 - Methods Of Group Instruction

This guide will acquaint the instructor with group instruction methods of teaching and help him provide more effective instruction. It will assist the instructor in choosing the most appropriate method of group instruction, encourage him to plan for this instruction, and provide him with an opportunity for practice of these methods.

Teacher Improvement

Study Guide C-3 - Methods of Individualized Instruction

This unit will help the instructor understand and appreciate the need for individualized instruction and familiarize him with the techniques and materials essential to this type of instruction. It will also provide the instructor with some suggestions for dealing with the problems of individual differences, individual needs, and correlation. The instructor will be shown the importance of teaching students how to study, and provided with a suggested study technique which he can teach his students. Finally, the instructor is offered some suggestions for coping with the problem of evaluating individualized instruction.

Study Guide C-4 - Organizing And Conducting Effective Demonstrations

This study guide has been designed to aid the instructor in using the demonstration as a tool for effective teaching. The instructor is acquainted with the importance of a properly planned demonstration, provided several suggested situations in which to practice demonstrations, aided in evaluating the effectiveness of his demonstrations, and helped to recognize when demonstrations can be most valuable in imparting information.

Study Guide C-5 - Principles of Learning

This study guide has been designed to help the instructor understand the learning process and to acquaint him with the processes for developing skills. It will aid the instructor in distinguishing between superficial learning, permanent learning, and in realizing that the capacity to learn varies widely with students.

Study Guide C-6 - Individualized Instruction In The Related Classroom

This study guide is to aid the instructor in providing a study technique he can teach his students. It will help him understand the importance of individualized lessons. There are practical suggestions for supervision and evaluation for the individualized planning. This study guide also contains suggestions on providing individualized instruction when instructional aids are not available.

Study Guide C-7 - Conference Techniques In Teaching

This study guide has been prepared to acquaint the instructor with the conference technique. It will further an understanding of the specific conditions of conference technique and skills of group instruction.

Study Guide C-9 - Use of Laboratory Procedures In Teaching Trade Technology

This unit is to assist the instructor in selecting items of trade information which can be better understood by teaching the principles involved. The study guide can be used in developing laboratory procedures and in showing how appropriate instructional materials can be used to teach principles and their applications.

Study Guide C-10 - Correlation of Shop and Trade Technology Instruction

When one instructor shares instructional duties with another, both should decide the best method of securing instructional correlation. Instructors are obligated to give instruction which will be functional in the lives of their learners. A knowledge of the principle of correlation will provide a means of organizing the instruction in a trade and industrial education program in such a way that it will be more helpful and meaningful to those they teach. This manual was prepared as an aid for acquiring this principle.

Study Guide C-11 - Selection And Use Of Teaching Aids

This study guide will help the beginning instructor to become familiar with certain audio-visual aids which can enrich and strengthen his teaching program. It will assist him in preparation of the aids. The guide will encourage him to learn the sources of the teaching aids he will want to use.

UNIT D - SELECTION AND ORGANIZATION OF SUBJECT MATTER IN TRADE AND INDUSTRIAL EDUCATION

Study Guide D-2 - Trade and Occupational Analysis

The study guide is designed to familiarize the instructor with trade or occupational analysis procedures and terminology. It will help in learning a method of determining what to teach by knowing the values of trade and occupational analysis work in vocational trade and industrial curriculum construction. Finally, this study guide provides opportunity to put the analysis procedures into practice.

Study Guide D-4 - Course of Study Construction

The purpose of this guide is to study the elements and learn the technique of constructing a course of study. It will serve as a master plan for an entire one or two year trade program with the units of work blocked out, plans for their development set down, and an indication of the order in which they will be taken up and how they will be presented. Prerequisites for the study of this program should be the completion of the study guides on Instruction Sheet Writing (D-1), Trade and Occupational Analysis (D-2), Course Outline Writing (D-3), and Preparing and Using Lesson Plans (D-5).

Study Guide D-5 - Preparing And Using Lesson Plans

This study guide can be used by the instructor to identify the characteristics of a good lesson. The "Four Step" lesson plan is explained in this study guide. The "Four Step" plan is applied to shop and other related lesson plans.

Study Guide D-6 - Effective Teaching Of Safety

This guide is designed to assist the shop instructor in setting up and operating a shop safety program. The situations for teaching methods of safety are in this unit. The shop instructor will realize that safety is a con-

tinuous process and will learn technique through the development of committees and teams to assist in making the shop a safe place in which to work. Finally, the study guide will aid in the development of tests and reports for safety programs.

Study Guide D-7 - Developing And Constructing Teaching Aids

This study guide has been prepared to provide the instructor with the basic knowledge needed to construct his own teaching aids. With this help, the instructor will be encouraged to develop teaching aids which will assist in effective instruction and make his job more meaningful and easier in the long run.

UNIT E - SHOP AND LABORATORY ORGANIZATION AND MANAGEMENT

Study Guide E-3 - Developing Appropriate Student Conduct

This unit is to help the instructor realize the importance of the establishment and maintenance of good shop and classroom conduct which is the product of the instructor's habits, conduct, personal appearance, speech, etc. It offers suggestions to the instructor on maintaining good discipline and the latest text materials on the subject of discipline.

Study Guide E-5 - Sponsoring A Vocational Industrial Club

This study guide is designed to help the instructor with the official youth organization of Trade and Industrial Education. It will assist in the organization and operation of the local clubs. This unit contains factual information regarding the Purpose, Pledge, Creed, Symbol, Opening and Closing Ceremony, and other important aspects to help guarantee a strong youth organization.

INSTRUCTOR TRAINING - Leader's Manual - STIM-1 (Also listed on p. 26)
(12 units of instruction, to be covered
in approximately 15 clock hours)

The course outlined here has two basic objectives. First, to provide the future tradesman-instructor with an approved method of instruction based on the laws of learning which will enable him to teach others the related technology or the manipulative skills of his trade.

Second, to build a corps of qualified, trained instructors for trade, public service, and industrial occupations in the adult training field.

A series of charts accompany the instruction plans and are to be used by the instructor trainer as teaching aids in presenting his course of instruction.

The appendix contains hints and suggestions to the instructor trainer for the improvement of the instructor training course and handouts to aid in conducting the course.

INSTRUCTOR TRAINING - Handouts - STLM-1 (Also listed on p. 26)

A portfolio of 19 handout sheets designed to be used in conjunction with the Instructor Training Course (STIM-1). Each sheet "points up" some highly important information contained in the course.

HANDBOOK FOR TRADE EXTENSION TEACHERS - MIS-7

This handbook has been prepared by the teacher educators of the Trade and Industrial Education State Staff as a guide to a four hour training program for trade extension teachers.

The following time allocations are suggested: Organization - 15 minutes, Teaching Aids - 30 minutes, Methods - 30 minutes, 4-Step Method - 2 hours, 45 minutes.

Each participant in a teacher training session should be furnished a copy of this booklet. Also it will be desirable to furnish copies of this booklet to trade extension teachers who are unable to attend an organized training session.

It is hoped that this booklet will stimulate the trade extension teacher to seek further information which will be helpful to him as a vocational education instructor.

OCCUPATIONAL COMPETENCY TESTS - MIS - 10

This booklet is designed as a general guide for those persons who undertake the special assignment of writing a trade competency test for a specialized field, working in collaboration with a teacher trainer, faculty advisor and/or other qualified staff member. The content covers test development procedures, construction of technology and performance tests, test administration procedures, and evaluation of test results.

MANUAL OF STANDARD FORMATS - For Written Instructional Aids - MOSF-1

Preparation of instructional aids for teacher and student use are an important part of a teacher's responsibility. Written instructional materials have taken on many varied styles and formats over the years. This manual is an attempt in standardizing the formats to be used in preparing written instructional materials and also to be used in conjunction with the teacher education program. The formats for the various materials are the result of extensive study on the part of curriculum committees who took into consideration such factors as: organization, presentation of material, economy, simplicity of style, ease of reproduction, and uniformity. In addition to the information on how to prepare written instructional materials, the manual also provides information as to why they should be prepared and suggestions on how they should be utilized by the instructor.

DIVERSIFIED COOPERATIVE TRAINING

Diversified Cooperative Training

DIVERSIFIED COOPERATIVE TRAINING

Occupational Training Plans - Compilation - TP 1-45 - Bound Set

These forty-five training plans were developed as a valuable aid in conducting more effective cooperative training programs.

A compilation of TRAINING PLANS AND PROGRESS RECORDS, plastic bound in a durable cover, may be obtained for the following trades: Aircraft Mechanics, Automatic Pinspotter Mechanic, Auto Mechanics, Automotive Collision Repair, Baking, Bricklaying, Cabinet Making, Carpentry, Carpet and Linoleum, Cleaning and Pressing, Commercial Cooking, Custodial Work (School), Dairy Processing, Dental Assistant, Dietitians Assistant, Doctor & Dental Assistant, Drafting, Electrical Appliance Servicing, Electric Motor Repair, Electrical Wiring, Farm Machinery Servicing, Floriculture, Furniture Upholstery and Repair, Industrial Maintenance, Industrial Sewing Machine Mechanic, Lithography, Machine Trades, Making and Installing Neon Signs, Meat Cutting, Medical Laboratory Technicians, Monumental Stone Cutting, Motion Picture Projectionist, Painting and Decorating, Photography, Plumbing, Pre-Nursing, Printing, Radio & Television Servicing, Residential Wiring, Sheet Metal Work, Sign Painting, Watch and Clock Repair, Welding, Wheel Alignment and Frame Straightening, X-Ray Technician Assistant.

Each Training Plan and Progress Record is invaluable:

At the time of the first interview of the coordinator with the student, when determining the best possible choice of occupational training;

During interviews with prospective or already participating on-the-job instructors to determine which skills can be taught effectively;

In regular interviews with the student during the course of training, in order to keep the student up-to-date on the progress he is making and the goals that lie ahead;

In follow-up visits at the place of business of the on-the-job instructor, to make certain that the student is having the opportunity to progress from skill to skill within the scope of the facilities;

In the final interview with the student prior to graduation, at which time the record of the student's progress to date can be reviewed and a copy of the Training Plan and Progress Record can be presented to the student as the latter goes from the school to find full time employment.

Any of the above listed occupational training plans can be purchased individually or in a bound volume.

VOCATIONAL EDUCATION IN DIVERSIFIED COOPERATIVE TRAINING-MIS-4

This manual is a description of the objectives, standards, and operating policies of a trade and industrial education program planned to meet the needs of the small community. While several occupations may be included in this program, the individual student receives training in only one; thus the term "diversified" applies to the program as a whole and not to the experience of the student. For those schools and communities that are considering instituting such a program, this manual will be a valuable asset.

D. C. T. REFERENCE MATERIALS - MIS-9

A listing of instructional materials for the teaching of prominent vocational subjects. These materials have been chosen for their general excellence, by committee, and are comprised of publications from most states active in vocational education. Also listed, with the title of each publication, are the reference materials for each, plus the address from which the listed materials may be obtained.

MISCELLANEOUS

Miscellaneous

VOCATIONAL INDUSTRIAL CLUB OF OHIO (HANDBOOK)

This book is an invaluable aid for new members and officers of the Vocational Industrial Club of Ohio. Each and every member should be presented one of the manuals. It contains the purposes of V. I. C., the Pledge, the Creed, the Opening and Closing Ceremony, etc. The manual contains 89 pages.

OHIO LEGISLATION APPLICABLE TO VOCATIONAL EDUCATION WITH ATTORNEY GENERAL'S OPINIONS - 1956 - MIS-6

A listing from the Ohio Code of Ohio Laws and Attorney General's Rulings affecting Vocational Education. It is designed to help teachers and administrators in Ohio understand the regulations affecting the programs in the public schools.

TEACHING PARLIAMENTARY PROCEDURE - MIS-11

The Parliamentary Procedure booklet is a valuable aid for those wishing to master parliamentary procedure or to develop the ability to participate effectively and correctly in a business meeting, as well as to preside over an ordinary business meeting. This booklet contains lesson plans giving the instructor step by step procedures to follow for teaching a specific skill.

OCCUPATIONAL WORK EXPERIENCE PROGRAM - MIS-17

A description of the objectives and operating policies of an Occupational Work Experience Program planned to meet the needs of the limited academic achieving student. It is anticipated that not only may the Occupational Work Experience Program contribute to the development of the academic under achievers as productive citizens, but that it should eliminate the temptation of assigning this level of student to the regular vocational education programs for which they are not qualified.

Vocational Education Sound Filmstrips

The Divisions of Vocational Education and Guidance & Testing have cooperated in producing three color sound filmstrips with the following titles: "Your Future Through Vocational Education," "Your Future Through Technical Education," "Vocational and Technical Education for a Changing World of Work."

These filmstrips are proving to be of great value to school administrators, guidance counselors, vocational education directors and supervisors, and other educational groups who are concerned with providing high school students and young adults with concrete knowledge relating to the several vocational areas. The dramatic presentations enable the students and others to make more intelligent decisions in planning for an educational program which will lead to employment of their choice.

YOUR FUTURE THROUGH VOCATIONAL EDUCATION

"Your Future Through Vocational Education" is directed to the high school student who is at the point of selecting a vocation, and stresses the importance of choosing the right one. School counselors find this an invaluable aid with which to challenge the student. The program has 144 frames, and is approximately 25 minutes in length.

Record sound film strip	$10.40
Tape sound film strip	15.20
Postage & Handling	.75 for each copy

YOUR FUTURE THROUGH TECHNICAL EDUCATION

"Your Future Through Technical Education" relates the importance and place of the technician in our society, and gives the student an idea of what he must accomplish to become a technician. Specific examples of technician's work, and areas in which they are becoming important are listed. The film has 69 frames and is approximately 15 minutes in length.

Record sound film strip	$ 7.60
Tape sound film strip	15.20
Postage & Handling.	.75 for each copy

Vocational Education Sound Filmstrips

VOCATIONAL AND TECHNICAL EDUCATION FOR A CHANGING WORLD OF WORK

"Vocational and Technical Education for a Changing World of Work" presents a broad view of vocational education and its value for high school students, post high school students and adults who wish to upgrade their job skills. This filmstrip consists of 110 frames and is approximately 19 minutes in length.

Record sound film strip	$10.40
Tape sound film strip	15.20
Postage & Handling.	.75 for each copy

All filmstrips are available in either record or tape versions. Write to the Instructional Materials Laboratory, Trade and Industrial Education, 1885 Neil Avenue, Columbus, Ohio 43210, for descriptive leaflets and prices.

PRICE LIST

Note: Ohio Schools and other Ohio Public Agencies should deduct 20% discount from the following prices

INDUSTRIAL OCCUPATIONS

BRICKLAYING

BRLM-1	$1.60
BRLM-2	2.00
BRA-1	.65
BRA-2	.65

ELECTRICITY

ELIM-1	$1.50
ELLM-1	1.42
ELEX-1	.65
ETIM-2	1.25

RESIDENTIAL WIRING

ELLM-7	$1.25
ELA-7	.90

ELECTRONICS

ELLM-14	$1.05

ELECTRIC LINEMAN

ELTL-8	$1.82
ELTL-9	1.88
ELTL-10	1.50
ELTL-11	1.75
ELTA-8	.65
ELTA-9	.65
ELTA-10	.60
ELTA-11	.65

RADIO

ELIM-5	$1.28
ELLM-5	1.60

HYDRAULICS

HYLM-1	$2.00
HYLA-1	.70

MACHINE TRADES

MTLM-1	$3.25
MTLM-2	2.35
MTA-1	1.50
MTA-2	1.50
MTLM-3	1.23
MTIM-4	.96

100 SERIES - MACHINE TRADES JOBS AND JOB SHEETS (Jobs may be purchased individually or in a bound set)

MJJS-100, $2.75 per bound set

MJ-101	$.10	MJ-113	$.10
MJ-102	.10	MJ-114	.10
MJ-103	.10	MJ-115	.10
MJ-104	.10	MJ-116	.20
MJ-105	.10	MJ-117	.10
MJ-106	.10	MJ-118	.15
MJ-107	.10	MJ-119	.10
MJ-108	.10	MJ-120	.10
MJ-109	.30	MJ-121	.10
MJ-110	.15	MJ-122	.05
MJ-111	.10	MJ-123	.05
MJ-112	.15	MJ-124	.05

200 SERIES - MACHINE TRADES JOBS AND JOB SHEETS (Jobs may be purchased individually or in a bound set)

MJJS-200, $6.40 per bound set

MJ-201	$.10	MJ-214	$ .15
MJ-202	.15	MJ-215	1.50
MJ-203	.15	MJ-216	.30
MJ-204	.15	MJ-217	.10
MJ-205	.20	MJ-218	.55
MJ-206	.10	MJ-219	.10
MJ-207	.10	MJ-220	.10
MJ-208	.15	MJ-221	.25
MJ-209	.25	MJ-222	.35
MJ-210	.35	MJ-223	.10
MJ-211	.15	MJ-224	.20
MJ-212	.15	MJ-225	.20
MJ-213	.20	MJ-226	.20

PLUMBING

PLLM-1	$1.25
PLA-1	1.20
PLLM-2	1.25
PLCO-1	.25
PLCO-2	.25

SERVICE OCCUPATIONS

FIRE SERVICE TRAINING

FT-2	$3.44
FTIM-2	4.00
FTLM-2	.75

LAW ENFORCEMENT OFFICER TRAINING

LELM-1	$2.25
LEIM-1	3.25
LELM-II	2.25
LEIM-II	3.25

EMERGENCY VICTIM CARE AND RESCUE TRAINING

EVCRM	$4.15

CUSTODIAL TRAINING

CTLM-1	$2.25

SCHOOL BUS DRIVER TRAINING

SBLM-1	$1.25

HEALTH OCCUPATIONS

NPPN-1	$4.00
NPA-1	2.00
NALM-1	1.62
HHIG-1	2.50
HHTP-2	1.25

RESEARCH AND PROGRAM EVALUATION

MIS-12	.20
MIS-14	.85
MIS-13	.75
MIS-3	.25
MIS-15	.85
MIS-16	.85
MIS-18	1.65
MIS-19	2.65

SUPERVISORY TRAINING

INSTRUCTOR TRAINING

STIM-1	$3.00
STLM-1	.50

HUMAN RELATIONS

STIM-2	$2.80
STLM-2	.50
STFC-2	5.00
STTR-2	3.00

LEADERSHIP IN DISCUSSION TECHNIQUES

STIM-6	$2.80
STLM-6	.90
STFC-6	5.50

EFFECTIVE SPEAKING

STIM-4	$2.00
STLM-4	.65
STFC-4	4.00

JOB METHODS

STIM-5	$2.75
STLM-5	.50
STFC-5	5.00
STDK-5	11.55

TEACHER IMPROVEMENT

STUDY GUIDES

TISG-1	$ .65
TISG-2	.85
TISG-1&2	1.50
TISG-3	.30
TISG-13	.30

STUDY GUIDES (Cont.)

TISG-16	.80
TISG-18	.30
TISG-22	1.00
TISG-23	.25
TISG-25	$ .20
TISG-29	.30
TISG-31	1.50
TISG-32	.90
TISG-33	.30
TISG-34	.50
TISG-39	.25
TISG-40	.35
TISG-42	1.20
TISG-43	.20
TISG-44	.25

C-1	$.26	C-11	$.18
C-2	.60	D-2	.29
C-3	.20	D-4	.40
C-4	.27	D-5	.21
C-5	.26	D-6	.21
C-6	.40	D-7	.57
C-7	.28	E-3	.21
C-9	.35	E-5	.23
C-10	.75		

INSTRUCTOR TRAINING

STIM-1	$3.00
STLM-1	.50
MIS-7	.40
MIS-10	.75
MOSF-1	1.70

DIVERSIFIED COOPERATIVE TRAINING

MIS-4	.50
MIS-9	.35

TP-1-45, $4.40 per bound set

Training Plans, $ .20 per copy

- Aircraft Mechanics
- Automatic Pinspotter Mechanic
- Auto Mechanics
- Automotive Collision Repair
- Baking
- Bricklaying
- Cabinet Making
- Carpentry
- Carpet and Linoleum
- Cleaning and Pressing
- Commercial Cooking
- Custodial Work (School)
- Dairy Processing
- Dental Assistant
- Dietitians Assistant
- Doctor & Dental Assistant
- Drafting
- Electrical Appliance Servicing
- Electric Motor Repair
- Electrical Wiring
- Farm Machinery Servicing
- Floriculture
- Furniture Upholstery and Repair
- Industrial Maintenance
- Industrial Sewing Machine Mechanic
- Lithography
- Machine Trades
- Making and Installing Neon Signs
- Meat Cutting
- Medical Laboratory Technicians
- Monumental Stone Cutting
- Motion Picture Projectionist
- Painting and Decorating
- Photography
- Plumbing
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1967

ADVANCED SALES TECHNIQUES

Instructor's Guide

Prepared by

Division of Vocational Education
William E. Johnson, Assistant Superintendent

Distributive Education Section
H. E. Ruppert, Director

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

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DATE: June 5, 1967

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INTRODUCTION

This manual is organized and presented as a teaching aid for an adult distributive education class. It may be used by a distributive education teacher-coordinator on the secondary school level, or it may be used in a post-secondary vocational technical school. Personnel serving in private enterprise who come in contact with the public may find it helpful if used on an individual basis.

Personnel departments, business associations, and civic organizations will find this manual of value in promoting adult sales classes.

The length of teaching time required to cover material in this manual will depend upon the amount of discussion given each unit and the amount of audio visual aids used. Some units are to be considered more important than others and should be allowed more time. At least ten meetings of one hour for ten days would be justified.

The first unit is intended to show the student how we learn from coming into contact with other people. It is also intended to create an interest in telling the group what its members will be taught about salesmanship. The subsequent units analyze a sale in smallest details, teach the selling points, and then explain the salesman's part in the American economic system.

The overall objectives of this course in advanced selling techniques are: (1) to give a better understanding of the techniques involved in selling, (2) to aid in securing greater efficiency (sales per customer) in selling, (3) to give customers quicker and better service by teaching salesmen how to serve customer's needs and interests, (4) to increase the sales of a salesman, thereby increasing his purchasing power and standard of living, (5) to aid the salesman in building a clientele, (6) to create a demand for more goods brought about by new inventions and automation, and (7) to help the salesman realize his place and importance in the American economic system.

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GENERAL SUGGESTIONS TO THE INSTRUCTOR

To aid in using this teaching manual in the most effective way, the following suggestions are offered:

1. Read introduction, including the overall aims and objectives.

2. Read the complete manual to get an overall picture of how the steps of a sale are used as tools of the trade. These salesmanship tools are made available to be used when needed, but are not necessarily needed, for every product or customer.

3. Consider your time schedule, as well as the needs of the class, and adapt the teaching outline to fit both.

4. Use the conference method of teaching whenever possible.

   a. Ask questions which stimulate, advance, and provoke discussion.

   b. Keep ahead of the discussion so you can sense its trend. Keep the discussion on the "beam."

   c. Use chalkboard, or paper easel to note important points as they are developed. Use the words and expression of participants as often as possible.

   d. Appreciate the personal reactions of people so that you do not hurt their feelings.

   e. Maintain a sense of humor.

   f. Avoid arguments.

   g. Keep in mind, and emphasize when necessary, that the good of the group comes first.

   h. Keep one person from doing all the talking.

   i. Avoid talking too much yourself, and, when you do talk, don't be unduly assertive.

   j. Give everyone adequate attention. Don't slight anyone. Be fair.

   k. Avoid arousing antagonism.

UNIT I

INTRODUCTION

UNIT I

INTRODUCTION

I. Aims and objectives of this unit:

A. To show the students how we learn.
B. To tell the group how they will be taught in this class.
C. To inform the group of what they will learn in subsequent meetings.

II. General outline of this unit:

A. Who is a salesman?
B. Selling to basic needs and desires.
C. Who is a clerk or truck driver?
D. Barbers and beauticians as salespeople.
E. When you sell, what do you sell?
F. Buying process.
G. How you sell yourself, your company, and your merchandise.

III. Materials and teaching aids needed for this unit:

A. Chalkboard
B. Chalk and eraser
C. Crayon or marker
D. Paper easel
E. Sample of certificates
F. Paper and pencils

UNIT I

INTRODUCTION

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTOR
I. Introduction	
A. Roll call	Write your name, sex, age, address, employer (name of company), (salesperson, supervisor, department head, etc.) on a sheet of paper and turn it in at the end of the class. From then on only sign your name on sheet of paper for roll.
B. Instructor's name	Write your name on chalkboard, your title or job, and the name of your school system or company.
C. What distributive education is	Distributive Education is a vocational training program for those who have already entered, or contemplate entering, the various fields of distribution as their life's work. This includes positions in wholesale, retail, or service organizations.
D. Introduction of guests	
E. Background of experience	
1. Instructor's	List the various types of sales experiences, noting years or months on the chalkboard, and secure the total. (Newsprint sheets and marks-a-lot may be substituted for or used with chalkboard.)
2. Class Member's	Take the above total and place it next to your name,

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTOR
	then list the members and their total sales experience. Add the total sales experience of the class. Explain to the group that you will not be the authoritv (only the leader) in answering the questions and problems but that you will use the total experience of the group just as you would if you had that much experience yourself. Also point out that a member, by failing to contribute, will reduce the experience and authority of the group. By using this conference method of instruction a member will not be put on the spot as a "know it all." Tell the class you expect to learn something from them, too. There may be some in the group that have more experience than you, and you hope to profit by their experiences.
F. Comparison of learning to be a top notch salesman to learning to be a good fisherman, golfer, cook, hunter, seamstress, card player, etc.	Ask if there are any fishermen in the group. How does a person learn to fish, play golf, or anything else? By listening to others, watching others, trying their methods and if they work, adding it to your own methods and techniques. The same can be done in selling. All you ask the group to do is try it. The class members are not expected to agree with you or their fellow members on everything that is said. They are

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTOR
	expected to try it on their jobs to see if it will work for them. If ideas produce results, we will continue to use them.
G. Certificates	Certificates are given for being present and absorbing as much as possible. There will be no test or exam. (Mention absences allowed.)
II. Organization and Content	
A. Who is a salesman?	Get members to write their definition on a sheet of paper. Go around and look at them. Get some of them to read them and draw key words such as: knowledge, desires, needs, service, enthusiasm, help, etc. Compose a definition that will cover all the above, such as: A salesman is one who serves a customer in such a way that he will return for future sales or services, and will also refer friends and relatives. A salesman is one who helps customers buy.
B. Selling to basic needs and desires	Ask the group what basic needs and wants that customers buy for. Point out that all sales satisfy one or more of these basic needs or desires.
1. Food and drink	
2. Shelter and comfort	
3. Communication and transportation	
4. Attracting opposite sex	

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
5. Welfare of loved ones	
6. Recreation and exercise	
7. Freedom from fear and danger	
8. Developing one's potential	
9. Social acceptance	
10. Health (freedom from pain and longer life)	
C. Who is a clerk or truck driver?	A clerk may be defined as one who says "Can I help you?" or "May I help you?" and then gives you what you ask for and wraps the package and makes change. Sometimes a salesperson has to clerk but later he reverts back to salesmanship by suggestive selling.
1. Do salespeople have to clerk sometimes or drive trucks sometimes	A salesman is more than a truck driver if he calls on a customer or client with a load of goods.
D. Barbers and beauticians as salespeople	Ask members where they get their hair cut, or fixed, and ask them why.
E. When you sell, what do you sell?	
1. Yourself	
a. So people will like you	

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
b. So people will want to associate with you	
c. So people will have faith in you	
d. So people will want to buy from you	
e. So people will refer customers to you	
F. Buying Process	We have heard or read of the four steps of a sale: Gaining attention, creating interest, creating desire, and producing action. (Store Salesmanship, Robinson-Blackler-Logan, pp. 20-31.)
1. Pre-approach	
2. Meeting the customer-approach and greeting	
3. Selecting the goods for the customer	
4. Presenting the merchandise physically	
5. Presenting the goods verbally	
6. Salesperson's (objective) demonstration	

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
7. Customer's (subjective) demonstration	
8. Applying the appropriate selling technique	
9. Summarizing the build-up	
10. Suggestive selling	
11. Routine details	
12. Follow-up	Tell class what's to come in the next meeting: Tomorrow we will have a thirty minute sound film on selling yourself and we will discuss the first two of the twelve steps of a sale. We will start on time and end on time.

UNIT II

PRE-APPROACH

UNIT II

PRE-APPROACH

I. Aims and objectives of this unit:

A. To remind the group of their duties before approaching customers.
B. To stress the value of merchandise information.
C. To define prospects.
D. To suggest a source of prospects.

II. General outline of this unit:

A. Salesperson's appearance.
B. Advertisements.
C. Merchandise appearance.
D. Previous store experiences.
E. Features that attract customers.
F. Keeping customer records.
G. Overcoming objections.
H. Merchandise knowledge.
I. Prospects.

III. Materials needed for this unit:

A. Chalkboard
B. Chalk and eraser
C. Paper easel
D. Crayon or marker
E. Paper and pencils

UNIT II

PRE-APPROACH

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
II. Pre-approach A. Salesperson's appearance 1. Dress a. Business b. Conservative c. Should not detract from merchandise d. Cleaned and pressed 2. Personal grooming a. Hair b. Fingernails c. Shoes 3. Cleanliness a. Teeth b. Body odors c. Breath	In adult classes a salesperson's dress should be elaborated upon but grooming and personal cleanliness should be dealt with lightly to keep the discussion from becoming too elementary.
B. Advertisements 1. What and when 2. Prices 3. Competitor's 4. Store's bulletin boards	Ask group if they have ever been caught by a customer who asked for an article that is currently being advertised.
C. Merchandise appearance 1. Displays	Displays should be kept neat and clean to give a good

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
a. Counter b. Wall c. Floor	appearance. Merchandise should be rotated so it will not become shopworn.
2. Samples	A salesman calling on a prospect should always check his sample case before making an appearance.
D. Previous experiences in store	
E. Features that attract customers	
1. Air	
a. Fresh b. Heated c. Air-conditioned	
F. Keeping customer records	
1. Record of purchases 2. Mailing lists	
G. Overcoming objections	The alert salesperson will keep a record of questions and objections asked by customers so he may answer them or meet them before they arise. (Store Salesmanship, Robinson-Blackler-Logan, pp. 32-36.)
H. Merchandise knowledge	A mimeographed check list sheet on this knowledge of merchandise would be helpful and save time. (Advanced Selling. Basic Instruction Series, Janie Sullivan, page 104.
1. Use of product	
a. Primary and secondary uses b. Suitability c. Versatility	
2. How the product will perform	
a. Durability	

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
b. Degree of color permanence c. Shrinkage or stretchage (in case of textiles) d. Breaking strength e. Resistance to water, wind, wear, heat, light f. Cost of up-keep 3. How the product is made (construction) a. Size b. Weight c. Weave (in case of textiles) d. Finish e. Handmade or machine-made f. Pressed, molded, stamped, inlaid, etc. g. Conditions under which goods are made h. Packaging 4. How to use the product a. How to operate it, wear it, prepare it, eat it, apply it, arrange it, assemble it, display it, place it	

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
5. How to care for the product a. How to handle and adjust the product b. How to clean the product c. How to store the product d. How to repair the product e. How to oil and grease the product f. How to refrigerate the product	
6. Appearance of the product a. Beauty b. Style c. Ensemble possibilities	
7. Background of the product a. History of the article b. History of its manufacturer c. History of its uses d. History of competing articles e. Rarity f. Prestige	
8. Services available with the product a. Credit terms	Source of merchandise information will be covered in Unit VII - Presenting the Merchandise Verbally

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
b. Shipping terms c. Speed and cost of delivery	
I. Prospects	
1. Prospect defined	
a. One who has need for your product or service b. One who has the authority to buy c. One who is accessible	
2. Kinds of prospects	
a. Present customers	
(1) Prospects for future sales (2) Prospects for bigger sales (3) Prospects for sales of other products	
b. Old customers who are not buying	
(1) Find out the cause (2) Get them back (3) Treat them better	

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
c. New prospects (1) People you know (a) Your immediate family (b) Friends, acquaintances, relatives (c) People met in community activities (d) People met in clubs and social organizations (e) People from whom you buy (2) Through research (a) Newspapers (b) Classified directories (c) Trade and professional membership lists (d) Building permits (e) Tax lists	

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
(f) Commercial advertising lists	
(3) Past customers	
(a) Calling past customers in follow-up and asking them to refer customers to you	
(4) "Bird Dogging"	
(a) A number of people looking for salesmen and referring them to them	
3. Knowledge of prospect	If the salesman calls on a prospect or if he knows what customers are coming in, he should take time before the call to gain some knowledge of his prospect.
a. How to pronounce his name b. Financial ability c. His needs d. Past and present relations with the company - (Does he have an account with the company?) e. Name and title of person who does the buying or	(Selling to Today's Customer, pp. 249-250, 313-315.)

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
will influence the buying for a business concern	

UNIT III

MEETING THE CUSTOMER OR PROSPECT

UNIT III

MEETING THE CUSTOMER OR PROSPECT

I. Aims and objectives of this unit:

A. To present information concerning human relations.
B. To train students to remember names.
C. To emphasize the importance of making customers feel at home in the business.
D. To teach types of approaches.

II. General outline of this unit:

A. Company representative.
B. Creating good customer impressions.
C. Courtesy.
D. Types of approaches.

III. Materials and teaching aids needed for this unit:

A. Chalkboard
B. Chalk and eraser
C. Paper easel
D. Crayon or marker
E. Paper and pencils
F. 16mm projector and screen
G. Film--By Jupiter
H. Film--The Right Approach

UNIT III

MEETING THE CUSTOMER OR PROSPECT

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTOR
III. Meeting the customer or prospect A. Company representative 1. Who the company is 2. Who you work for	If you meet a customer or do a job for them, you are the company. In most cases the customer does not know the owner, the manager, or even the department head. In his eyes the salesman is the company. You are working for yourself and your dependents but you are working with (name of company).
B. Creating good customer impressions 1. Customers get impressions from	Any bad impression you make on a customer or any bad service you render him hurts the company; which is yourself, your fellow workers, and the management. If management makes a bad impression on a customer they are hurting you.
a. Your appearance b. Your facial expressions (1) eyes (2) mouth (a) smile c. Physical movements (1) Body (a) posture (b) poise	One's first impression lasts the longest. This first impression is made in the approach and greeting.

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTOR
d. Voice (1) tone quality (2) volume (3) what you say (4) how you say it	The first few words you say will form more impression than any others in your sales talk.
e. Attitude f. Alertness g. Enthusiasm	We will have a film on enthusiasm later that will cover its importance.
C. By Jupiter (16mm sound film) 1. Courtesy a. Something which comes from inside b. Patience and understanding of someone else's problems and troubles c. Being helpful and friendly to someone because you like and understand him	By Jupiter is a twenty-eight minute film on meeting people and selling yourself. It has been copyrighted by Marshall Field and Company, the largest retail store in the world, and is about a false god looking down on a business man on earth. It first shows man using the wrong technique and getting nowhere in accomplishing his aims in everyday life. Then by an act of this false god, Jupiter, he is able to relive his day and meet his objectives by the technique Jupiter teaches him. (By Jupiter, 16mm sound film)
2. Proverbs a. A soft answer turns away wrath. b. You can catch more flies with sugar than you can with vinegar. c. Courtesy is contagious d. Say and do	

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTOR
things to make life more pleasant for someone else and they will be extra nice to you. e. Put something in the Bank of Human Relations that will pay you back dividends. f. Courtesy is not the tip of a hat, a warm handclasp, or a big fat compliment. g. Courtesy is patience and understanding of someone else's problems and troubles. h. Kindness like corn increases with sowing. i. Every time you go out of your way to be kind to someone you are laying the groundwork for someone to be kind to you. j. Save another guy's face in an argument so that you can save your own. D. Types of Approaches 1. Address approach	Some of the films that are shown in this course are old, and some of them are modern. This shows economy in the education department since these films are very expensive. It also shows that some of the techniques used some time ago still hold true today.

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTOR
a. Address customer by name. (1) How to remember names (a) Associate with other names you know. (b) Associate with places. (c) Associate with things.	The trouble with most people who cannot remember names is that they do not take time out to remember the names of people that they meet. They will meet someone and right away they are either listening to this person or someone else, or they are thinking about what they are going to say. This can be avoided by asking the person they meet how to spell his name or if he is related to someone that you know with the same last name. To find out a person's name when you should know it and no one is around that you may ask, ask the person how he spells his last name. If it is a name like Smith, you can say, "It's spelled without an 'e'?" The same holds true for Brown. The only name you can get caught on is Jones.
(2) Remember to remember names	Go through the class and have each member give his last name and let the class practice association. Have members of class meet three people in the class that they did not know before. At the next meeting they will have to go back to these people and call them by name.
(3) Keep book with names of customers or prospects (4) Get names off charge accounts. (5) Get names off checks	
2. Merchandise approach a. Walk up to customer and give merchandise information	The merchandise approaches do not have to be elaborate. Simple statements that tell the customer something like the following will be sufficient: This is advertised

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTOR
	in _____. We have these in sizes _____ to _____. These are on special today. This suit is made of dacron. This sweater is 60 percent virgin wool and 40 percent nylon. This shirt is the new style. This shipment just arrived. Never use superlatives like nice unless you tell why.
3. Conventional (greeting) approach a. Use simple greeting with a smile b. Do not use "May I help you?" c. Nod to waiting customers.	Simple greeting approaches are more effective than using "Can I help you?" or "May I help you?", which sounds like a broken record. A few examples are: Have you been served? Is someone waiting on you? Be with you in a minute. Sorry you had to wait. Good morning. Good afternoon. Good evening. Ask the class if they get tired of hearing "May I help you?" when they shop.
4. The Right Approach (16mm sound film) a. Advertising and displays invite customers into the store. b. Salesperson must make the customer welcome. c. Try to give your undivided attention to your customer. d. Try to answer customers' questions before they ask. e. You must have knowledge of merchandise before approaching customer. f. Use the merchandise approach. g. Excuse yourself from one customer to recognize	The 16mm sound film, <u>The Right Approach</u> is an old film, but it shows the proper methods of meeting, approaching, and greeting customers.

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTOR
another. h. Encourage customers to handle the merchandise. i. Make an "I'm looking" customer feel at home. j. Suggest for immediate or future purchase. k. Try to find out what customer wants without asking a lot of questions. l. If customer is just looking, make him welcome, but suggest ideas for occasions like birthdays or Christmas.	

UNIT IV

SELECTING THE MERCHANDISE

UNIT IV

SELECTING THE MERCHANDISE

I. Aims and objectives of this unit:

   A. To determine what merchandise should be selected.
   B. To suggest methods that may be used in selecting the right merchandise for the customer.

II. General outline for this unit:

   A. Points to be determined.
   B. Method of determining points.

III. Materials and teaching aids needed for this unit:

   A. Chalkboard
   B. Chalk and eraser
   C. Paper easel
   D. Crayon or marker
   E. Paper and pencils

UNIT IV

SELECTING THE MERCHANDISE

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
IV. Selecting the merchandise A. Determine 1. Size 2. Color 3. Style 4. Occasion 5. Use 6. Material 7. Quality 8. Quantity 9. Make 10. Ingredients 11. Price	Be sure to select the proper merchandise for the customer before you go to the next step of the sale so time and effort will not be wasted too often.
a. highest b. middle c. lowest	If you are working with a company that represents quality merchandise the customer will expect you to bring out the highest-priced first. You can then go down to something less expensive (never use the word cheaper) or inexpensive at the customer's request. Some salespeople like to start at the middle and then they can go down if necessary or trade up if they can. Some salespeople like to bring out all three price ranges and then let the customer decide.
B. Method 1. Observation a. style b. size	

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
c. color d. present interest of customer in display	You can determine the colors customers should wear by the color of their eyes, complexion and hair. If a customer is interested enough to be examining merchandise on display, it shows that he is interested in present or future purchase of it.
2. Hints or statements a. Tell what they want. b. Tell the purpose. c. May mention advertisement or display heard or seen	Customer's hints or statements may give you a lead for suggestive selling later.
3. Questions a. phrasing questions	Do not ask questions such as, "Do you like this?" Put the word "how" in front of it so the answer will not be "no." Some questions may embarrass the customer, such as, "What size do you wear?" or "You want this for evening wear?" or "You don't want a hundred-dollar ring, do you?" In estimating sizes you do so according to article and individual, for example: shoes - underestimate; men's coats - overestimate; large head - underestimate; skinny person - overestimate; fat person - underestimate; waist lines - underestimate. A convenient statement to make when customers are disturbed by a larger size is to say that the sizes run a little smaller in that brand.

UNIT V

PRESENTING THE MERCHANDISE PHYSICALLY

UNIT V

PRESENTING THE MERCHANDISE PHYSICALLY

I. Aims and objectives of this unit:

To show the psychological effect the handling of goods has on customers.

II. Materials and teaching aids needed for this unit:

A. Chalkboard
B. Chalk and eraser
C. Paper easel
D. Crayon or marker
E. Paper and pencils

UNIT V

PRESENTING THE MERCHANDISE PHYSICALLY

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
V. Presenting the merchandise physically	To give merchandise the appearance of value, always present it on a cleared counter. Remember when you display merchandise in a window display, space creates value. You get the same effect on a counter. Presenting the merchandise physically is the physical gestures you make with your body and merchandise when you bring out the merchandise. You may present the goods verbally before you present it physically or you may present the merchandise physically and verbally at the same time.
A. Psychological effect	Remove any uninteresting merchandise.
1. Value	Do not throw the merchandise around or down on the counter. Handle it as if it had value. Feel it or use it. Hold the merchandise for a while before you give it to the customer. Example: Fill a fountain pen, admire it, and write your name with it before making a gesture for the customer to take it and write with it. Take the nylon hose slowly out of the box using both hands, run your hand through one pair and then examine it yourself with a pleasing, self-satisfied smile, then show it to the customer. Take the gun off the rack, feel its weight, put it up to your shoulder and aim with it. Most of the time the customer will reach for it before you offer it to him. This is a hold-over from
2. Delicate	
3. Ownership	

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
4. Refine	babyhood. If you keep something from an individual he will want it more. Run your hand back and forth over a fine piece of furniture and keep feeling its finish while you are talking about it. Pat a used car while you are giving the selling points as if to say, "This is a fine 'baby'."
5. Tough	Drop a lawn mower out of the trunk of a car, before the prospect, when you are taking it out to show that it can take rough treatment. Use rough treatment when demonstrating a drill press.
6. Physical move	If the customer does not reach for the merchandise, move the merchandise toward him or sort of hand it to him so that he will automatically reach for it.

UNIT VI

FOLLOW-UP OF REMEMBERING NAMES

UNIT VI

FOLLOW-UP OF REMEMBERING NAMES

I. Aims and objectives of this unit:

A. To test the ability of students to remember names.
B. To reemphasize the importance of associating names to be remembered.
C. To further develop the method of remembering names.

II. Materials and teaching aids needed for this unit:

A. Chalkboard
B. Chalk and eraser

UNIT VI

FOLLOW-UP OF REMEMBERING NAMES

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTOR
VI. Follow-up of remembering names A. Method B. Evaluation C. Applied practice	Ask for volunteers from the group to stand up and name the three people they met at the last meeting. Ask them how they remembered the names. Ask the group if anyone met anyone outside of the group and how they remembered the name by association.

UNIT VII

PRESENTING THE GOODS VERBALLY

UNIT VII

PRESENTING THE GOODS VERBALLY

I. Aims and objectives of this unit:

A. To give students a source of merchandise information.
B. To encourage the students to have faith in themselves.
C. To inspire enthusiasm.
D. To illustrate how to sell quality merchandise.

II. General outline of this unit:

A. What you say.
B. Source of merchandise information.
C. How you say it.

III. Materials and teaching aids needed for this unit:

A. Chalkboard
B. Chalk and eraser
C. Paper easel
D. Crayon or marker
E. Paper and pencils
F. 16mm projector and screen
G. Film--How To Sell Quality
H. Film--The Power of Enthusiasm

UNIT VII

PRESENTING THE GOODS VERBALLY

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
VII. Presenting the goods verbally	
A. What you say	Refer back to Merchandise Knowledge, Unit II, and relate merchandise information. Never use superlatives such as "nice" in your sales talk unless you tell the reason.
1. Merchandise information	
B. Source of merchandise information	
1. Tags and labels	
2. Manufacturer's literature	
3. Advertisements	
a. your own	
b. your competitor's	
4. Trade publications	
5. Observation of goods	Examine and study merchandise when you are not waiting on customers and learn merchandise information.
6. Buyers	
7. Fellow salespeople	
8. Customers	
a. Testimonials	
9. Your own use	
C. How you say it.	
1. Faith	Have faith in yourself to go up to bat with prospects and know that you will fail sometimes, but, on the other hand sometimes you will make a home run.

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
a. In yourself	
(1) Babe Ruth (a) 851 home runs (b) 1,330 strike-outs	Don't be afraid to fail. Babe Ruth is considered to be one of the best baseball players of all time and was known as the "King of Swat," but if you look at his professional record he was actually the king of strike-outs, striking out more times than any other player in history. (How I Raised Myself from Failure to Success in Selling, Frank Bettger, page 253.)
(2) L.S.U. student	A certain Louisiana State University student was despondent because he had to work his entire way through school and at that time did not rate socially on the campus. Upon being examined by the campus physician he was ordered to the Charity Hospital in New Orleans to have his tonsils removed. During his stay there he was able to see the lowest physical existence of humanity. This student left the hospital, not only with his tonsils removed, but with a mental cure for life since he realized he had two good hands, two good feet, and the ability to climb as far as he cared to in life.
b. In your company	If you do not like the company you are working for, quit. You are not doing them any good and certainly you are not helping yourself.
c. In your product for the customer	In most cases, if you would like to own the merchandise, it is easy to sell. Sometimes you may not like the article but you still have to sell it. As long as you are satisfied that your customer is satisfying his needs and desires for a just price, that is all you have to be

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
	concerned about. A good example of this is modern art.
2. Your speech a. English (1) Depends on customer b. Tone quality c. Distinction	Use correct grammar in all your sales talks, but never let it be above the level of your customer.
3. How to Sell Quality (16mm sound film) a. When you shave price, you shave the quality. b. A quality salesman: (1) arouses desires for quality (2) Creates an atmosphere of quality (3) Breaks down a big price (4) Turns sales objections into sales-talk (5) Look quality, talk quality, believe quality c. Secret of how to sell quality	The 16mm sound film How to Sell Quality can be shown with any of the units, but it must proceed the 16mm film, The Power of Enthusiasm, which is a good audio-visual aid for this unit. How to Sell Quality first shows a milk routeman giving the added advantages of using his milk. Then an insurance salesman shows what the cut-rate policies have taken away. A wholesale salesman shows a retail jeweler how to sell quality silverware by dividing the additional price by the number of years of use. At a town council meeting a manufacturer's representative showed multiple uses for his equipment which actually would be cheaper to the taxpayer.

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
(1) Add the benefits and values. (2) Subtract the things that are taken away when you don't buy quality. (3) Show multiple uses. (4) Divide cost by number of years quality is used.	
d. We must sell quality to meet competition. e. Higher standards than just the ordinary attract buyers. f. Sell quality by comparing its features to those of the cheaper product.	
4. <u>The Power of Enthusiasm</u> (16mm sound film)	The film <u>Power of Enthusiasm</u> first shows a salesman of service whose sales were dropping due to loss of enthusiasm. His supervisor made a few calls with him and analyzed his problem. This salesman had good home relations, was healthy, and had good customer relations, but lacked the necessary knowledge of his service to have enthusiasm.
a. The more convincing your sales talk is the more volume you will turn over. b. Extra knowledge makes your sales talk convincing.	
(1) Extra knowledge allows:	A good many businessmen who have the knowledge and are healthy are prevented from becoming successful because they have problems at home.
(a) quicker answers	

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
(b) convincing sales talk (c) confidence c. Customers prefer to buy from one who knows their product. d. Good salesmen are made, not born. e. Enthusiasm and knowledge are the greatest assets to selling. f. Enthusiasm is knowledge on fire. g. Developers of enthusiasm: (1) good home relations (2) energy (good health) (3) sincerity with customers (good customer relations) (4) knowledge h. Confidence, sincerity, enthusiasm is provided by knowledge.	

UNIT VIII

DEMONSTRATIONS

UNIT VIII

DEMONSTRATIONS

I. Aims and objectives of this unit:

A. To inform students how a salesman should demonstrate his merchandise.
B. To acquaint students with methods that may be used to persuade customers to demonstrate goods to themselves.
C. To encourage salesmen to talk in the positive.
D. To help the students to get their customers to visualize ownership of the merchandise.

II. General outline of this unit:

A. Salesman's demonstration.
B. Customer's demonstration.
C. Making sales convincingly.

III. Materials and teaching aids needed for this unit:

A. Chalkboard
B. Chalk and eraser
C. Paper easel
D. Crayon or marker
E. Paper and pencils
F. 16mm sound projector and screen
G. Film--<u>Presenting Your Sales Case Convincingly</u>

UNIT VIII

DEMONSTRATIONS

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
VIII. Demonstrations	
A. Salesman's demonstration	
1. Point out the construction	Point out the construction of the merchandise with your hand. Use such phrases as these: "Notice the double stitching here," "Look at this reinforcement," "How do you like this finish?"
2. Demonstrate how it works a. How to start and stop b. How to fill (pen) c. How to use (1) What colors they should wear (2) What styles they should wear	When the salesman demonstrates merchandise to a customer he is actually a teacher, and is teaching the customer all he knows about the product.
3. Demonstrate how to care for a. How to clean or launder b. How to oil	If any feature is complicated such as disassembling and cleaning, it may be wise to withhold this until after the sale is closed.

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
4. Any special features	
a. Safety features	
b. New features	
B. Customer's demonstration	The salesperson's demonstration should have been so effective and the teaching so interesting that the customer will want to use superlatives at this time.
1. Use of five senses	Get customer to use one or more of the five senses.
a. Touch	Get customer to handle and feel merchandise or try it on.
b. Taste	Get the customer to taste a sample.
c. Smell	Get the customer to smell merchandise such as cosmetics or leather goods.
d. Hearing	Get the customer to listen to the radio, timepiece or motor.
e. Sight	Get the customer to examine the merchandise.
2. Affirmative suggestions	Make only affirmative suggestions to accomplish the above. Example: "You can try it on here; step this way." (affirmative) "You don't want to try it on, do you?" (negative)
3. Visualizing product in use	
a. Swimsuit	Get the customer to picture himself using the merchandise after he has bought it. Make statements like this: "You are going to look good skiing in this suit this weekend."
b. Car	You are going to have a carefree vacation with this car.
c. New dress	Are you going to be able to wear the new dress this weekend?

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
d. Camera e. Air conditioner	You are going to be able to get a full eight hours of sleep when you have to work the night shift after we install this unit in your bedroom. You will be shutting your door and you won't be able to hear the children in the rest of the house. Get each salesman in the class to make one on their own merchandise.
4. Do not talk too much	If a salesman keeps on talking, he will not give the customer time to visualize ownership of the product.
5. Indicators of a decision a. Face (1) eyes (2) mouth (3) expression of interest (4) A frown of disapproval	Watch for indicators of a decision to buy. It may come at this time or sooner in your sales talk. Some easily distinguishable indicators of a decision to buy are a look of acceptance in the eye, a smile of approval, a facial expression of interest, or by the way the customer feels the merchandise or handles it. Certainly a frown of disapproval will tell you that the customer has not been sold. If he shakes his head or puts the merchandise down you may have to go back and select some other item and start over.
b. Positive action (1) interested (a) nodding his head (b) handling the merchandise (c) feeling the merchandise	

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
(2) disinterested (a) shaking his head (b) putting the merchandise down	
c. Indirect agreement	At this time a customer will make a statement such as, "I wonder if this tie would go with a grey suit." This indirect agreement tells you that he wants the tie, but is not quite sure of the color.
d. Certain types of objections	Certain types of objections such as fading, shrinking, or cost of operation will tell the salesman that the customer wants to make the purchase. Example: "I believe this is a good air conditioning unit, but I am afraid it would increase my electric bill too much." The salesman should answer this objection by saying, "Yes, you are running an attic fan now and after you install this unit in your home you will have a smaller fan running in this unit and you will also have a compressor that runs part of the time. I don't know how much it costs you to run your attic fan, but here are the figures compiled by Gulf States Utilities for the four summer months under average conditions for 1,000 square feet." If these types of objections are answered satisfactorily, buying action will occur.

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
C. Presenting your Sales Case Convincingly 1. Come to court with witnesses. a. Witnesses are vital to the presentation of a case convincingly. b. Support your statements with witnesses. (testimonials) 2. Qualify your witnesses a. Qualify your witnesses before you present his testimony. b. Good for winning confidence of your customers. Convince your customers of your product before you begin your testimony or sales talk. This is presenting the goods verbally. 3. Make tests testify a. You move your prospect from the judge's stand to the witness stand. b. "You are my witness." c. You must effectively convert	In selling, the customer is the judge and jury. The 16mm sound film <u>Presenting Your Sales Case Convincingly</u> presents the sales case to a customer like a trial lawyer presents his case to a judge and jury. Tell the group that you know that each and everyone of them has his own particular sales presentation, but ask them if they are satisfied with the amount of sales they make compared to the amount of work they put into it. Let's see if we present our sales case like a trial lawyer does to get results.

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
your customer from a judge of the product to a witness to its quality Use of subjective and objective demonstration.	
4. Show externally the fire of internal belief.	
a. Show enthusiasm.	
b. A salesman weakens his chances when he displays mousiness.	
c. To be believable, believe.	
d. Explanation of how to present goods verbally.	
e. Showing your determination and belief in your product during your sales talk convinces your customer.	
f. To convince, be convinced; to make believe, you believe.	
5. Use only strong lengths in your chain of testimony.	
a. A chain is only as strong as its weakest link.	
b. Do not exaggerate.	

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
Beware of little exaggerations. c. Understate and overprove. d. Tell only the strongest points in your salestalk. e. Do not slip in a weak point. f. One weak statement can destroy all the strong statements you have already made.	

UNIT IX

APPROPRIATE SELLING TECHNIQUE

UNIT IX

APPROPRIATE SELLING TECHNIQUE

I. Aims and objectives of this unit:

A. To show the methods of closing sales.
B. To become aware of common objections.
C. To train the students how to distinguish between excuses and real objections.
D. To develop technique in meeting objections.

II. General outline of this unit:

A. Trial close.
B. Objections.
C. Serving according to type of customer.

III. Materials and teaching aids needed for this unit:

A. Chalkboard
B. Chalk and eraser
C. Paper easel
D. Crayon and marker
E. Paper and pencils
F. 16mm sound projector and screen
G. Film--Overcoming Objections

UNIT IX

APPROPRIATE SELLING TECHNIQUE

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
IX. Appropriate Selling Technique	In the preceding unit the customers tried the merchandise themselves. During this time the salesperson observed the customers for indicators of a decision to buy. When this indicator is recognized, moves to close the sale should be immediately taken. This is the psychological moment to close the sale.
A. Trial close	
1. Verbal move	Some typical verbal moves to close the sale are:
a. Wear it	Do you want to wear it or do you want me to wrap it?
b. Wrap it	
c. Charge - cash	Do you want to charge this or pay cash?
d. Gift wrap	Do you want this gift wrapped?
e. Deliver	Do you want this delivered tomorrow?
f. Pick-up	When do you want to pick this up?
g. Lay-a-way	Do you want this put on lay-a-way?
h. How financed	How do you want it financed?
i. Trading up	You want three pairs for $3.69, don't you? (trade up)
2. Physical moves	
a. Reaching	
(1) Charge pad (2) Sales slip (3) Wrapping paper	Reaching for a charge pad or sales slip is a good physical move to close a sale. Others are: reaching for wrapping paper or bag, reaching for a pencil and putting date on sales ticket, or walking toward the cash register. (positive) Some salespeople suggest additional merchandise to go with the article as a means of closing the sale.

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
b. Writing date c. Walking toward register d. Suggesting additional merchandise	
3. Physical and verbal moves	Physical and verbal moves should be developed by each salesman and are often made at the same time. A high school distributive education student's move to close his sale of men's suits is typical: After covering the necessary steps of the sale he would get the customer to try on the pants and then he would start marking the length with chalk in front of the mirror. During this process he would look up at his customer and say that it would take three days for altering. Most customers immediately respond that they need the pants sooner, which this salesman was obliged to carry out.
B. Objections	
1. Types of sales resistance	Sales resistance that comes early in the selling process comes in the form of excuses to prevent the salesperson from interesting the customer in the merchandise.
a. Excuses	
(1) To stop the salesperson	These should not be considered real objections. Some of these are: "I haven't time to look at it now." "I don't think I'm interested." "I'm well supplied now."
(2) To put off a decision	Other excuses that arise in sales but after some of the selling points are given are caused by lack of interest or some hidden objection. They usually appear as follows: "I must talk it over with someone else" or "I will be back later."
b. Real objections	When a customer objects to the need of merchandise the salesperson

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
	should make no further attempt to sell. If this is not true the salesperson should bring out points that will make the customer see what it will actually mean to do without the merchandise.
c. Price	
(1) Specific	A customer may have a specific objection such as "I can't afford it" or "The price is too high." The best way to meet these objections is to establish values in the customer's mind.
(2) Comparative	A customer may make a comparative price objection relative to a cheaper article in the store or a similar article carried by another store. Salespeople must be able to explain the difference in value. It may be wise to ask the customer about the value of competing merchandise such as: How many coats of varnish does that table have? This one has three. (Store Salesmanship, Brisco-Griffith-Robinson, pp. 66-85.)
d. Particular feature	A customer may object to a particular feature of the merchandise such as size, weight, or style. These objections must be met by one of the following methods:
2. Meeting objections	
a. Indirect denial method	Indirect denial or "Yes, but..." method. Agree with the customer and then tell how he is wrong. Examples: "Yes, this coat is expensive, but it has room to be let out, and it can be worn for two years." "Yes, this is high, but look what you get for your money."

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
b. Reverse English method	In using the reverse English method of meeting objections you turn the objection into a selling point. Examples: "This raincoat is too light." "That's an advantage, you can carry it in your purse." "I like the house, but I don't like the ditch in the back yard." "Yes, but the water from your property will drain into it and you will never have any complaints from neighbors about your water draining on their property."
c. Reverse position method	Ask the customer to explain the objections. Lessen the objections by listening and he might overcome the objection.
d. Superior point method	Admit the objection, then point out all the other good features that will offset the objection.
e. Question method	Convert the objection into a question which when answered will overcome the objection. Examples: "What you want to know is if you can make a profit if you stock our merchandise." "Your price is too high. I can buy shoes cheaper." "I notice you are wearing an 'X' suit. Are you satisfied with it?" "Yes." "Why don't you try one of our $22.50 suits?" "I wouldn't feel right in a cheap suit." "That's the same in shoes, and besides in the long run these are cheaper."
f. Direct denial	"This will fade." "Absolutely not; this material has been vat-dyed and has been tested thoroughly, and I assure you it is color-fast."
g. Use of testimonials	Make use of a neutral third party by telling your customer how this party uses the product.

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
h. Keep your temper down.	Don't let customer's objections rile you into losing a sale. Keep your temper on ice.
i. Recognize the objection as a stall.	When customers stall, it shows that their desire is too low. Give selling points and demonstrate features.
j. Anticipate objections.	As you accumulate experience in selling a product, you will find some objections are common. Overcome these these objections before they are made. (Store Salesmanship, Brisco-Griffith-Robinson, pp. 66-85.)
3. Overcoming Objections 16 mm sound film	
a. Lessen the objection by listening (1) Let customer get off his mind what he has on it. (2) Do not interrupt. (3) Do not talk too much (4) Let the customer talk. (5) Soften an objection by hearing it out.	
b. Convert the objection into a question (1) An objection inviting an argument should become a	An appliance salesman converted the objection into a question.

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
question inviting an answer. Use subjective demonstration. (2) Answer. Do not argue.	
c. Soften the bump with testimonials. (1) Use a cushion of other people. (2) Transfer the burden of disagreement. (3) Your customer's pride is sacred. (4) He is not having his objection overruled by you.	An ice cream salesman and a machinery salesman used a neutral third party to cushion objections.
d. Keep your temper on ice. (1) Show no suggestion of temper. (2) The quickest way to cook your own goose is to lose your temper. (3) Do not let your face show your thoughts (4) Keep cool.	A laundry salesman had to hold his temper in order to keep from losing a sale.
e. Recognize the objection that is only a stall	A tobacco salesman had to recognize the objection was only a stall wearing whiskers.

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
wearing whiskers. (1) Recognize the real face behind the whiskers. (2) Build up buying benefits. (3) Low desire masquerades as high price. (4) Back of those false whiskers is a customer whose desire for your product is not high enough.	
f. Use today's objections as a sharpener to make tomorrow's sales talk sharper. (1) Plan your sales talk so that questions are answered before they are asked.	All salesmen have to keep improving their sales talks and demonstrations to keep objections from arising.
C. Serving according to type of customer 1. "I'm just looking" customer	An "I'm just looking" customer is one of the easiest customers to sell to. She is one that wishes to look around, and may not wish to buy at once, and does not want salespeople tagging along. Welcome them into the store by saying, "Make yourself at home. I'll be right over here. If I can help you, let me know." They may not wish to buy at the present time. Step away from

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
	them and make believe you are arranging stock and watch them through the corner of your eye. When they raise their head, they are ready to buy or they need help. If you follow them you will follow them to the door. Serve other customers, if any.
2. Wavering customers	They cannot make up their minds which article to buy. They are undecided. Remove all uninteresting merchandise and narrow the goods down to two or three items. Give the selling points of only one. Then move to close the sale by saying, "You can take this one home and if you would rather have the other, you can exchange it."
3. Bargain hunter	One who wants a very good product or service but does not want to pay the price for it. Give merchandise information showing the customer what she gets for her money and also point out what the cheaper product does not have.
4. Wise customer	Easy customer to serve. May be either truly wise or falsely wise. One who knows or thinks he knows more about the merchandise than the salesman does. Bring out the merchandise for them to inspect. Let them talk themselves into a sale.
5. Silent customer	One who doesn't say anything. This type of customer does a lot of thinking and listening. Give one point at a time and ask questions which cannot be answered with yes or no.
6. The snob customer	Treats the salesperson as if he is an inferior person. She treats a salesperson as though she owns him. Follow out her orders, but be polite and show her that you have pride. Stay composed. Give her as much merchandise facts as possible so that she will know that you are well informed and educated.

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
7. Suspicious customer	This customer is distrustful of all that the salesperson says. Serve her by demonstrating and have the customer explain the merchandise. Ask questions that will lead her to talk about the merchandise, but do not give your opinions.
8. The different customer	One who takes the opposite point of view. This customer has reasons for doubting the salesperson. Let customer discover qualities herself and answer questions with facts.
9. Argumentive customer	A customer who will continually argue with you. Give in gracefully and do not argue back. This type of customer will add to your information.
10. Those who delay	A customer who has fear of her own judgment; she has little money to spend. Serve her by showing economical, durable, but rich looking merchandise.
11. Stubborn customer	Insists on certain types or brands of merchandise. Substitute if you can, but do not continue to show substitutes. If you do not have that brand or type of merchandise, try to order it. If you cannot order the merchandise, refer customer to place where she can purchase it. Telephone if you have time.
12. Cautious customer	One who asks many questions before buying. Answer questions with facts and demonstrate. Show only solid, durable, and thoroughly useful merchandise.
13. Conceited customer	One who is always using "I," "My," or "Mine." Serve them by using "you" and "yours" in your sales talk.
14. Nervous customers	They are impatient and cannot stand delay. Recognize them if you are waiting on another customer. Hurry yourself and act a little nervous, but stay controlled.

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
15. Slow customers	Do not want to be rushed. Show them only a small amount of merchandise. Excuse yourself tactfully to wait on another customer.
16. Shy customer	Generally a man buying a present for a woman. Estimate sizes for this customer by observation of other customers or salespeople. Give suggestions and mention exchange if it is allowed by the store.
17. Dignified elderly customer	One who has finished his responsibilities of life. Be polite and respectful and bring out the best merchandise for him to inspect. Do not try to tell him anything about merchandise unless asked.
18. Foreign customer	Anyone who is out of his regular environment. This is the only customer that you use superlatives on. You can give a little opinion.
19. Child customer	They have not yet reached the age of maturity. They are the future buyers. Sell them nothing that you would not sell their parents. They will bring their parents to the store.
20. Talkative customer	One who thinks salespeople have time to listen. Listen if you have time, but excuse yourself to serve a waiting customer. Try to sell him something and he will leave.
21. Ill-informed customer	Generally buying for someone else. Get permission to call the actual customer.
22. Comparative buyer	One who compares all prices with other stores. Give merchandise information and ask the customer to check your competitor's merchandise to see if it has certain features. Then make another move to close the sale.
23. Exchange customer	Refund or correct size or exchange for other merchandise.

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
	The cause of exchange is that the salesperson did not select the right merchandise or did not thoroughly sell the merchandise to start with or it was defective merchandise.
24. Rude customer	A customer who is obnoxious about your asking questions (disagreeable). Explain to the customer the necessity of obtaining information. A soft answer turns away wrath. Keep your temper on ice.
25. Race, creed, or color	At one time there were religious prejudices. Today in Texas there are the Mexicans; in California, the Chinese; in New York, the Porto Ricans; and in the North and South the Negroes, with racial and color prejudices on both sides. A salesman's individual prejudices should not cause a business to lose sales that are bought and paid for by advertising and good will. He may avoid using "Yes, sir," or "No, sir" if he wishes by being tactful and using other words such as "I don't know," or "I will check and see." Remember all customers should be treated courteously because they are the property of the store and not the salesman's personal possession.

UNIT X

SUMMARIZE THE BUILD-UP

UNIT X

SUMMARIZE THE BUILD-UP

I. Aims and objectives of this unit:

A. To teach students when to summarize.
B. To determine when to substitute another product.
C. To help the salesman realize the importance of summarizing before attempting another move to close the sale.
D. To help the salesman retain his customer tactfully so that he may have more time to create a desire for the merchandise.

II. Materials and teaching aids needed for this unit:

A. Paper easel
B. Crayon or marker
C. Paper and pencils

UNIT X

SUMMARIZE THE BUILD-UP

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
X. Summarize the build-up A. When 1. Not sold 2. Put off B. How	In the appropriate selling technique we discussed trial moves to close sales. When this move to close the sale does not work and the salesman is sure he has selected the right merchandise, the customer may not be completely sold or may just be trying to put off the sale. The salesman should go over the high points of the sale and then make another move to close the sale. On large money items such as insurance, real estate, cars, appliances, and some expensive clothing the salesman may have to summarize several times. If at any time the salesman realizes that he has selected the wrong merchandise for the customer, he should start over.

UNIT XI

SUGGESTIVE SELLING

UNIT XI

SUGGESTIVE SELLING

I. Aims and objectives of this unit:

A. To further develop a salesman's method of increasing sales.
B. To stress the importance of suggestive selling.
C. To check the students' method of suggestive selling.
D. To teach the students various ways of suggestive selling.

II. General outline of this unit:

A. Related or tie-in sale
B. Unrelated
   1. Necessity items
   2. Specialty items
   3. Trading up
   4. Gifts
   5. Future sales
   6. Other departments
   7. Hints
   8. Affirmative suggestions
   9. Negative suggestions

III. Materials and teaching aids needed for this unit:

A. Chalkboard
B. Chalk and eraser
C. Paper easel
D. Crayon or marker
E. Paper and pencils

UNIT XI

SUGGESTIVE SELLING

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
XI. Suggestive Selling	
A. Related or tie-in sale	After the customer agrees to purchase an article, the salesman should suggest a related item to tie-in to the original sale. Some examples of these are: shirt-tie, hat-shoes or purse, shoes-socks or polish, gun-shells, television set-service policy.
B. Unrelated	
1. Necessity items	There are many necessity items that may be suggested. Salesmen should examine their merchandise to realize the items they carry that may be considered necessities in everyday life. Here are a few: department store-handkerchiefs or women's hose; filling station-oil, or tires; drug store-toothpaste, aspirins or razor blades; grocery store-bread, coffee, or sugar; record shop-needles.
2. Specialty items a. On sale b. New stock c. New fashion d. Currently advertised	Some of the items that are stocked may be special in nature. They may be reduced, new stock, new fashion or advertised in a current magazine or newspaper.
3. Trading up a. More than one b. Higher-priced	An easy way to increase sales is to trade up. Suggest more than one article, such as three pairs of hose at a certain price, or suggest a greater amount, such as ten pounds of sugar instead of five. Another method of trading up is to suggest to the customer to buy the higher-priced article.

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
4. Gifts a. Christmas b. Wedding c. Graduation d. Mother's Day e. Father's Day	Suggesting for gift purchases is very appropriate for certain days or seasons. Leading statements or questions may be made or asked, such as, "Have you finished your Christmas shopping?" "Do you have to buy any wedding presents or graduation presents this year?" "Father's Day is next week. Let me show you an ideal gift."
5. Future sales	Suggest for future sales by asking customers if they would like you to call them when new merchandise comes in or ask them if they would like to open a charge account if they do not have one.
6. Other departments	Suggest that the customer visit other departments or fellow employees before leaving the store. Example: "Have you been in the household department? They have a special on towels today."
7. Hints	Continually listen for hints customers may make. They may be in the market for a gift for a certain occasion.
a. Gifts	
b. Going to a beach	The customer may mention going to a beach; a suggestion of a beach ball, towel, or crab nets would be in order in some stores.
c. Daughter going to a party	Occasionally a hint will allow you to mention a suggestion for a member of the family.
d. Vacation	Quick-drying lingerie, tires, suitcases, or sporting goods would be ideal suggestions for someone going on vacation.
8. Affirmative suggestions	Always suggest in the affirmative and in a helpful way. Examples: "Let me show you something that I know you will enjoy for everyday use." "You want three pair for $3.95, don't you?"

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
	"Do you have an extra fishing line in your tackle box? You will need one if you find yours rotten on your fishing trip." "I think you would prefer the (not 'our') $369.00 unit. You won't be running your compressor twenty-four hours a day." (Customer buys some records.) "Here is a Victor needle; you will enjoy playing your records with it. It will not only bring out the tone quality, but you will play one thousand records with it before needing a replacement."
9. Negative suggestions	Always talk in the positive; never use negative suggestions. Examples of negative suggestions: "You don't want anything else, do you?" "You don't want to try it on, do you?" "You don't want anything for evening wear, do you?" "You don't want a $369.00 unit, do you?"

UNIT XII

ROUTINE DETAILS

UNIT XII

ROUTINE DETAILS

I. Aims and objectives of this unit:

A. To show the students the importance of routine details.
B. To suggest ways in which mistakes may be avoided.
C. To remind the group of some of the routine details that are part of the salesman's job.

II. Materials and teaching aids needed for this unit:

A. Chalkboard
B. Chalk and eraser
C. Paper easel
D. Crayon or marker
E. Paper and pencils

UNIT XII

ROUTINE DETAILS

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
XII. Routine Details A. Charging B. Wrapping C. Making change D. Lay-a-way E. Delivery F. Restocking G. Displays	On every job there are details that have to be performed although the employee may not care to do it. Salesmen are required to fill out charge slips, wrap packages, make change, fill out lay-a-way forms, prepare merchandise for delivery, restock and straighten up the display after the sale is made. A good many customers are lost due to laxity on the part of a salesman in performing these duties. Mistakes are made by not writing names and addresses in a legible handwriting. Shortages sometimes occur through faulty method of making change. Sometimes salesmen fail to inform customers of the terms of lay-a-way or charging, or to specify when merchandise may be delivered. NOTE: Curriculum guides are available on cashiering, credit and collections, and gift wrapping from Distributive Education Section, Louisiana State Department of Education.

UNIT XIII

FOLLOW-UP OF THE SALE

UNIT XIII

FOLLOW-UP OF THE SALE

I. Aims and objectives of this unit:

   A. To introduce the students to the technique of follow-up so they will increase their clientele.
   B. To increase the students' prospects by follow-up.
   C. To show the student how to follow up a sale.

II. Materials and teaching aids needed for this unit:

   A. Chalkboard
   B. Chalk and eraser
   C. Paper easel
   D. Crayon or marker
   E. Paper and pencils

UNIT XIII

FOLLOW-UP OF THE SALE

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
XIII. Follow-up of the Sale	Call customers on telephone or go and visit them when you are not busy to see how they are getting along with the merchandise you sold them. Ask them if they have any neighbors or friends to whom they would like to recommend that product. Suggest additional merchandise you have available. Follow up on (future sales of suggestive selling) names to call on merchandise when it comes in.

UNIT XIV

TELEPHONE SELLING

UNIT XIV

TELEPHONE SELLING

I. Aims and objectives of this unit:

   A. To teach the group the proper method of taking incoming calls and making outgoing calls.
   B. To show how customers are lost by bad telephone habits.

II. General outline of this unit:

   A. Incoming calls.
   B. Outgoing calls.

III. Materials and teaching aids needed for this unit:

   A. Chalboard
   B. Chalk and eraser
   C. Paper easel
   D. Crayon or marker
   E. Paper and pencils
   F. 16 mm projector and screen
   G. The film--A Manner of Speaking

UNIT XIV

TELEPHONE SELLING

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
XIV. Telephone Selling A. Incoming calls 1. Answer promptly. 2. Identify your department. 3. Identify yourself. 4. Speak directly into transmitter 5. Speak clearly. a. Do not chew gum. b. Do not put a pencil, pipe, or cigarette in your mouth. 6. Keep pad and pencil handy. 7. Don't say "who's calling?" 8. Call back if necessary. B. Outgoing calls 1. Place your own calls. 2. Identify yourself. 3. Request department or individual needed. 4. List frequently used numbers.	Telephone calls take precedence over visiting customers because the telephone customer cannot see that you are busy. A salesman should excuse himself from a customer only to answer the call and then get permission to call back if necessary.
C. A Manner of Speaking 16 mm sound film 1. Excuse yourself when too busy to	The 16 mm sound film, A Manner of Speaking, shows a manager of an advertising agency how his salespeople treated his customers over the phone. He happened to call

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
answer phone. 2. Answer promptly. 3. Identify yourself. 4. Transfer calls properly. 5. Keep pad and pencil handy. 6. Leave a message when you leave your telephone. 7. Place and receive your own calls. 8. List frequently used numbers. 9. Do not say "Who's calling?" Ask instead, "May I tell him who's calling?" 10. If you have to leave the line, explain why. a. Ask if you should call back. 11. Terminate calls courteously. 12. Telephone as you would be telephoned to.	in one rainy day and was not recognized by his staff. He was trying to postpone a meeting with one of his clients, but due to bad telephone habits on the part of the company the meeting was not canceled which resulted in the loss of this client. A representative of the telephone company was called in and a complete analysis was made of telephone selling.

UNIT XV

CONCLUSION

UNIT XV

CONCLUSION

I. Aims and objectives of this unit:

   A. To reemphasize the use of the twelve steps of the building-up process.
   B. To illustrate the channels of distribution.
   C. To show the students how important their jobs are in the American economy.
   D. To award the certificates.

II. General outline of this unit:

   A. Summary of the building-up process.
   B. The American Economy.
   C. Reference material.
   D. Certificates.

III. Materials and teaching aids needed for this unit:

   A. Chalkboard
   B. Chalk and eraser
   C. Paper easel
   D. Crayon or marker
   E. Paper and pencils
   F. Certificates

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
XV. Conclusion A. Summarize the twelve steps of the building-up process. 1. Pre-approach. 2. Meeting the customer. 3. Selecting the merchandise. 4. Presenting the merchandise physically. 5. Presenting the goods verbally. 6. Salesman's demonstrations. 7. Customer's demonstrations. 8. Applying selling technique. 9. Summarizing the build-up. 10. Suggestive selling. 11. Routine details. 12. Follow-up of the sale. B. The American Economy 1. Channels of distribution a. Producer-manufacturer b. Jobber-wholesaler c. Retailer d. Consumer	Did you ever stop to think about the part we play in the American economy? What will happen to the economy if the salesman in retailing or the jobber in wholesaling slacks up on his job? The salesmen are the spokes of the wheel of progress. He gains the attention of the customer, arouses the interest, creates the desire and produces buying action. As a result of millions of salesmen's efforts throughout the nation and in foreign countries, we can produce goods by mass production and even automation and enjoy the highest standard of living known to man. (Retailing Principles and Practice, G. Henry Richert, pp. 47-67)

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
C. Reference material	Get the local library to mimeograph available books on salesmanship and pass them out to the group.
D. Awarding certificates	It may be appropriate to turn this job over to the Adult Sales Clinic's promoting agency.

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_____ Vocational-Technical School

Louisiana State Department of Education
Distributive Education Section

_____ Chamber of Commerce
Retail Council

Sales Clinic Evaluation

Your name _____

Your Employer _____

Job Classification _____
(Salesman, etc.)

1. What did you like best about the Sales Clinic?

2. What part do you feel should be eliminated?

3. What should be added, if anything?

4. Would you recommend it to your fellow employees?

5. Other Remarks:

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STUDENT'S INSTRUCTIONAL HANDBOOK IN TYPEWRITING

FOR

GREGG TYPEWRITING FOR COLLEGES, SECOND EDITION

LLOYD, ROWE, WINGER

VT 02252

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U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

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GENERAL INFORMATION

The following sheets, some of which are yellow, will give you various information which you will need throughout your typewriting course. The job sheets will frequently refer to items within these pages. To become even more proficient in your knowledge of the typewriter and its use, it is a good idea to review all of this material from time to time.

The Supplementary Materials referred to in the job sheets are the green pages in the back of the book.

ORGANIZATION OF MATERIALS

Whether you are an advanced student or a beginner, there are certain preparations you should make before you begin to type. The condition of your work area tells a lot about what kind of office worker you will make.

The frame of your typewriter should be even with the front of the table or desk. The cover should be folded neatly and put either in a drawer or any other designated place. Your book should be at your right in good reading position slightly tilted. Sufficient paper should be at the left of the machine, arranged so that it will not blow or fall off your desk. Erasers, carbon paper, and onion skin paper should be handy if you are going to use them.

Check the posture chart posted on your bulletin board or the technique check list on pages iv and v for correct sitting position at the typewriter.

CARE OF THE MACHINE

So that you can produce the best possible work, your typewriter must be properly cared for. Daily, you should brush the printing faces of the typebars with a stiff-bristled brush. With a long-handled, soft-bristled brush, dust inside the machine paying particular attention to the basket where erasure dust may have fallen. Wipe your entire desk and under the machine. It is not necessary to lift the machine--simply tilt it back slightly and dust under it. Be sure your machine is covered when not in use.

Your instructor will tell you if you should clean the typewriter with "Mr. Scat" or another chemical solution made for this purpose. If so, apply the solution generously to the face of the typebars with the applicator provided. Brush briskly over the typebars. Insert a sheet of paper and strike each key until there is no excess fluid remaining on them. If the "o's," "b's," or any other circular letters are still clogged, repeat the process. Some typewriter manufacturers recommend the use of a plastic type cleaner rather than a liquid. Ask your instructor to tell you which kind to use.

TECHNIQUES TO BE CHECKED

1. Arms--almost motionless; very steady
2. Back--straight, leaning forward slightly
3. Bell--consciously listened for
4. Bell--margin stop is set to use its warning
5. Bell--reaction to it is quick, without looking up
6. Body--centered on the letter J
7. Body--leans forward from the waist
8. Body--faces the machine and table squarely
9. Body--is positioned well back in the chair
10. Carriage return--a toss, not a throw or drag
11. Carriage return--hand gets "home" instantly
12. Carriage return--made without looking up
13. Continuity--no dawdling between tasks
14. Continuity--no dawdling while typing
15. Copy--placed at the right of the machine
16. Copy--slopes, is on easel or prop; not flat
17. Effort--constant, purposeful, sincere
18. Elbows--relaxed; hanging loose, but close to body
19. Eyes--remain constantly on the copy
20. Feet--both squarely on floor
21. Fingers--the A- and ;-fingers are firm anchors
22. Fingers--are kept curved, are never straight
23. Fingers--spread when you reach for margin release
24. Hands--bounce a little, but not much
25. Hands--close together (you could lock thumbs)
26. Hands--flat across the backs

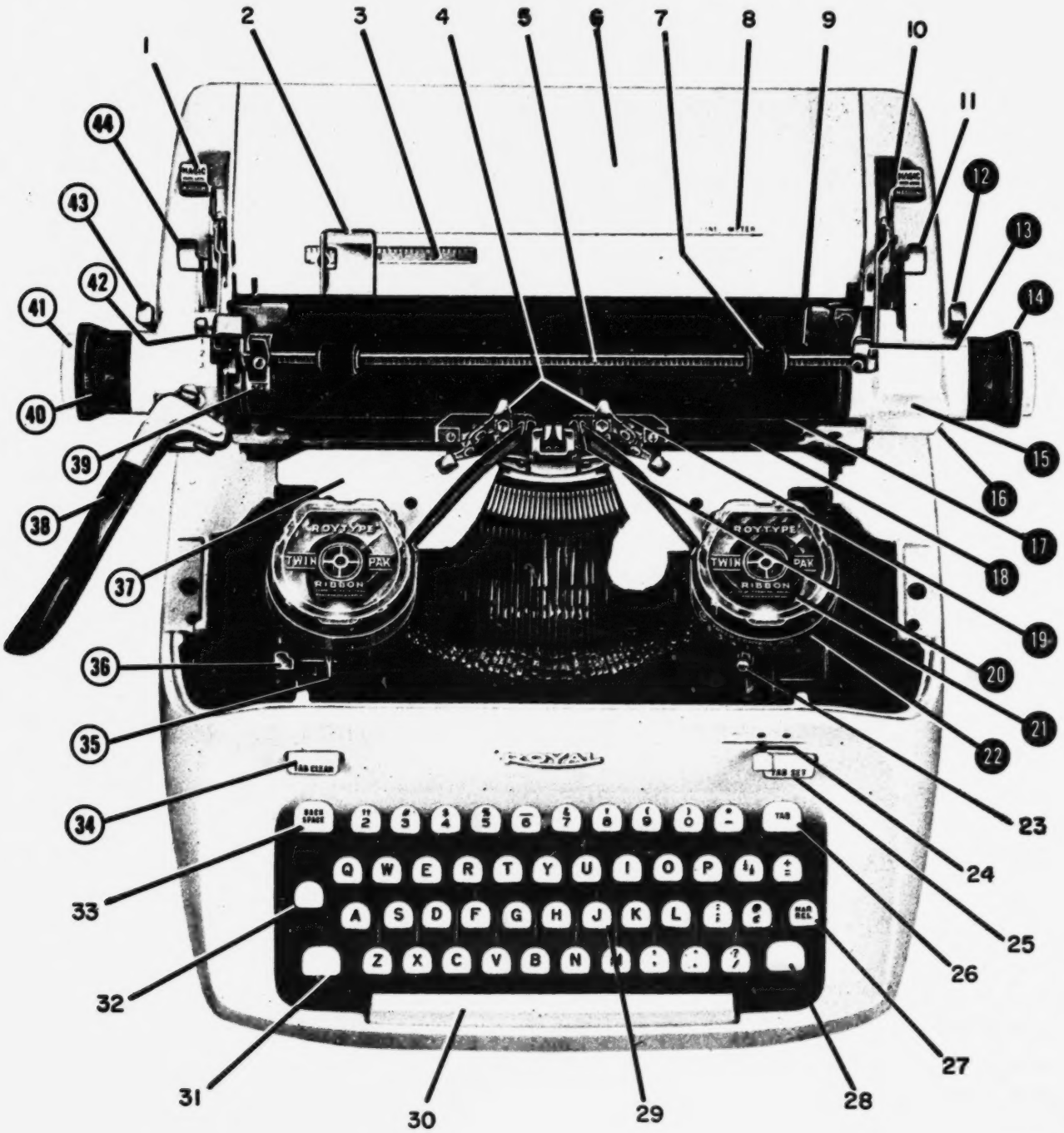
TECHNIQUES TO BE CHECKED (continued)

27. Hands--base of hand does not touch the machine
28. Head--is erect, turned to face the copy
29. Margin release--used without fumbling or looking
30. Margin sets--used quickly, efficiently
31. Margin stops--reset, not recalculated*
32. Nails--trimmed short, are kept unbroken
33. Neck--straight, not bent or craned
34. Paper--insertion is correct, quick, efficient
35. Paper--straightening is quick, automatic
36. Paper--paper release is used
37. Poise--no exclamations, paper yanking, frowns
38. Rhythm--you show obvious effort for steadiness
39. Shift lock--used without fumbling or looking up
40. Shifting--the F- and J-fingers "stay at home"
41. Shoulders--are up and back, but are relaxed
42. Stroking--clean-cut, firm, brisk, decisive
43. Stroking--steady, unhesitant, continuous
44. Stroking space bar--use a "bounce-off" stroke
45. Tabulator--stops set and cleared efficiently
46. Tabulator--used without fumbling or looking up
47. Thumb left--kept close to left forefinger
48. Thumb, right--hovers ½ inch above the space bar
49. Thumb, right--hovers over center of space bar
50. Wrists--kept level, with no arch and no dip

---

* Example: To change from 50 to 60 spaces, move each stop out 5 spaces; don't recalculate the settings.

Royal Standard



1	"Magic" Margin (left)	26	Tabulator
2	Paper Guide	27	Margin Release
3	Paper Guide Scale	28	Right Shift
4	Disappearing Card Fingers	29	Finger-Flow Keys
5	Paper Lock Scale	30	Speed Spacer
6	Paper Table	31	Left Shift
9	Removable Cylinder	32	Shift Lock
10	"Magic" Margin (right)	33	Back Space
11	Paper Release Lever	34	Tab Clear
12	Right Carriage Release	35	Ribbon Reverse
14	Right Cylinder Knob	41	Variable Line Spacer
18	Printing Point Scale	42	Line Space Selector
24	Ribbon Color and Stencil Control	43	Left Carriage Release
25	Tab Set	44	Line Finder

Courtesy of Royal Typewriter Company, Inc.

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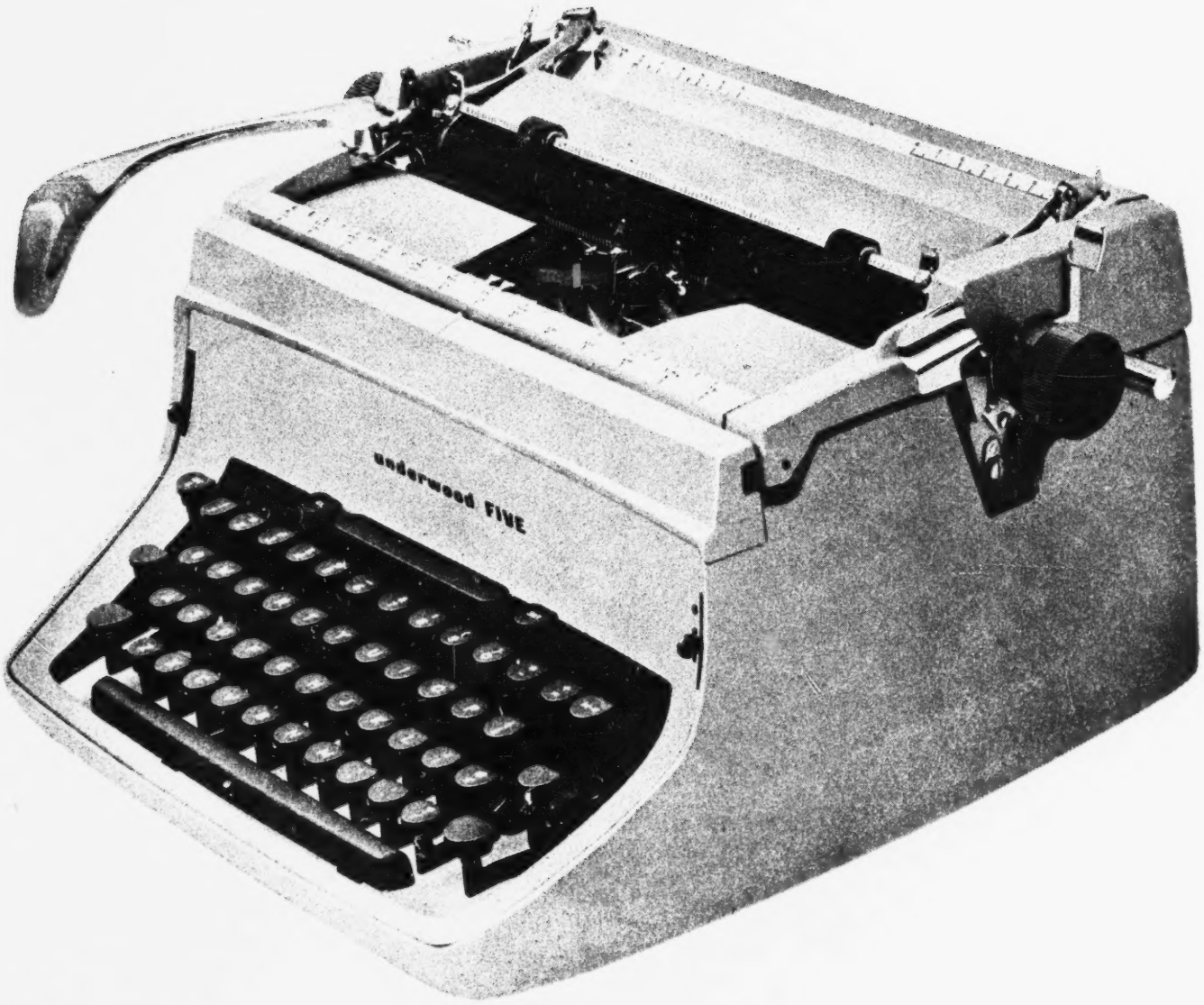
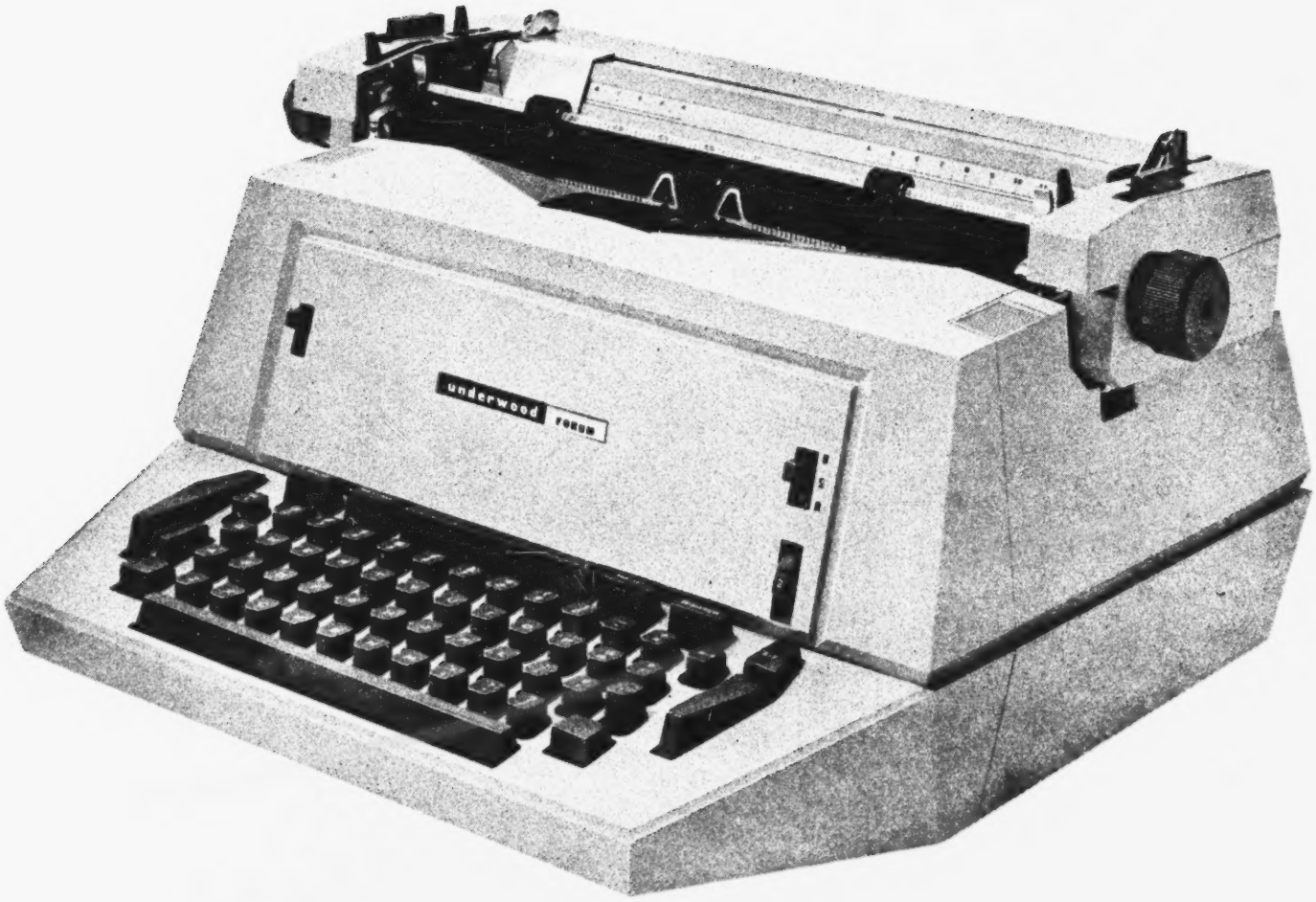
Underwood Standard



Courtesy of Olivetti Underwood Corporation

Underwood Electric

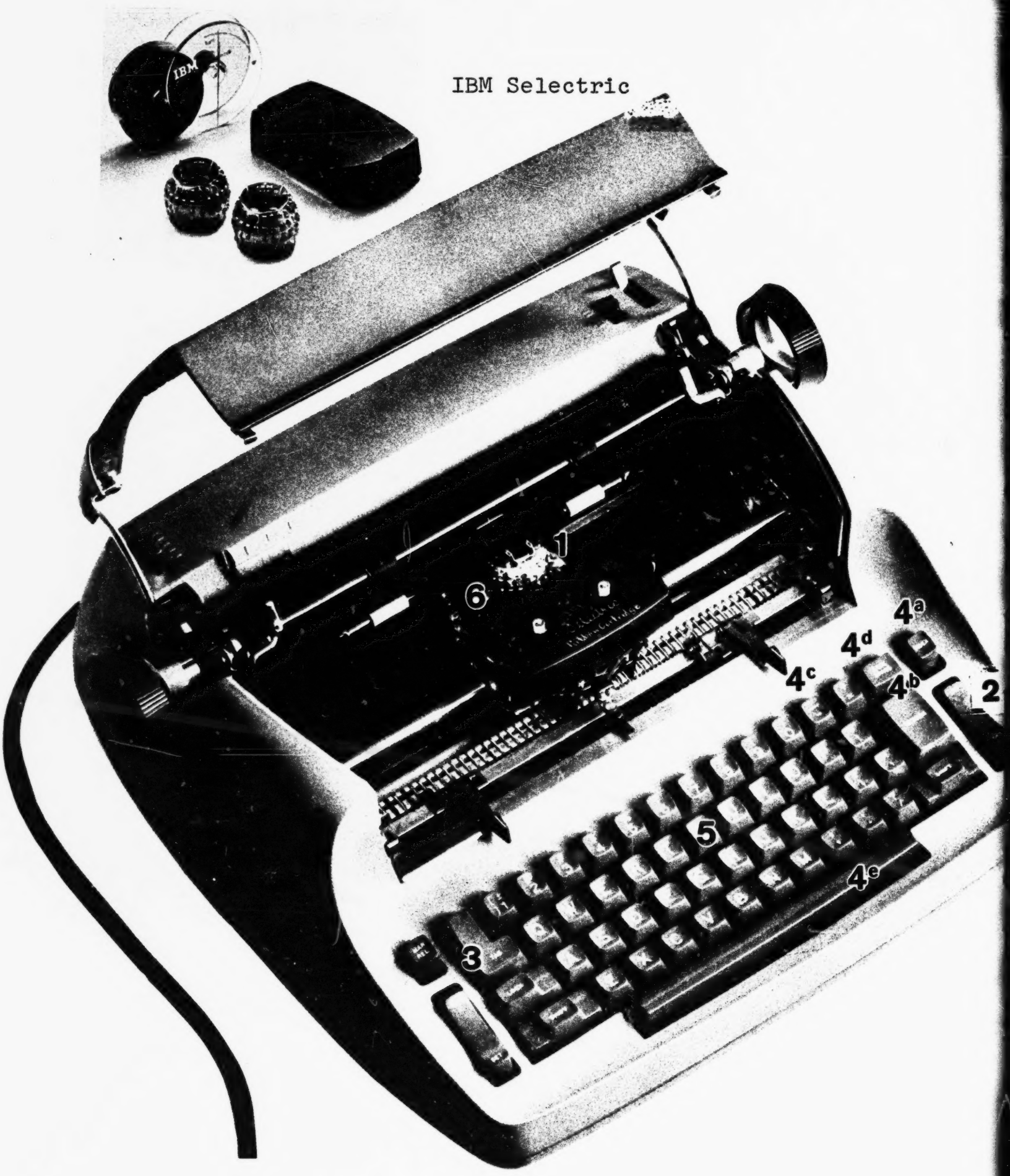


Courtesy of Olivetti Underwood Corporation

Royal Electric

Courtesy of Royal Typewriter Company, Inc.

IBM Selectric



1	Single Printing Element	4c	Underscore-Hyphen Key
2	On-off Switch	4d	Backspace Key
3	Tab Key	4e	Space Bar
4a	Index Key	5	Curved Keyboard
4b	Return Key	6	Ribbon Cartridge

Courtesy of International Business Machines Corporation

IBM Standard Electric

Courtesy of International Business Machines Corporation

E R R O R A N A L Y S I S C H A R T

ERROR	TROUBLE	CAUSE	SUGGESTED REMEDY
maie (make)	Wrong reach	Overreaching or underreaching for a key	You just need more practice using this difficult reach
laf (lag)	Adjacent reach	Usually indicates the need for more practice or a faulty hand position	Keep wrists low and fingers close to home keys
saki (sake)	Opposite reach	You used the correct finger but on the wrong hand	You need more practice on these letters
bilss (bills)	Doubling wrong letter	Due to lack of concentration	Type double letters more slowly until you have control
threee (three)	Extra letters	Due to nervousness or from sloppy and hurried stroking	Slow down and relax
wen to (went to)	Omissions (letters)	Omissions are errors of timing or reading too fast	Slow down and strike the key firmly. Keep your eyes on the word being typed until you have control. Then read no more than one word ahead
I plan go (I plan to go)	Omissions (words)	You looked up and lost the place or you were misled by proximity in copy	Same as above
plaec (place)	Transpositions	Due to typing or reading too fast	Go back to letter by letter typing until you have control
ju st (just)	Spacing (between letters)	Poor stroking rhythm	Don't let your finger linger on a key

ERROR	TROUBLE	CAUSE	SUGGESTED REMEDY
index card (index card)	Spacing (extra)	You are riding the space bar or striking it too heavily	Keep the thumb a half inch above the space bar and use a rhythmic stroke
indexcard (index card)	Spacing (omitted)	You did not strike the space bar at all, or you struck the space bar at the same time you hit the last letter of a word; or you did not strike the space bar hard enough	Tap your space bar with the same quick snappy stroke that you use on any key and say the word "space" to yourself after each word
Race (Race)	Poor Capitals	You released the shift key too soon or did not press it all the way down	Hold the shift key down firmly while you strike the letter, then release it quickly. Use a 1, 2, 3, count
MN (mN)	Capitalizing (wrong letter or failure to do so)	You were anticipating the typing of a capital letter and were too eager	Concentrate
We MAY SEe (We MAY see)	Shift Lock (all caps)	You failed to release or set the Shift Lock Key	Concentrate and keep alert
so ld (sold)	Crowding	Two or more type bars collide or two keys were struck so close together that one letter touches another	Practice rhythm drills. Select a rhythmic speed that will avoid crowding or uneven stroking
gam (game)	Piling	One letter is typed on top of another	Listen for the bell. Count the number of strokes that can be made after the bell rings before the carriage sticks
Claim (Claim)	Strikeovers (intentional)	Improper use of the backspace key	This is the unpardonable sin in typing

ERROR	TROUBLE	CAUSE	SUGGESTED REMEDY
——— ——— —— ——	Occasional line much too long or short	Bell does not ring loudly enough or you are not responding to it	Learn to distinguish the sound of your own bell, and know exactly how many letters you can type after the bell sounds its warning
They took the car from him	Irregular left-hand margin	You are throwing the carriage too hard or not hard enough	Return the carriage with a quick movement of your wrist and just hard enough so that it will glide into position
be do if be do if be do if	Irregular indentions or tabulatings	The tab bar was released too soon. Or, you were using the space bar instead of the tab	Hold the tab bar down until the carriage fully stops
there (their)	Confusing like words and poor spelling	Slow down, be alert and check pronunciation and spelling in the dictionary	Could be due to lack of concentration, reading too far ahead, mispronunciation of a word or your inability to spell even in longhand
keep (keep)	Uneveness in copy (light and dark letters)	You are typing in jerky spasms instead of in a smooth rhythmic pattern	Type as though you hear music and snap the keys harder
lake (lake)	Shadowed letters	You are pushing keys, mashing them down	Peck or snap the keys and release them more quickly. Fingers should be curved
	Miscellaneous errors		Study carefully to determine the cause

Joyce Wilson
Lesson 1, Unit 1
April 15, 1961
◁40▷

S A M P L E L E S S O N

Type 2 perfect copies of each line

```
fff fff fff jjj jjj jjj fff  jjj
fff fff fff jjj jjjj
fff fff fff jjj jjj jjj fff jjj fff jjj
fff ff f
fff fff fff jjj jjj jjj fff jjj fff jjj

ddd ddd ddd kkk kkk kkk ddd kkk d-d kkk
ddd ddd ddd kkk kkk kkk ddd kkk ddd kkk

sss sss sss lll lll lll sss lll sss lll
sss sss sss lll lll
sss sss sss lll lll lll sss lll sss lll

aaa aaa aaa ;;; ;;; ;;; aaa ;;; aaaa
aaa aaa aaa ;;; ;;; ;;; aaa ;;; aaa ;;;
aaa aaa aaa ;;; ;;; ;;; a;;
aaa aaa aaa ;;; ;;; ;;; aaa ;;; aaa ;;;

fff jjj ddd kkk sss lll aaa ;;; fff jjj
fff jjj ddd kkk sss lll aaa ;;; fff jjj

aaa ddd add add add aaa lll all all all
aaa ddd addd
aaa ddd add add add aaa lll all all all

lll aaa ddd lad lad jjj aaa lll jal jal
lll aaa ddd lad lad jjj aaa lll jal jal

aaa sss ;;;
aaa sss ;;; as; as; fff aaa ddd fad fad
aaa sss ;;; as; as; fff aaa ddd fad fad

a as ask asks asks; f fa fal fall falls
a as ask asks asks; f fa fal fall falls

l la las laas
l la las lass lass; f fl fla flas flask
l lalas
l la lass lass lass; f fl fla flas flask
l la las lass lass; f fl fla flas flask

a ad add adds adds; s sa sal sala salad
a ad add adds adds; s sa sal sala salad
```

Circle all errors

Leave 3 blank lines between drills

```
a dad; a lad; a salad; a lass; a flask;
a dad; a lad; a salad; a lass; a flask;

dad asks a sad lad; a sad lass asks dad
dad asks a sad l ad
dad asks a sad lad; a sad lass asks dad

dads ask a fad; a lad asks dad as a fad
dads ask a fad; a lad asks dad as fad
dads ask a fad; a lad asks dad as a fad
```

/ Staple Here

James Nelson
Lesson 13, Unit 3
April 26, 1961

S A M P L E S E S S O N

```
aa;;sslldd(jj)                                  Type 2 perfect copies
aa;;sslldkkffjjgghhffjjddkkss(s)                of each line
aa;;sslldkkffjjgghhffjjddkkssllaa;;ssll
aa;;sslldkkffjjgghhffjjddkkssll(ss)  <------ SS (single space)
aa;;sslldkkffjjgghhffjjddkkssllaa;;ssll
                                     <------ DS (double space)
aB cD eF gH iJ kL . (MM)
aB cD eF gH iJ kL . mN oP qR sT uV wX yZ
aB cD eF gH iJ kL . mN oP qR s(T)
aB cD eF gH iJ kL . mN oP qR sT uV wX yZ

to the, to you; to her, to him, to do so
to the, to you; to her, to him, to do so
                                     <------ Leave 3 blank lines
                                             between drills

lo lo9 191 999 1 day 9 days 1 19 91 1919
lo lo9 191 999 1 day 9 days 1 19 91 1919

11 and 19 and 119 and 191 and 91 and 99.
11 and 19 and 119 and 191 and 91 and 99.

de de3 d3d 333 3 days 3 hours (13339)
de de3 d3d 333 3 (kays)
de de3 d3d (d)
de de3 d3d 333 3 days 3 hours 13 39 1913
de de3 d3d 333 3 days 3 hours 13 39 1913

;p ;p0 ;0; 000 0 days 10 hours 100 1,000
;p ;p0 ;0; 000 0 days 10 (hou rs)
;p(;)p0
;p (;0)
;p ;p0 ;0; 000 0 days 10 hours 100 1,000

10 and 30 and 90 and 101 and 130 and 90.
10 and 30 and 90 and 101 and 130 and 90.


We MUST sign up AT (LAEST)
We MUST si(ng)
We MUST sign up AT LEAST (L)
(W)e
We MUST sign up AT LEAST 1,390 (ore)
We MUST sign up AT LEAST 1,390 more men.
We MUST sign up AT LEAST 1,390 more men.


She worked 11 hours(@)day for 11.1 days.
She worked 11 hours a day for 11.1 days.
She worked 11 hours a day for 11.1 days.

The 19 men WORKED until 9 p.m. on May 9.
The 19 men WORKED (UN)
The 19 men worked until 9 p.m. on May 9.
```

Did th3
Did the 3 men catch 333 fish in 33 days?
Did the 3 men catch 333 fish in e3 days?
Did the 3 men catch 333 fish in 33 days?

The 10 men in Squad 10 counted 100 jets.
The 10 men in Squad lo
The 10 men in Squad 10 counted 100 jets.

If Mr. Quigley can have sixteen crews out by the middle of June, you can take the first prize.

This prize is worth taging too; it provides a January excursion up to Quimby for all wiiners.

taking taking taking taking taking taking taking taking
taking taking taing
taking taking taking taking taking taking taking taking

winners winners winners winners winners winners winners
winners winners winners winners winners winners winners

If Mr. Quigley can have sixteen crews out by the middle of June, you can take the first prize.

This prize is worth taking, too; it pro

27 Words
-10 1 err. *
17
17 wam
1/17

If Mr. Wuigley can have sixteen crews out by the middle of June, you can take the first prise.

This prize is worth taking, too; it provides a Ja

29 Words
-20 2 errs.
9
9 wam
1/9

If Mr. Quigley can have sixteen crews out by the middle of June, you can take the first prize.

The prize is worth taking, too; t provid

28 Words
-10 1 err.
18
18 wam
1/18

to to it it or or if if us us go go is is dodo do
to to it it or orif 75 (12 sec.)

to to it it or or if if us us go go is is do do do 95 (12 sec.)
to to it it or or if if us us go go isis do

the the man man and and for for she she her her her 90 (12 sec.)
the the man man and and for for she s

the the man man and and for for she she her her her 100 (12 sec.)
the the amn man and and for for she she her her

---

* Note alternate method in job sheet, page 7.

STATE VOCATIONAL-TECHNICAL & TRADE SCHOOLS of LOUISIANA

BASIC INSTRUCTIONS

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1. Read "Principal Parts of Manual Typewriters" on pages 2-5 in your textbook. Pay particular attention to the illustration describing the machine you are using. Refer to the drawings on pages vi-xi of these job sheets. As you read about a machine part, locate it on your typewriter and touch it. The lower portion of page 5 of the textbook shows the parts you will particularly need to know and be familiar with for the first lesson. Review them thoroughly.

2. Read Supplementary Sheet 3, "Pica or Elite?" and determine which type you are using. (Green sheets in the back of this book.) Page 7, paragraph 6 in the textbook gives more information about pica and elite type.

3. Read "Horizontal Spacing," pages 6 and 7 of the textbook.

   NOTE: Read Supplementary Sheet 1, "Finding the Center of the Paper," for further instruction. Read also, "Figuring a 40-space Line," page 2 in the Supplementary Sheets.

4. Read "Vertical Spacing," page 8 of the textbook.

5. If you have not already done so, read "Organization of Material" in the yellow pages preceding these job sheets.

6. Tell your instructor when you have completed reading the above information. If there is any part of it that you do not understand, ask her to explain it to you now.

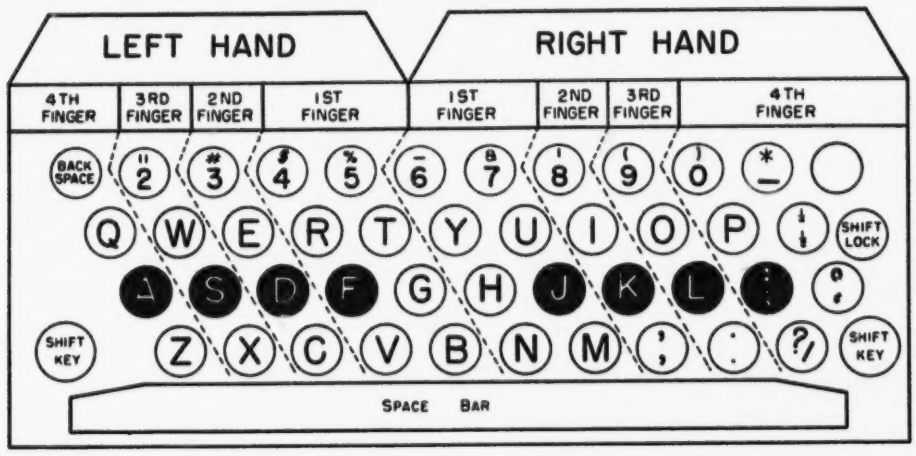
7. Now your instructor will want to go over with you the "Steps in Preparing to Type," page 9 of your textbook. She will also tell you what supplies, if any, you will need to furnish throughout your typing course.

8. Turn to page 5 in your WORKBOOK. Complete the Learning Guide following all instructions carefully. Remember, a great deal of your success in typewriting will depend on your ability to follow instructions.

9. Your instructor will tell you whether you should turn in your Learning Guides after you have completed them.

Lessons 1-6

1. Study the diagram below. Notice the home-row keys are in black. If your instructor permits, and it is an easier reach for you, strike the number 6 with the "F" finger instead of the "J" finger and the letter "C" with the "F" finger instead of the "D" finger.



2. Study the Technique Check list on pp. iv and v in these job sheets. Your instructor will observe, make suggestions, and perhaps grade you from time to time on your typing techniques. But, Practice These Correct Techniques at all Times whether graded or not.

3. Turn to the sample lesson on pp. xv-xvii in the yellow pages of this book. Note the procedure you are to use in typing each lesson. Ask your instructor if you should turn in your work at the completion of each Unit, each Lesson, or daily.

4. You will, of course, make errors. These will undoubtedly concern you. There is an error analysis sheet in the yellow pages which should help you discover the cause of your errors. You will want to keep this handy as problems arise.

5. WORKBOOK. Read page 7, "A Look at Lesson 1."

6. Type Lesson 1, pages 10 and 11. Be sure to read the material in the colored margin as you proceed with the lessons. Compare your typed lesson with that on page 8 of your WORKBOOK.

7. Refer to page iii in the yellow pages, "Care of the Machine." Ask your instructor to tell you how often you should use one of the chemical or plastic cleaners on your machine, but remember, you should always dust and cover your machine daily.

8. WORKBOOK, page 9. Learning Guide.

9. Type Lessons 2, 3, 4, pages 12-16, following marginal instructions.

   NOTE: Study the keyboard chart in each lesson before you begin typing. Feel the new reaches several times before you actually strike the keys. Remember to proofread carefully everything you type, and circle your errors. A typed page is never complete until you have checked for errors.

10. Type Lesson 5, pages 16 and 17.

    NOTE: Disregard paragraph 5-D and Learning Guide, WORKBOOK, page 1, until Lesson 18.

11. Type Lesson 6, page 18.

Lessons 7-12

1. Type Lessons 7, 8, 9, 10.

2. WORKBOOK. Your teacher may want you to use the Skill Scoreboard on page 3 of the WORKBOOK. If so, ask her to explain it to you and begin using it with Lesson 7.

3. Type Lesson 11, pages 25 and 26.

   NOTE: Read paragraph 11-D carefully. If you do not understand the tabulation technique introduced, ask your instructor to help you.

4. Type Lesson 12, pages 26 and 27.

   NOTE: When you have completed Lesson 12, your instructor may want you to type the accuracy Clinic Alphabet practice on page 11 of your WORKBOOK. You should ask her.

5. Remember to proofread and circle all errors. Review the Technique Check List in the yellow pages of this book.

Lessons 13-18

1. Type Lesson 13, pages 28 and 29.

   NOTE: Study paragraph 13-G carefully. Read Supplementary Sheet 1, "Horizontal Centering" at the bottom of the page.

2. WORKBOOK: Learning Guide: Horizontal Controls, page 13.

3. Type Lesson 14, pages 29 and 30.

4. Read Supplementary Sheet 6, "Vertical Centering." Refer to page 8 of your textbook for more explanation.

5. Type Lesson 15, pages 30 and 31.

   NOTE: After you have read paragraph 15-G you should type the exercise shown on a half sheet of paper. Center it both vertically and horizontally. If you make a typographical error, go right on. Do not start over. Proofread and circle your errors when you have completed the typing.

6. Type Lesson 16, pages 32 and 33.

7. WORKBOOK, Learning Guide: Vertical Controls, page 15.

8. Type Lesson 17, pages 33 and 34.

9. Turn back to page 17, Lesson 5, paragraph 5-D and study carefully how your speed is measured.

10. WORKBOOK, Learning Guide: Computing Typing Speed, page 10.

11. Read Supplementary Sheets 4 and 5.

12. Turn back to the sample lesson (yellow pages) and study the correct procedure to follow when setting up a lesson to hand in which includes timed writings.

13. Type Lesson 18, pages 34 and 35.

    NOTE: Take 2 one-minute timed writings on paragraph 18-B, page 35. Take at least 1 one-minute writing on paragraph 18-F.

IMPORTANT: As soon as you complete each timing, proofread, circle errors, figure your score, and place it in the right-hand margin beside your timing. Your instructor will tell you if you should subtract 10 from your gross count when figuring your score.

Examples: When following Supplementary Sheet 5-D

30	Words	20 wam
-10	1 Error	1/ 20
20		

When <u>not</u> deducting for errors

30/1/1

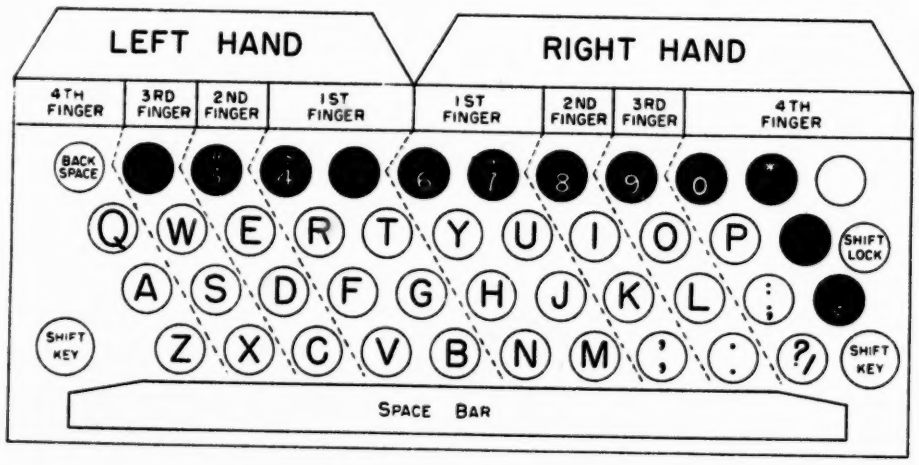
Words
Error
One minute

Follow the same procedure for all future timed writings.

14. If you are using the Scoreboard Chart in your WORKBOOK, turn to it and record your score.

Lessons 19-24

1. Study the diagram below. Note that the numbers and symbols are in black. If your instructor permits and it is an easier reach for you, strike the number 6 with the "F" finger instead of the "J" finger.



2. Type Lessons 19, 20, 21, 22, 23, and 24, pages 36-43.

   NOTE: As each new number key is introduced, feel the reach several times without actually striking the key. Remember, keep your eyes on your copy.

   NOTE: In Lesson 21, page 39, omit paragraph 21-H at this time.

3. The two paragraphs below may be used with each lesson as one-minute timed writings. Set your goal a little higher with each lesson.

   (1) There is no doubt that you can learn to type well[10] if you type in the right[15] manner. It is always easier to[20] do what we are striving[25] for if we think positively.[30] [31]

   (2) A man who reads will go[5] far in an office. The more[10] you read, the more you[15] can learn. The big jobs[20] require men who read more[25] and learn more.[28]

4. NOTE: Type the optional review of centering, Lesson 21, page 39.

5. WORKBOOK, Learning Guide: "Spacing after Punctuation," page 17.

6. a. WORKBOOK, General Information Test on Part 1, page 19.

   b. Textbook Progress Test on Part One, Lesson 25, pages 44 and 45. Follow all instructions carefully.

   NOTE: Your instructor may wish to use the WORKBOOK and textbook tests as review material for you. If this is the case, after you have completed the textbook and WORKBOOK tests, ask for your instructor's test for Part I.

Lessons 26-27

1. WORKBOOK. If you are using the Scoreboard Chart on page 3, record your timed writing progress. You will not be reminded any more, so keep the chart handy for daily use if necessary.

2. Type Lessons 26 and 27, pages 47-49. Read the instructions in the colored margins carefully and type each exercise accordingly.

   NOTE: Paragraph 27-A, page 48, tells you how to respond to the margin bell. Since there are others typing around you, you will have to learn to distinguish the sound of your bell from any other. In an office you will probably also be typing in an area with others, so now is a good time to become accustomed to outside distraction. Concentration is one of the keys to success.

3. WORKBOOK, Learning Guide: Making Line-Ending Decisions, page 25.

   NOTE: If you haven't already, you will want to familiarize yourself with Gregg's 20,000 Words. It is a ready source for both spelling and word division in many cases. Since it is such a helpful aid, you may wish to buy your own copy. Your instructor can tell you the approximate price.

Lessons 28-29, pages 50-52.

1. Type Lessons 28 and 29, pages 50-52.

   NOTE: Take 2 two-minute timings on paragraph 28-B. Type the first one, then read the marginal information and type the second timing. Decide whether speed or accuracy should be your goal and target on your goal.

2. Follow all marginal instructions for the remainder of the two lessons.

3. WORKBOOK, Learning Guide: When Not to Divide Words, page 27.

Lessons 30-31, pages 53-55.

1. Type Lessons 30 and 31.

   NOTE: Read carefully paragraph 31-A.

2. Paragraph 31-F. Take a five-minute writing on this paragraph. Relaxation is very important when typing for a sustained period. Before you begin, let your arms hang down by your side and relax your shoulders. Then assume correct typing position and begin.

3. WORKBOOK, Learning Guide: How to Divide Words, page 29.

4. Ask your instructor which parts of the Speed Clinic Material you should type. (Page 31 in your WORKBOOK).

Lessons 32-33

1. WORKBOOK, Learning Guide: Basic Parts of Business Letters, page 33. Your instructor may have illustrations of business letters she will want to show you. You should ask.

2. Type the drills on page 56, Lessons 32-33. Paragraphs 32-A, 32-C, and 32-D. Read paragraph 32-B carefully and experiment with your own name, etc.

3. Read paragraph 32-F, page 57 and follow the instructions when setting up letters 1, 2, and 3 on the next two pages.

4. Memorize the Placement Guide (blue block) in the left column, paragraph 32-F.

   NOTE: Even though the number of spaces is given, you should know how to figure a 4-, 5-, or 6-inch line. Remember, pica spacing has 10 spaces to an inch; so a 4-inch line would be: 10 X 4 = 40 space line. Elite spacing has 12 spaces to an inch; so a 4-inch line would be: 12 X 4 = 48. (round off, calling this a 50-space line) Read Supplementary Sheet 2 "Converting Inches to Spaces."

5. Ask your instructor if you should use the "Production Scoreboard" on page 4 of your WORKBOOK for the next few jobs.

6. Instructions for the letters to follow are in paragraph 32/33-G. Read these instructions carefully before proceeding. Use WORKBOOK Letterheads, pages 35, 39, and 41. Type Letters 1, 2, 3, and 4, pages 58 and 59 after you have read the two notes below.

   NOTE: You may wish to tear page 37 from your WORKBOOK to use as an aid in setting your margins. Be careful not to become dependent upon it, however. Your goal is a mailable letter in the shortest possible time.

   NOTE: Read Supplementary Sheet 11-S, "Erasing" and paragraph 56-A, page 92 in the textbook. Your instructor may wish to demonstrate how to make a good erasure. Be sure to ask. She will also tell you when you should begin correcting your errors.

OPTIONAL: If you are to begin making corrections at this point, turn to page 77 in your WORKBOOK, Learning Guide: Making Corrections and follow instructions given. If your instructor does not want you to erase now, the Learning Guide should be completed at the end of Lesson 52.

Lessons 34-35, pages 60-62.

1. Type paragraphs 34-A, 34-B. Read paragraph 34-C, page 60.

2. WORKBOOK, Learning Guide: Sequences of Punctuation and Quotation Marks, page 45.

3. Type paragraph 34-D following marginal instructions.

4. Set your own goals for the letters on pages 61 and 62 using the suggested ones at the top of page 61 as guides. After you have typed them satisfactorily, cut a stencil of Letter 5, page 61. Your instructor will give you detailed instructions on how to cut it and run it off after you have completed the job.

Lessons 36-37

1. Type drills 36-A, 36-B, and 36-C, page 63. Take at least 2 one-minute timings on paragraph 36-C.

2. Type 36-D following marginal instructions. When typing paragraph 36-37-E, use WORKBOOK pages 47-50 or plain paper, whichever your instructor prefers.

Lessons 38-39

1. Type the drills on page 65. Lessons 38-39.

   NOTE: In this lesson type at least two perfect copies of paragraph 38-A.

2. Paragraph 38-C. If you need to review horizontal centering, refer to Supplementary Sheet 1 or page 7 in your textbook.

3. Read paragraph 38-E and F carefully.

4. WORKBOOK, Learning Guide: Basic Tabulation, page 51.

5. Follow instructions given in paragraphs 38-39-G and type page 67 accordingly.

6. Take a five-minute timing on paragraph 38-D. Do NOT underline the word "Tabulation."

7. Read the instructions for "Typewriter Mystery Games," on the next two pages of this book. Type any one of these to hand in.

TYPEWRITER MYSTERY GAMES

GENERAL DIRECTIONS

Symbols are represented as 3sp--means strike Space Bar 3 times; 8X--means strike X 8 times; 5%--means strike % 5 times; etc.

Mystery No. 1

Vertical Placement: 18 lines down
Horizontal Placement: 60-space line

Line
1 - 36sp 1X
2 - 35sp 3X
3 - 35sp 4X
4 - 35sp 4X
5 - 35sp 4X
6 - 35sp 4X
7 - 36sp 2X
8 - 32sp 1X 4sp 1X
9 - 32sp 2X
10 - 32sp 3X
11 - 32sp 4X
12 - 32sp 7X
13 - 32sp 10X
14 - 31sp 11X
15 - 31sp 11X
16 - 32sp 10X
17 - 32sp 9X
18 - 8sp 8X 16sp 9X
19 - 5sp 14X 13sp 9X
20 - 2sp 6X 9sp 5X 9sp 11X
21 - 1sp 4X 15sp 3X 7sp 13X
22 - 4X 18sp 3X 6sp 11X
23 - 3X 21sp 3X 5sp 9X
24 - 1sp 4X 2sp 3X 16sp 3X 3sp 9X
25 - 2sp 7X 3sp 48X
26 - 3sp 4X 13sp 32X
27 - 21sp 30X
28 - 22sp 28X

Mystery No. 2

Vertical Placement: 12 lines down
Horizontal Placement: 40-space line

Line
1 - 12sp 8%
2 - 9sp 13%
3 - 8sp 6% 2sp 6%
4 - 5sp 18%
5 - 3sp 20%
6 - 2sp 2% 4sp 15%
7 - 8sp 15%
8 - 6sp 2% 3sp 12%
9 - 5sp 2% 6sp 10%
10 - 4sp 2% 8sp 10%
11 - 3sp 2% 10sp 5% 1sp 3%
12 - 2sp 2% 11sp 6% 2sp 3%
13 - 1sp 2% 12sp 8%
14 - 2% 13sp 11%
15 - 2% 13sp 14%
16 - 2% 13sp 17%

Mystery No. 2 (Cont'd)

17 - 2% 13sp 19%
18 - 2% 13sp 21%
19 - 2% 13sp 22%
20 - 2% 13sp 13% 3sp 7%
21 - 2% 13sp 14% 4sp 6%
22 - 1sp 2% 13sp 13% 5sp 5%
23 - 1sp 2% 13sp 13% 6sp 5%
24 - 1sp 2% 14sp 12% 7sp 4%
25 - 1sp 2% 15sp 11% 8sp 3%
26 - 1sp 2% 16sp 9% 10sp 1%
27 - 2sp 2% 16sp 8%
28 - 2sp 2% 16sp 8%
29 - 3sp 2% 16sp 7%
30 - 3sp 2% 17sp 6%
31 - 4sp 2% 16sp 6%
32 - 5sp 2% 15sp 5%
33 - 6sp 2% 15sp 4%
34 - 8sp 2% 13sp 3%
35 - 10sp 3% 10sp 2%
36 - 12sp 11%
37 - 12sp 2% 7sp 2%
38 - 7sp 7% 7sp 2%
39 - 6sp 6% 7sp 4%
40 - 17sp 5%
41 - 16sp 4%

Mystery No. 3

Vertical Placement: 16 lines down
Horizontal Placement: 88-space line
(For this design, insert paper the long way--that is horizontally.)

Line
1 - 8sp 9%
2 - 8sp 9% 30sp 8%
3 - 10sp 5% 19sp 21%
4 - 10sp 5% 19sp 21%
5 - 10sp 5% 19sp 17%
6 - 10sp 5% 19sp 6% 7sp 4%
7 - 6sp 34% 7sp 4% 9sp 28%
8 - 2sp 38% 7sp 4% 7sp 30%
9 - 2sp 38% 7sp 4% 6sp 31%
10 - 2sp 49% 6sp 31%
11 - 4sp 47% 6sp 31%
12 - 4sp 47% 6sp 31%
13 - 3sp 3% 8sp 11% 5sp 11%
1sp 9% 6sp 31%
14 - 2sp 39% 1sp 9% 6sp 31%
15 - 1sp 40% 1sp 46%
16 - 6% 9sp 9% 7sp 9% 18sp 5%
2sp 5% 4sp 5% 2sp 5%
17 - 17sp 5% 11sp 5% 21sp 3%
4sp 3% 6sp 3% 4sp 3%
18 - 88/ (strike diagonal sign 88 times)

Mystery No. 4
Vertical Placement: 7 lines down
Horizontal Placement: 75-space line

Line
1 - 2sp 3% 18sp 3%
2 - 1sp 6% 14sp 5%
3 - 1sp 7% 12sp 6%
4 - 9% 10sp 8%
5 - 10% 8sp 9%
6 - 14% 1sp 12%
7 - 9% 5sp 14%
8 - 8% 7sp 13%
9 - 1sp 6% 7sp 13%
10 - 1sp 1% 1sp 1% 1sp 2% 7sp 13%
11 - 1sp 2% 3sp 1% 7sp 1% 1sp 1% 1sp 9%
12 - 2sp 3% 1sp 4% 4sp 2% 3sp 8%
13 - 2sp 2% 2sp 5% 4sp 10% 2sp 1%
14 - 2sp 1% 2sp 7% 4sp 9% 3sp 1%
15 - 2sp 1% 2sp 8% 5sp 6% 5sp 1% 6sp 10%
16 - 2sp 1% 1sp 10% 5sp 5% 6sp 20%
17 - 3sp 12% 4sp 3% 7sp 24%
18 - 7sp 2% 2sp 7% 2sp 2% 6sp 28%
19 - 9sp 1% 2sp 10% 6sp 30%
20 - 10sp 1% 3sp 7% 6sp 32%
21 - 10sp 1% 16sp 33% 2sp 2%
22 - 10sp 1% 15sp 38%
23 - 9sp 2% 15sp 38%
24 - 8sp 3% 15sp 35%
25 - 7sp 4% 15sp 35%
26 - 8sp 3% 15sp 34%
27 - 8sp 3% 15sp 35%
28 - 9sp 3% 14sp 35%
29 - 9sp 3% 15sp 35%
30 - 10sp 3% 5sp 4% 6sp 18% 10sp 7%
31 - 11sp 13% 4sp 16% 12sp 7%
32 - 11sp 15% 3sp 15% 13sp 7%
33 - 11sp 9% 4sp 3% 2sp 15% 13sp 7%
34 - 11sp 9% 6sp 2% 2sp 14% 14sp 6%
35 - 12sp 8% 7sp 2% 1sp 15% 14sp 5%
36 - 12sp 8% 8sp 1% 2sp 7% 2sp 6% 13sp 5%
37 - 12sp 8% 8sp 1% 2sp 6% 4sp 5% 14sp 4%
38 - 12sp 7% 9sp 1% 3sp 5% 4sp 5% 15sp 3%
39 - 12sp 7% 9sp 1% 4sp 4% 4sp 5% 15sp 4%
40 - 12sp 7% 9sp 2% 3sp 4% 3sp 6% 16sp 4%

Mystery No. 4 (Cont'd)

Line
41 - 12sp 7% 9sp 2% 3sp 4% 2sp 7% 16sp 4%
42 - 12sp 7% 10sp 1% 3sp 12% 18sp 4%
43 - 12sp 7% 10sp 1% 3sp 4% 5sp 2% 19sp 5%
44 - 13sp 3% 1sp 2% 11sp 1% 3sp 9% 20sp 5%
45 - 12sp 3% 2sp 2% 11sp 1% 5sp 1% 26sp 6%
46 - 10sp 2% 5sp 2% 12sp 1% 4sp 1% 26sp 7%
47 - 8sp 2% 6sp 2% 13sp 1% 4sp 1% 25sp 1% 5sp 2%
48 - 9sp 8% 13sp 1% 5sp 2% 24sp 1% 5sp 2%
49 - 30sp 1% 6sp 1% 24sp 7%
50 - 30sp 1% 6sp 1%
51 - 31sp 6%

Mystery No. 5
Vertical Placement: 18 lines down
Horizontal Placement: 35-space line

Line
1 - 2sp 2X 15sp 3X
2 - 2sp 4X 11sp 6X
3 - 2sp 5X 9sp 7X
4 - 2sp 6X 7sp 8X
5 - 3sp 8X 3sp 9X
6 - 5sp 9X 3sp 6X
7 - 7sp 10X 12sp 4X
8 - 9sp 25X
9 - 13sp 18X
10 - 10sp 3X 7sp 8X
11 - 11sp 9X
12 - 8sp 2X 10sp 12X
13 - 6sp 28X
14 - 5sp 28X
15 - 4sp 26X
16 - 3sp 19X
17 - 2sp 17X 4sp 9X
18 - 1sp 15X 3sp 15X
19 - 1sp 14X 2sp 18X
20 - 1sp 12X 2sp 20X
21 - 10X 3sp 22X
22 - 10sp 24X
23 - 33X
24 - 32X
25 - 1sp 18X 1sp 11X
26 - 1sp 17X 1sp 10X
27 - 2sp 14X 2sp 9X
28 - 3sp 12X 3sp 5X 4sp 7X
29 - 5sp 6X 12sp 9X

Lessons 40-41, pages 68-70.

1. Type two perfect copies of each line in paragraph 40-A.
2. Type remaining drills on page 68. Take 2 one-minute writings on paragraph 40-D.
3. Read paragraph 40-C carefully.
4. Follow instructions in paragraph 40-E for typing Table 4.
5. WORKBOOK, Learning Guide: Tables with Column Headings, page 53.
6. Follow instructions in paragraphs 40-41-G for typing Tables 5, 6, and 7, page 70.

Lessons 44-45

1. Type the drills on page 73, Lessons 44-45. Read the contents of paragraph 44-B before typing the drill.

2. Read paragraphs 44-D and E carefully. Your instructor may have illustrations of manuscripts to show you. If so, this will help you determine the parts of a manuscript.

3. Follow instructions in paragraphs 44-45-F and type the exercise.

   NOTE: WORKBOOK, page 59 is a visual guide for a short manuscript. Read instructions for using it before typing your short manuscript.

4. Cut a stencil of the manuscript on page 76 after you have typed it once. Your instructor will review with you how to cut the stencil and run it off.

Lessons 46-47, pages 77-79

1. Type the drills on page 77, Lessons 46-47.

2. Follow the directions given in paragraph 46-47-D, page 78 for Manuscripts 5, 6, 7, and 8. Ask your instructor whether you should use WORKBOOK FORMS, pages 61-64 for these manuscripts.

   NOTE: There are several acceptable ways to type manuscripts. Your instructor may wish to explain some of these to you for your own information. She may also have various forms for you to see. Ask her to talk with you about this.

Lessons 48-49

1. Type review lessons 48-49, pages 80 and 81 following all marginal instructions. Use WORKBOOK letterhead for Letter 15, page 67.

2. WORKBOOK, pages 65 and 66. You may wish to type these timed writings in order to build your skill as well as check your progress.

Lesson 50, pages 82-83

1. WORKBOOK test, pages 69 and 70. General Information Test on Part II.

2. Proceed with Progress Test on Part II, Lesson 50, pages 82 and 83. Follow all instructions carefully.

3. If your instructor has another test for you, ask for it now.

4. On page 75 in your WORKBOOK are speed and accuracy drills. With the help of your instructor, you should decide which of these drills will help you achieve your goals.

Lessons 51-52

1. It's time to change typewriters--you may come back to your favorite machine later. Your instructor wants to explain to you now how to operate the other makes of typewriters in the room. (You will get some practice on the electric typewriters when you begin the lessons in the second half of your text.)

2. Type the drills on pages 85 and 86, Lessons 51-52. Read the marginal instructions and then set your goals for these drills.

3. Read paragraph 52-A carefully. Refer to the machines parts diagrams in the front of this book to determine where the variable line spacer is on your machine. Follow the instructions given for the practice material.

4. Type the remainder of the drills on page 86 and those on page 87. Take at least 1 five-minute writing on paragraph 52-E.

5. BE SURE TO PROOFREAD CAREFULLY.

6. OPTIONAL: Learning Guide, page 77. (If you didn't complete it in Lesson 32-33).

Lessons 53-54

1. Type Lessons 53-54, page 88-90. Read paragraph 54-A carefully and follow the practice instructions.

Lessons 55-56

1. Type the drills on page 91, Lessons 55-56 following marginal instructions. Be sure to circle your errors.

2. Type paragraph 55-F for practice, then take a one-minute writing.

3. Paragraph 56-A. Read carefully even if you are already making corrections. It is a good review. Type the remainder of the drills on pages 92 and 93 following marginal instructions.

Lessons 57-58

1. Type the drills on page 94.

2. Read paragraph 57-D and the marginal note which accompanies it. Your instructor may wish to discuss "sight placement" with you in more detail. Be sure to ask.

3. Type the exercises on pages 95 and 96, Lessons 57-58. Use WORKBOOK forms for cards 1-6, pages 80 and 81.

Lessons 59-60

1. Type paragraphs 59-A, B, and C, page 97, Lessons 59-60.

2. WORKBOOK, Learning Guide: Special Parts of Business Letters, page 83. Your bulletin board display of letter illustrations may show these special parts. It will help you to see each part correctly placed.

3. From this point on, you will need to make a carbon copy of all your letters. In an office, this is automatically required--at least one carbon for the files. Other carbons are noted as explained in paragraph 59-60-D. Weights and various other characteristics of carbon paper will be described to you later. For making the single carbon required now, you may follow the instructions given below.

   Method I

   1. Place a sheet of onion-skin paper flat on the desk; then place a sheet of carbon paper with the glossy side down. Add the original to the top.

   2. Turn the pack so that the glossy side of the carbon paper faces you and tap it lightly on the desk to straighten the sheets.

   3. Insert into the machine using the paper-release lever to make the pack roll in easier. Straighten the pack more if it is necessary and operate the paper release several times to eliminate wrinkles. (Wrinkles on carbon copies are called "treeing" and spoil the appearance and sometimes the readability of the carbon copy).

   Method II

   1. Arrange the original and onion skin paper for normal insertion into the machine.

   2. Turn the cylinder knob until the sheets are slightly gripped and lay the first sheet over the top of the machine.

   3. Insert the carbon paper with the glossy side facing you, then roll into typing position.

NOTE: Page 111 of your textbook illustrates Method I described on the preceding page.

HOW TO ERASE ON CARBON COPIES

Of course, all typographical errors must be corrected on carbons as well as on the original. The following steps will explain the procedure.

1. Move the carriage to the left or right--away from the typing mechanism.

2. Turn the cylinder forward so that the alignment will not be disturbed.

3. Place an erasure shield, 3 X 5 card, or even a small folded piece of paper back of the original and in front of the carbon; then erase the error on the original.

4. Turn both the original and carbon sheet over the top of the machine and erase the error on the copy. Use a pencil eraser or any other soft eraser. Your regular typewriter eraser is not satisfactory for errors on carbons.

5. Type the correction.

NOTE: Most of this will be assigned as review in your textbook as it is presented. There will be, however, new information provided, so be sure you read everything carefully.

4. Type Letter 17, page 98, Lessons 59-60. Make one carbon on all future letters unless otherwise instructed. Use the WORKBOOK Letterhead, page 85. Address the simulated envelope on page 86, WORKBOOK. Follow the instructions given for all future WORKBOOK letterheads.

5. Type Letter 18, page 99 using WORKBOOK Letterhead, page 87.

6. Type a ditto master of Letter 18, page 99. Your instructor will explain the process to you and show you how to run it off.

7. You have advanced far enough now that your production work must be neat and correct--in other words: All letters you turn in should be "MAILABLE." There are several things which have equal importance in making a letter (or any other production work) "MAILABLE." These are:

    a. Good neat erasures. If you erase a hole in your paper or leave smudges from erasing or any other visible marking, the erasure is not acceptable.

    b. Correctly spelled words and names. Your 20,000 Words should be beside you constantly.

    c. Good placement. A letter which is too high or low or too far to the left or right does not present an attractive picture. The over-all, first impression depends on good placement.

    d. No strikeovers. This is the "unforgivable sin" in typing. Nothing is acceptable with a strikeover.

    e. Consistent punctuation following salutation and complimentary closing. Don't mix open, closed, or standard punctuation.

    f. Properly erased errors on carbons.

8. Ask your instructor if she wishes to discuss these or other good typing qualities with you.

9. Type Letter 19, page 100. Use WORKBOOK Letterhead, page 89.

10. Study the illustrations at the top of page 101 in the textbook. Practice folding a letter using scratch or used paper.

11. Type Letters 20 and 21, page 101. Use WORKBOOK Letterhead, pages 91 and 93.

Lessons 61-62

1. Type Lessons 61-62, pages 102 and 103 according to marginal instruction; however, remember to correct your errors on assignment 61-62-D beginning at the bottom of page 102. Use WORKBOOK Letterheads, pages 95-98.

Lessons 63-64

1. Type the drills on page 104, Lessons 63-64 according to marginal instructions.

2. Read paragraphs 63-64-D and follow the procedure described for typing Form 4. Use WORKBOOK Form, page 99. Make a carbon copy of all interoffice memos.

3. Type Forms 5, 6, and 7, page 106, Lessons 63-64. Use WORKBOOK Forms on pages 100 and 101. On page 102 in your WORKBOOK there is an illustration of an interoffice envelope. Its use is explained in the copy below the illustration.

Lessons 65-66, pages 107-109.

1. Type the drills on page 107 following marginal instructions.

2. Read paragraphs 65-66-D. Type Forms 8, 9, 10, and 11, pages 108-109, using WORKBOOK Forms, pages 103-105.

3. Study the illustrative telegram on page 109. Type Forms 12 and 13, page 109. Use WORKBOOK Forms, page 107. Make a carbon copy of each telegram.

Lessons 76-68

1. Type these review lessons following all instructions carefully, after you have reviewed the illustrations at the top of page 111, Use the WORKBOOK Forms provided on pages 109, 111, and 113.

2. Take a five-minute writing on the copy on page 113 in your WORKBOOK.

Lessons 69-70

1. WORKBOOK, Learning Guide: Revision Marks, page 115.

2. Follow all marginal instructions for completing the exercise on page 112, Lessons 69-70.

3. Type the manuscript on pages 113 and 114. Ask your instructor to show you how to make a carbon copy while using the visual guide on page 117 of the WORKBOOK.

Lessons 71-72

1. Type the drills on page 114, Lessons 71-72.

2. Read Manuscript 13-14 <u>before</u> you type it. The content will help you to type the footnotes properly.

3. Type the manuscript on pages 115 and 116, Lessons 71-72. If your instructor has an illustrative manuscript with footnotes, compare yours with it and criticize your own work. Manuscripts are not easy to type, and you may wish to retype yours in order to improve it.

Lessons 73-74

1. Type paragraphs 73-A, 73-B, and 73-C, following marginal instructions.

2. Type Letter 27, paragraph 73-74-D. Use WORKBOOK Letterhead, page 119. Don't forget to make a carbon copy.

3. Type Forms 17-18, page 118 according to instructions.

4. You have already been erasing your errors for quite a while. Manuscript 15-16 will be a good review on the art of erasing. Read it <u>before</u> you type it. Make a carbon copy.

Lesson 75

1. Complete the General Information Test on Part III, WORKBOOK, pages 123 and 124.

2. Proceed with Progress Test on Part III, Lesson 75, pages 119 and 120. Follow all instructions carefully. WORKBOOK, pages 125-128.

3. If your instructor has another test for you, ask for it.

Before beginning Part IV, Read Supplementary Sheet No. 11, "Crowding and Spreading for Manual Typewriters." Insert a sheet of scratch paper in your typewriter and practice the crowding and spreading examples shown at the bottom of Supplementary Sheet No. 11. Let your instructor see your practice work.

If your school has an offset press available, your instructor will want to show you how to type an offset master. She will demonstrate the procedure for preparing the master.

WORKBOOK II will now be needed. See your instructor.

Lessons 76-77

1. Type all the skill drive exercises in Lessons 76-77, pages 122-124 according to marginal instructions.

2. WORKBOOK, Learning Guide: Review of Word Division, page 133.

Lessons 78-79

1. Type both lessons, pages 125-127 following instructions carefully.

   NOTE: If you are still making more than the acceptable number of errors, ask your instructor to give you some special assignments before you begin Lesson 80.

Lessons 80-81

1. Follow marginal instructions for typing these number review lessons.

UNIT 14

Lessons 82-83

1. Type drill material on page 130, Lessons 82-83. Disregard marginal instructions for paragraph 82-C. Instead, type the drill concentrating on accuracy.

2. Type Letter 29, page 131. You may use the visual guide in your WORKBOOK, page 135 and Letterhead on page 137.

   NOTE: Disregard the error limit discussed in paragraph 82-83-D, page 130. You should always concentrate on accuracy, and, of course, you erase and correct all errors on production work.

   BE SURE TO MAKE A CARBON COPY.

3. Type Letters 30, 31, 32, page 132. The preceding instructions apply for all letters, Use WORKBOOK Letterhead, pages 139, 141, and 143.

   NOTE: Remember, your letters must be "MAILABLE."

Lessons 84-85

1. Omit paragraph 84-A, but type paragraph 84-B until the words are easy for you to type.

2. Type paragraph 84-C disregarding marginal instructions. Type for accuracy.

3. Since you have been asked to erase and correct all errors on production material, you will not be told anymore to disregard textbook instructions which indicate an error limit in a given time. Always type each letter as rapidly as possible, but accuracy is more important than speed.

4. Type Letters 33-37 using WORKBOOK Letterhead, pages 145-153.

Lessons 86-87

1. Type the drills on page 136, Lessons 86-87.

2. Paragraph 86-87-D tells you what you are to do with letters 38-41. Type each letter after you have read the instructions carefully.

Lessons 88-89

1. Review tabulation techniques by reading Supplementary Sheet 7, a and b parts. Different machines have different levers for controlling tab setting and clearing. Be sure you understand how your machine operates.

2. Type Lessons 88-89, pages 138-140, following marginal instructions.

3. Type Tables 14-18, pages 139 and 140. Make carbon copies of each table.

Lessons 90-91

1. Type the drills on page 141, Lessons 90-91, following marginal instructions.

2. Read paragraph 90-D before typing Tables 19 and 20, page 142.

3. Type Table 19.

   NOTE: There are three methods of ruling lines: (1) Leave the paper in the typewriter--take a pencil and place it in the corner of the left card holder or at the edge of the card holder and move the carriage up and down and across. (2) Leave the paper in the typewriter and strike the underscore key for all horizontal lines. Then take your paper out of the typewriter and insert the paper the long way; strike the underscore key again. (3) Remove your paper from the typewriter and draw your lines in pencil by using a ruler. CAUTION: Typewritten and pencil lines should not be combined on any table.

4. Type Table 20 using any one of the methods described for producing the table in "boxed" form.

5. Type Tables 21 and 22, page 143, after you have read and understood the instructions in paragraph 91-E.

6. WORKBOOK, Tabulation Clinic, page 159.

Lessons 92-93

1. Type drills 92-A and 92-B.

2. Paragraph 92-C. Type the copy once for practice and review the contents. Type again on WORKBOOK paper, page 161. Center it horizontally but not vertically. Leave three blank spaces between the printed title, "Three Ways to Type Any Table," and your first line of typing.

3. Type tables 23, 24, and 25, page 145 using WORKBOOK paper, pages 162, 163, and 164. Follow instructions carefully.

Lessons 94-95

1. Type the drills on page 146, Lessons 94-95. Ignore marginal instructions for paragraph 94-C and take 2 five-minute writings. Try to keep your errors within ½ error per minute.

2. Review the use of revision symbols on page 112, then type manuscript 19, page 147, using WORKBOOK Form, page 165. Make a carbon copy.

3. Type manuscript 20, WORKBOOK Form, page 167.

4. Ask your instructor if you should type manuscripts 21 and 22.

Lessons 96-97

1. Type the drills on page 149, Lessons 96-97.

2. Type manuscripts 23 and 24, following instructions within the box at the top of page 150.

3. Type manuscript 25. Be sure to read "Notes about Book Manuscripts" at the top of page 151 before you type. You will want to make two carbon copies of this exercise instead of just one. Assemble your carbon pack exactly the same way as for one carbon--just add another carbon and another sheet of onion skin. Remember you'll always have one more sheet of paper than of carbon paper. If your stroking is firm and even, you will not need to increase your pressure.

4. WORKBOOK--"Typing-Technique Checkup," page 169. Ask your instructor to help you evaluate your typing when you have completed it.

Lessons 98-99

1. Type the drills on page 152. Disregard marginal instructions. Instead, for paragraph 98-A and B, type each line twice. Paragraph 98-C. Take 2 five-minute writings. Try to keep your errors within ½ per minute.

2. Type Letter 42, page 153, using WORKBOOK Letterhead, page 173.

3. Type Table 26, page 153, and Manuscripts 26 and 27 according to instructions.

4. WORKBOOK, General Information Test on Part IV, Lesson 100, pages 175-176. Proceed with textbook progress test, pages 154 and 155. Use WORKBOOK forms, pages 177-180.

5. If your instructor has another test for you, ask for it.

Lessons 101-102

1. Omit the marginal instructions on page 157, Lessons 101-102, and type each drill once. Evaluate your own work according to your own progress goals. If you decide you need to repeat any of the exercises, do so.

2. Read paragraph 101-H, page 158. This report describes features and varieties of carbon paper--information every secretary or typist should know. After you have studied the information, type the exercise according to the instructions in paragraph 101-B, page 157. Make two carbon copies.

3. Type the exercises on page 159 according to the suggested goals in paragraph 102-A.

4. WORKBOOK, Speed Clinic, page 181. OPTIONAL--you decide.

Lessons 103-104

1. Type the exercises on page 160, Lessons 103-104, following marginal instructions. Omit paragraph 103-B at this point.

2. Paragraph 103-B is a continuation of the report you previously typed about carbon paper. Follow the same instructions given for it. Type paragraph 103-H.

3. Read the marginal notation 104-A, page 162 and type the exercises on page 162 accordingly.

4. If you have not already typed on an electric typewriter, your instructor will want to show you how to operate one now. Repeat the drills on page 162 on the electric typewriter after you have studied the parts diagram which corresponds to the machine you are assigned to use. You will find the diagrams on pages viii-xi in the yellow pages of this book.

5. Read Supplementary Sheet No. 11 "Crowding and Spreading on Electric Typewriters." Insert a sheet of scratch paper in your electric typewriter and practice the examples shown at the bottom of the Supplementary Sheet. If you are using an I B M Selectric, your instructor will demonstrate the technique.

Lessons 105-106

1. Type the exercises on pages 163 and 164. Set your own goals for these exercises and type each as many times as you need to in order to achieve your goal. Marginal instructions may be disregarded.

2. There are three ways to make lines end evenly at the right margin. This is called "justifying" the lines. The most common illustration of "justified" lines is in your daily newspaper or any magazine you pick up. Office typists are frequently called upon to produce copy with an even right margin, so it is important that you learn how it is done.

   a. You may sometimes change a word or a sentence so that all your lines will end evenly.

   b. You may put some extra spaces between the words, to spread them out so that they fill lines evenly. When you do this, try to avoid putting the extra spaces of one line directly under those of the preceding line.

   c. If you prefer, you may spread or squeeze some words, thus stretching or condensing a line to make it fit.

   In all cases, you must type a line first, then see how much space is to be saved or added, and type it over with all the lines "justified." Regardless of the method you choose to use, you will always have to make a "rough" copy first in order to determine how much "justifying" is necessary. Look at the following copy and the illustration of the rough draft and finished copy. Then type the paragraphs with a 20-space line with single spacing. Center your copy and indent each paragraph three spaces.

Once in a while a typist has a task/// that is important/// enough for him to/// take extraordinary// pains in making it// look professional,// such as in writing// books and submitting articles to a maga-/ zine or newspaper.//	Once in a while a typist has a task that is important enough for him to take extraordinary pains in making it look professional, such as in writing books and submitting articles to a maga- zine or newspaper.

Once in a while a typist has a task that is important enough for him to take extraordinary pains in making it look professional, such as in writing books and submitting articles to a magazine or newspaper.

When you wish to justify a group of lines (that is, make all the lines end at the same point), you start by typing a first draft. You set the margins for the length of line you want to fill; and then you type the material, making every line come as close as you can to your desired point of line ending. Scrutinize the draft carefully and note exactly how many spaces have to be saved or inserted to make the lines end evenly. With a pencil, indicate where you will squeeze or spread the words. Finally, retype your good copy, being sure that you observe your marking. If you forget one, you will soon know it and have to start over.

Lessons 107-108

1. Omitting marginal instructions, type paragraph 107-A twice.

2. Take a five-minute timing on paragraph 107-B, then type it as directed for manuscript 29, using WORKBOOK paper, page 183.

3. Type Letters 44 through 47, pages 166 and 167, using WORKBOOK Letterheads, pages 185, 187, 189, and 191. Do not hand in any of these until you have completed Letter 47, or you may wait until after you complete Letter 53 if your instructor prefers. Be sure to review the illustrations for each type, paying close attention to the placement of any special parts. Envelopes to be addressed for each letter are on the reverse side of each letterhead.

Lessons 109-110

1. Type each line in paragraph 109-A, page 168 twice.

2. If you have forgotten the meaning of various revision marks, turn to page 112 in your text and review. Read the marginal instructions accompanying paragraph 109-B and select your method for typing the paragraph.

3. Read carefully the instructions given in paragraph 109-110-C, page 168, for typing letters 48-51, pages 169 and 170. Use WORKBOOK Letterheads, pages 193-200. Type Manuscript 30 as directed. Remember to make carbon copies.

Lessons 111-112

1. Type paragraphs 111-A and 111-B, page 171, according to marginal instructions.

2. Read the instructions in paragraph 111-112-C, page 171 and type letters 52 and 53, page 172 accordingly. Use WORKBOOK Letterheads, pages 201 and 203.

3. Type manuscript 31 as directed. If you have held all your letters for the "Letter Style Books," assemble it now and turn it in.

4. Turn to Supplementary Sheet No. 10--"Sample Letter." Assume your supervisor has just received this letter. He reads it and asks you (the typist) to make a copy of the letter and address a large envelope. Send the letter to: Mr. Wayne Lott, Big Chain, Inc., 685 Ryan Street, Sulphur, Louisiana. When you retype the letter, leave off the page number, SAMPLE LETTER (Semiblock Form), the parts of the business letter, and spacing notes. The word C O P Y must be typed in the top left-hand corner of the page to certify that you are mailing a copy of the letter and not the original. The original is filed in your office.

5. Review Supplementary Sheet No. 7--"Tabulating," and type the two tables on the next page using the tabulating method explained in the Supplementary Sheet. Center each table horizontally and vertically on separate half sheets of paper.

NEW EMPLOYEES--ALL BRANCHES

January 1 - May 30

NAME	BRANCH	DEPARTMENT	POSITION	DATE
Adams, Yvonne	San Fran	Music	Clerk	Jan 20
Allison, Allan	Chicago	Advertising	Layouts	Mar 10
Baker, Alexander	Chicago	Drugs	Buyer	Mar 12
Boer, Willard	New York	Drugs	Clerk	Apr 2
Burton, Frederick	San Fran	Executive	Asst Mgr	Jan 2
Chinnock, Susan	New York	Executive	Secy	Apr 19
Counts, Edward	Chicago	Advertising	Photog	May 27
Doyle, Richard	New York	Off Eqt	Salesman	May 15
Drury, Caroline	Chicago	Jewelry	Clerk	Feb 8
Edwards, John	Chicago	Off Eqt	Salesman	Mar 10
Esuark, Rutheta	Chicago	Personnel	Director	Mar 18
Everett, Polly	New York	Shipping	Steno	Jan 18
Farmer, Paul S.	New York	Buyer	Buyer	Jan 25
Farmer, Ralph	New York	Furniture	Clerk	Feb 8

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SALES ESTIMATES OF PREFABRICATED HOUSES

Revised December 8, 1957

Quarter	Chicago	New Orleans	New York	San Fran	Totals
1	12,000	8,000	10,000	7,000	37,000
2	14,000	12,000	15,000	10,000	51,000
3	18,000	15,000	18,000	12,000	63,000
4	20,000	12,000	15,000	10,000	57,000
1st-year total	64,000	47,000	58,000	39,000	208,000
1	20,000	12,000	15,000	12,000	59,000
2	24,000	18,000	24,000	15,000	81,000
3	30,000	24,000	32,000	20,000	106,000
4	33,000	25,000	30,000	20,000	108,000
2nd-year total	107,000	79,000	101,000	67,000	354,000

Lessons 113-114

1. WORKBOOK, Learning Guide: Business Forms Review, pages 205 and 206.

2. Type the drills on page 173, Léssons 113-114, following marginal instructions.

3. Read the instructions in paragraph 113-114-D, page 173 before typing Forms 20-31. Use WORKBOOK forms, pages 207-218.

   NOTE: When actually typing forms of this type in an office, you will probably be using a secured carbon pack with the printed material on each carbon copy. It will not be necessary, therefore, for you to make carbons of any of these forms. Generally, there are several copies needed for various departments and these will be provided.

Lessons 115-116

1. Type each line in paragraph 115-A twice.

2. Paragraph 115-B is Form 32 (white block in margin). Read the instructions and study the form; then type, using WORKBOOK Forms on page 219 or 220.

   NOTE: The series of dots are called "leaders." If you were producing the entire form on the typewriter, you would want to be careful to place each dot directly below the one above, not staggered.

3. Read the copy below Form 34, page 178 before typing it on WORKBOOK Form, page 221. Be sure to cut the page properly because you'll need the lower half for forms in Lesson 117.

4. Type Forms 35-36, page 178, WORKBOOK pages 223 and 224.

5. Read all the information pertaining to Forms 37-41, page 179, and type them using WORKBOOK forms, pages 225-228.

Lessons 117-118

1. Type the drills on page 180, Lessons 117-118. After you have typed paragraph 117-C as a drill, type it in proper form using WORKBOOK Letterhead 54, page 229.

2. Using WORKBOOK voucher checks, page 231 and 232, type Forms 42-43, page 180.

3. After you have studied the illustrations at the top of page 181, type Forms 44-48 according to instructions. Did you save the lower half of WORKBOOK page 221 for Forms 46-47?

Lessons 119-120

1. Type two perfect copies of each line in paragraph 119-A, page 182.

2. Type paragraph 119-B as a five-minute timed writing, then type as Manuscript 32, page 182.

3. Read the marginal instructions accompanying paragraph 119-C and type accordingly.

4. Study the manuscripts on pages 183 and 184, then type. Set your own goal for finishing each. Be sure you proofread carefully.

5. Type a ditto master of Manuscript 35, page 184 after you have typed it once. Ask your instructor to review the technique with you if you've forgotten. You may wish to draw some marginal decoration. If so, your teacher will help you get started.

Lessons 121-122

1. Type paragraph 121-A, page 185 at least once.

2. Read the copy in paragraph 121-B, page 185, and type as a five-minute timing. Try to keep errors within ½ per minute.

3. Type Manuscript 37, page 186 in single spacing. (Omit Manuscript 38.) The copy contains information you'll want to learn. Read and study it carefully before you type. Make three carbons.

4. Study Manuscript 39, page 187. It, too, contains some vital information you'll want to retain. Type according to instructions. Make two carbon copies.

5. WORKBOOK, Learning Guide: Expressing Numbers, pages 235 and 236.

Lessons 123-124

1. Follow all textbook instructions for this review lesson, pages 188 and 189. Use WORKBOOK forms, page 237 and 238 for Form 49.

   NOTE: Sooner or later you will be required to complete an application form and a personal data sheet. You may wish to substitute your own "vital statistics" for those given in the text. Ask your instructor if you may.

2. WORKBOOK, General Information Test on Part Five, pages 239 and 240.

3. Proceed with Progress Test on Part V, Lesson 125, pages 190-191. Use WORKBOOK pages, 241 and 246. If your instructor has another test for you, ask for it now.

   NOTE: In your WORKBOOK, pages 247-249, there are some optional technique drills. You should utilize this material if you and your instructor consider it beneficial to you.

Before beginning Lesson 126, study display lettering examples on the following page. After you have read the instructions, design a display of your own and type it to turn in. Try to be original.

Lessons 126-127

1. Type two perfect copies of each line in paragraph 126-A, page 193.

2. Read the marginal instructions carefully for paragraphs 126-B, page 193, and type each drill, concentrating on the instructions you have been given.

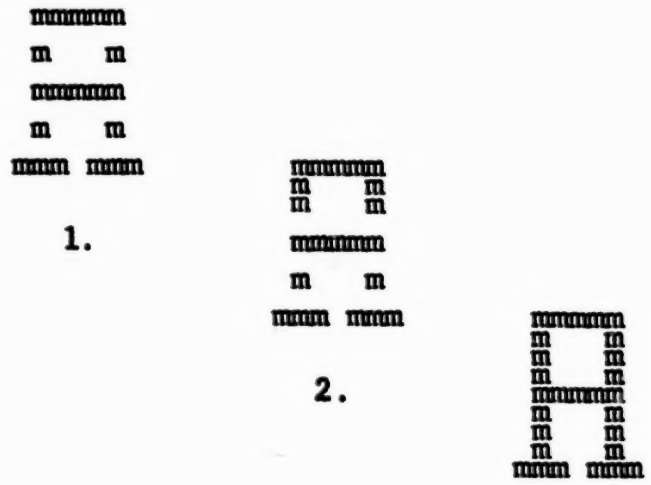
3. Type the entire manuscript on page 194. Read the second half of it on page 197.

4. Follow marginal instructions for all drills on page 195.

DISPLAY LETTERING EXAMPLES

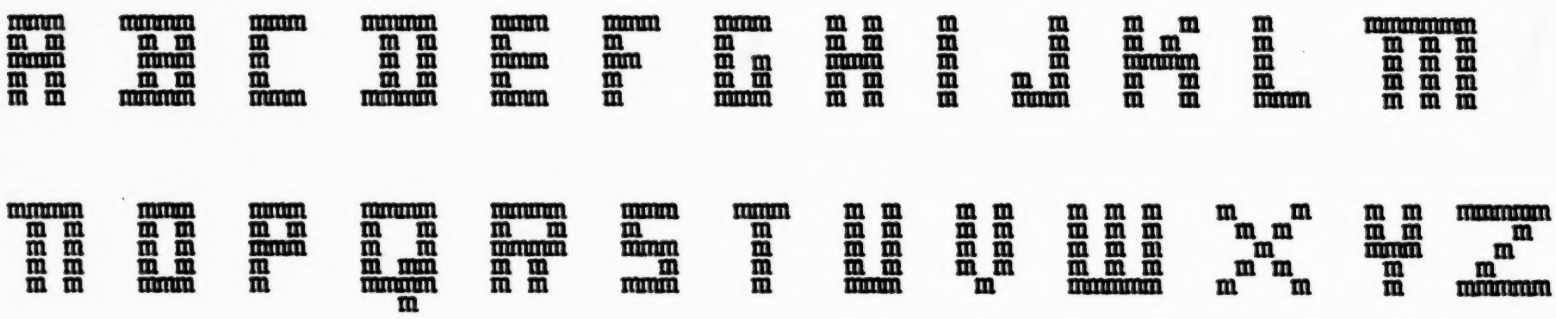
How to "Half Space" Vertically...

1. Type the material that will appear on the regular single-spaced lines.
2. Using the variable line spacer in the left cylinder knob, turn the paper down half a line (until the top of a small letter like w or m disappears under the aligning scale). Check the position by typing lightly one or two of the strokes that you wish to type between the single-spaced lines.
3. Having adjusted the paper for in-between writing, complete the fill-ins.

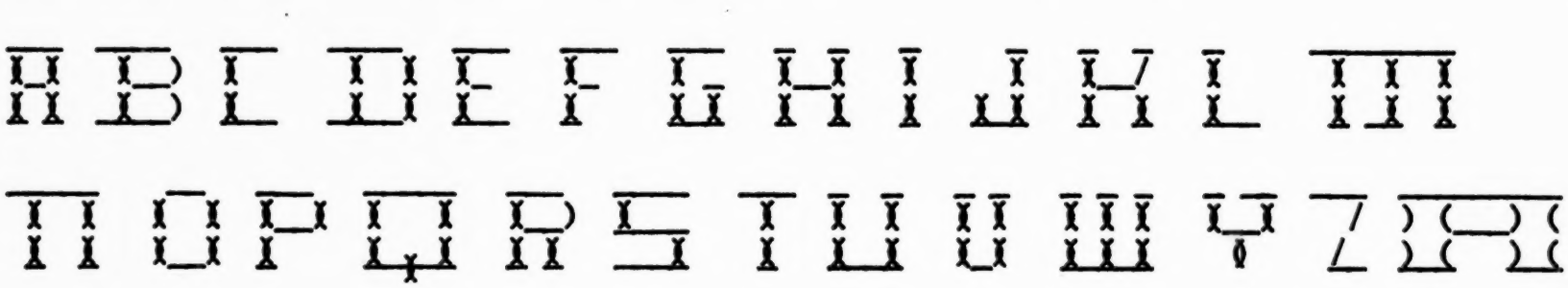


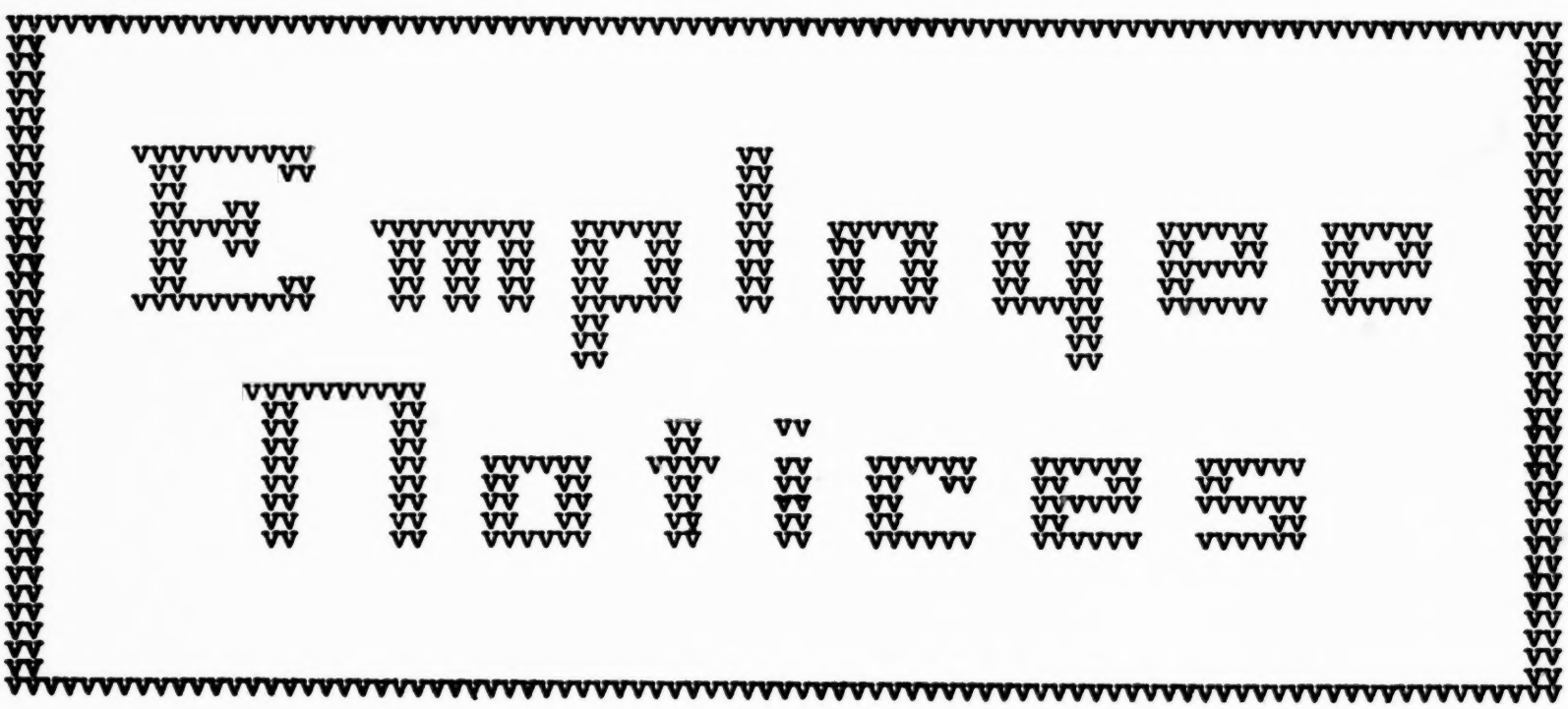
1. 2. 3.

Made with small "m's" and half-spacing



Made with pairs of parentheses, the underscore, and some diagonals





Lessons 128-129

1. Ask your instructor to help you evaluate your skill. Then decide which of the drills you should type in Lessons 128-129, pages 196-198.

   Be sure to read the material on page 197 if you haven't done so.

Lessons 130-131

1. Except for timing yourself, follow marginal instructions for drills on page 199, paragraph 130-F. Try to keep your eyes on your copy while typing the number reviews.

2. Practice the construction of the brackets used in the drills on page 200 by typing lines 24 and 25 first. After you have mastered the technique, complete all the drills on page 200.

Lessons 132-133

1. Omit marginal instructions for paragraphs 132-A and B, page 201. Type each line twice stressing accuracy.

2. Read paragraph 132-C for content, then type as a five-minute timed writing.

3. Read Letter 57 carefully, page 202, and study the second page headings illustrated on page 203. Type the letter using WORKBOOK paper, page 251. Use plain paper for the second page. Remember the carbon copy.

4. Type Letters 58 and 59, page 203 according to instructions.

   NOTE: The two illustrations of second-page headings are probably the most accepted and widely used forms. As is true with any other detail of format, there are other possible ways of doing it. Always check the files where you work to see what method your employer prefers, or ask. It is much less expensive to a company to take a few seconds to explain format procedures than to have you retype a letter.

Lessons 134-135

1. Type the drills on page 204. Take a five-minute timing on paragraph 134-C.

2. Type Letters 60-65, pages 205-206. Use WORKBOOK paper, pages 253-258. Study the stationery illustrations explained in the textbook and the additional material in the WORKBOOK.

Lessons 136-137

1. WORKBOOK, Learning Guide, page 259.

2. Type drills 136-A and B twice.

3. Read paragraph 136-C and follow marginal instructions for typing.

4. Read paragraph 136-137-D carefully. After you have read the entire paragraph, review it for study. The contents are points which you will need to know throughout your working experience.

5. Type Letters 66 and 67, page 208. Use WORKBOOK paper, page 261.

6. Type Letters 68, 69, and 70, page 209, using WORKBOOK paper, pages 263 and 265. Read the instructions carefully.

Lessons 138-139

1. Before beginning Lessons 138-139, turn to the extra practice material in your WORKBOOK, pages 267-270. Scan the material to determine which portion you need to practice. Spend a few minutes practicing using this material.

2. Type the drill material, paragraphs 138-A and B, page 210.

3. Type paragraph 138-C as a five-minute timed writing. As you proofread your copy, read also for content.

4. Type Tables 28-29 and 30-31, page 211, following textbook instructions.

5. Type Tables 32-33 and 34-35, page 212. Be extremely careful when you type the "leaders" shown in each table. They should be vertically straight as well as horizontally straight.

Lessons 140-141

1. Ignore the marginal instructions accompanying paragraph 140-B, page 213. Instead, set your own goals based on your achievement level and type as a five-minute timing. Repeat, after you have proofread, and increase your goal.

2. Type Table 36, page 214. Scan the material to help you determine where to set your tabs. The double rulings shown are made by using the variable line spacer for spacing. If you don't understand how to manipulate that part of your machine, ask your instructor to help you.

3. Read the printed copy above Table 37, page 215. The conclusion is on page 216. Following the instructions, type Tables 37, page 215, and 38, page 216. Make a carbon copy of both tables.

Lessons 142-143

1. Type paragraph 142-A, page 217 according to marginal instructions.

2. Read the marginal instructions accompanying paragraph 142-B, page 217. Follow them for producing the letter, except omit the ten-second pauses after each minute.

3. Type Table 39 according to instructions.

4. Type Letter 71, page 217. Use WORKBOOK paper, page 271.

5. Scan Table 40, page 218 to help you determine your tab stops. Type an exact copy after you have reviewed the information about "boxed" tables on pages 142 and 143 of your textbook.

Lessons 144-145

1. WORKBOOK, Learning Guide: Legal Papers, pages 273 and 274.

2. Type paragraphs 144-A, B, and C according to marginal instructions.

3. Read paragraph 144-145-D, items 1, 2, and 3, page 219. Omit the alternate suggestions.

4. If you did not read paragraph 144-C, page 220 for content when you proofread, do so now.

5. Type Manuscripts 42 and 43, pages 221 and 222 after you have studied carefully the marginal instructions. Rule lines with a red lead pencil.

6. Ask your instructor to show you some legal-sized paper and compare it to the standard 8½ by 11 you have been using.

7. Type forms 55 and 56, page 222 using printed WORKBOOK forms, pages 275 and 277. Complete the endorsement on the back of each printed form. Typing on printed forms of this type will be much easier if you release the Line-Space Ratchet Release.

8. Type Manuscript 44, page 223. Follow the instructions carefully. Make two carbon copies.

Lessons 146-147

1. Type each line in paragraph 146-A, page 223, twice.

2. Follow marginal instructions for typing paragraph 146-B.

3. Type paragraph 146-C following the "practice steps" instructions on the margin.

4. Read paragraph 146-147-D, but omit the alternate suggestions.

5. Type Manuscript 45, page 225. Make three carbon copies. Read the material before you type it. (Omit Manuscript 46.)

6. Type Manuscript 47-48, page 226. Use single spacing and make three carbon copies. Remember, your erasures should be just as neat on each carbon as they are on the original.

Lessons 148-149

1. Omit paragraphs 148-A and B, page 227. Take a ten-minute timing on paragraph 148-C, page 228. Proofread very carefully.

2. Type Tables 41-43, page 229 according to instructions.

3. Type Letter 72, page 229 using WORKBOOK paper, page 279.

4. Read Manuscript 49, page 230 before you begin typing. Then type it making three carbon copies. Rule with a red-lead pencil.

5. WORKBOOK, General Information Test on Part VI, pages 281 and 282.

6. Proceed with the Progress Test on Part VI, Lesson 150, pages 231 and 233. Use WORKBOOK paper pages 283 and 287. WORKBOOK III will now be needed. See your instructor.

Lessons 151-156

1. Unit 25, Lessons 151-156, pages 235 through 242, consists of skill development exercises. There is nothing new in any lesson. Study the marginal instructions accompanying each exercise and type accordingly, or alter the instructions, with the help of your instructor, to suit your achievement level better. Keep your work until you have completed Lesson 156. Compare your progress at the end of Lesson 156 with your work at the beginning of Lesson 151. Is your achievement level higher? If not, ask your instructor to help you discover causes for your weaknesses.

Lessons 157-158

1. WORKBOOK, Learning Guide: Review of Business Letters, pages 293, and 294.

2. Follow marginal instructions when typing drills, paragraphs 157-A, and B, page 243.

3. Notice the "Thumbnail Letter Index" in the margin of page 243, you will want to review the topics indicated as you type the letters in this unit.

4. Before beginning the letters on page 244, review the Letter Placement Guide Scale below.

	SHORT	AVERAGE	LONG
Estimate number of words in body of the letter.....	Under 100	100 to 200	Over 200
Set margin stops for corresponding line length*.....	4 Inches	5 Inches	6 Inches
Type date; then drop this many lines to inside address.....	5 Lines	5 Lines	5 Lines

*Reminder: There are 10 pica spaces to an inch & 12 elite spaces to an inch.

NOTE: Now that you have reviewed the Guide, keep in mind the placements it indicates, but try to type your letters accurately by "sight placement," i.e., insert the paper and type the letter with good visual placement without counting every line and space. Your ultimate goal, of course, is a "mailable" letter in the shortest possible time. You'll probably have to experiment a few times with "sight placement" before you master it.

5. Type Letters 74-77, pages 244, and 245. Be sure to read the instructions carefully and check all enclosures. Use WORKBOOK paper, pages 297-302. After these letters have been checked and returned to you, keep them--you'll need them for reference later.

Lessons 159-160

1. Warm up on paragraph 159-A, page 246 according to instructions.

2. Read paragraph 159-B carefully and absorb the contents. Type as a five-minute timed writing.

   NOTE: Notice the "bcc" and "cc" illustration in the margin, page 246.

3. Type Letter 78, page 247. Read the instructions carefully. Use WORKBOOK paper, page 303.

   NOTE: Be very careful to make all your erasures on carbon copies as neat as possible. Do not hand in until you have completed Letter 81, page 248.

4. Type Letters 79-81, page 248. Read the instructions carefully. Do you still have Letters 74-77? You should. Use WORKBOOK paper, pages 305-309.

Lessons 161-162

1. Type paragraph 161-A, page 249, three times.

2. Omit unblocked marginal instructions for Letter 82, page 249. Try to make an accurate copy the first time you type it. Use WORKBOOK paper, page 311. Keep the letter until you have completed Letter 84, page 250.

3. Type Letters 83 and 84, pages 249 and 250, using WORKBOOK paper, page 313 for Letter 83.

Lessons 163-164

1. Type each line in paragraph 163-A and B, page 251, twice.

2. Follow marginal instructions when typing paragraph 163-C.

3. WORKBOOK, Learning Guide: Alphabetic Filing Rules, pages 315-317.

4. Read the instructions carefully and type Form 57, page 252. Use WORKBOOK paper, page 319.

5. Study the illustration showing the use of the card holder, page 252 and type Form 58. Use WORKBOOK paper, pages 321, and 322. Type on both sides of the WORKBOOK forms.

6. Read "To Chainfeed Envelopes and Cards," page 253. Ask your instructor to demonstrate the procedure.

7. Type Form 59, page 253.

   NOTE: If you cut paper for these index cards, be certain that it is straight and each is the same size.

8. Type Form 60, page 253, using WORKBOOK paper, pages 323 and 324.

Lessons 165-166

1. Type paragraphs 165-A and B according to marginal instructions.

2. Take two five-minute timed writings or paragraph 165-C, page 254.

3. Do not read or study Form 61, page 255 before typing. As was suggested in paragraph 165-C, you must learn to "think while you type." Use WORKBOOK paper, page 325.

4. Omit Forms 62-63 unless your instructor tells you otherwise.

5. Read the printed material on page 256, Form 64, then type, using WORKBOOK paper, page 327.

6. Omit Form 65, page 256, if your instructor does not object.

7. Type Form 66, page 256. Follow instructions carefully. Use WORKBOOK paper, page 331.

Lessons 167-168

1. Type each line in paragraph 167-A, page 257, three times.

2. Omit paragraph 167-B marginal instructions. Type Form 67, using blocked instructions. Use WORKBOOK paper, pages 333 and 334.

3. Type Form 68, page 257, using WORKBOOK paper, page 335. Address the postal cards on page 336.

4. Type Letter 85, page 258, on plain paper--think as you type.

5. Cut a stencil of Letter 85. Show it to your instructor before you run off several copies.

Lessons 169-170

1. WORKBOOK, Learning Guide: Manuscript Review, page 337 and 338.

2. Type paragraphs 169-A, and B, page 259, according to instructions.

   NOTE: Beginning with paragraph 169-C, page 259, keep all the manuscripts you type through Lesson 174. Prepare the table of contents and title sheet before you hand in your work. You may, however, take any part of it to your instructor for help while you are working. Make one carbon of each assignment.

3. Take a five-minute timed writing on paragraph 169-C. Then, retype it carefully for your booklet according to instructions on page 268 (Manuscript 61).

   NOTE: You may want to use the visual guide on page 339 in your WORKBOOK.

4. Review formal manuscript arrangement on pages 113-114 of your textbook <u>and</u> ruled table arrangement, pages 139-140.

5. Type manuscript 51, page 260. Be sure you read the contents carefully. Each manuscript contains information you should know.

6. Type Manuscript 52, page 261. Read <u>all</u> instructions carefully.

7. Type Manuscripts 53 and 54, pages 262 and 263.

8. Type Manuscript 55, page 263.

   NOTE: Have you remembered to underscore all italicized words?

Lessons 171-172

1. Unless you need the practice, omit paragraphs 171-A, B, and C, page 264 and proceed with your manuscript booklet.

2. Type Manuscripts 56 and 57, page 265.

3. Type Manuscript 58, page 266. Remember, anticipate how many lines will be needed for the footnotes.

4. Type Manuscript 59, page 267. Review any proofreaders' marks you may have forgotten.

Lessons 173-174

1. Type each line in paragraphs 173-A and B, page 268, twice.

2. Take a five-minute timed writing on paragraph 173-C, page 268; then retype as Manuscript 60 for your booklet.

3. Prepare the table of contents and title sheets according to instructions given for manuscripts 62 and 63, page 269.

   NOTE: Be sure to align properly the "leaders" in the table of contents.

4. When you have completed all the manuscript assignments, collate your report properly and staple for a "bound manuscript." Proofread again carefully before you hand it in. The entire job should be perfect.

5. Type Form 69, page 269, using WORKBOOK forms, page 341.

6. Study the correspondence transfer form (Form 70, page 269) and the instructions before you type it. Use WORKBOOK paper, page 343.

   NOTE: This is a typical example of the type of instructions you will be expected to grasp immediately when you begin working. Think carefully!

7. WORKBOOK test, pages 345-346. General Information Test on Part VII.

8. Proceed with the Progress Test on Part VII, Lesson 175, pages 270-272. Use WORKBOOK paper provided.

9. If your instructor has another test for you, ask for it now.

Lessons 176-177

1. Before beginning Lessons 176-177, you may wish to practice speed and/or accuracy using the practice material in your WORKBOOK, pages 351 and 352.

2. Type each line in paragraph 176-A, page 274, three times.

3. Take 2 three-minute timings on paragraph 176-B. Proofread your first copy carefully and set your goal for the second one a little higher.

4. Type paragraphs 176-C and E according to instructions.

5. For the remainder of Lessons 176-177, pages 275-276, follow marginal instructions.

Lessons 178-179

1. Type the drills on page 277 according to instructions. Concentrate on keeping a steady rhythm at all times.

2. Type the first three paragraphs on page 278 as a five-minute timing. After you have proofread carefully, type the entire page as a 10-minute timing. Proofread carefully and rest your arms for a few minutes before proceeding with the remainder of the lesson.

3. Complete the drills on page 279 according to marginal instructions.

Lessons 180-181

1. These lessons contain drills with figures. Type them all following instructions carefully. Be sure to keep your eyes on the copy.

Lessons 182-183

1. Type each line in paragraphs 182-A and B twice.

2. Read paragraph 182-C before you type it as a five-minute timing.

3. Read paragraph 182-D and study it carefully.

4. WORKBOOK, Learning Guide: Review of Capitalization, pages 353-354.

5. After you have read the instructions, type letters 87, 88, and 89, page 283. It is important that you produce an accurate letter on the first attempt, so think carefully. Use WORKBOOK paper, pages 355, 357, and 359. Don't neglect to make the proper number of carbons.

6. Letters 90 and 91, page 284, should be typed with the same concentration you applied on the preceding ones. Use WORKBOOK letterhead, pages 361-363.

Lessons 184-185

1. Type each line in paragraph 184-A twice.

2. Read paragraph 184-B and study it carefully. Type, making one carbon copy for your own files. The information provided will always be useful to you.

3. WORKBOOK, Learning Guide: Review of Comma Usage, pages 365, 366.

4. Your instructor may wish to dictate Letter 92 to you. You should ask. If not, follow the instructions carefully for Letters 92 and 93. Use WORKBOOK paper, pages 367 and 369.

5. The instructions in No. 4 also apply to Letters 94, 95, and 96. Use WORKBOOK paper pages 369 and 371, but type Letter 95 on plain paper. Be sure to read the letters so you will know how many carbons you need to make.

Lessons 186-187

1. Read paragraph 186-C, page 288 in your textbook; then complete WORKBOOK, Learning Guide: Review of Semicolon Rules, pages 373, 374.

2. Type each line in paragraphs 186-A and B twice.

3. Type paragraph 186-C, page 288. Be sure you understand the rules for use of the semicolon before you proceed with the lesson.

4. Your instructor may wish to dictate Letter 97, page 289 to you. You should ask. If not, type it according to instructions.

   NOTE: From time to time, any office becomes very busy. During these times, your employer may be too rushed to prepare material for you to type; so you will probably be expected to turn out a finished copy from his dictation "directly into the typewriter."

5. Follow instructions in No. 4 for Letter 98, page 289.

6. Type Forms 72-73 using WORKBOOK paper, page 375. Remember the carbon copies.

Lessons 188-189

1. Type each line in paragraph 188-A and B, page 290 twice.

2. Read paragraph 188-C, then take 2 five-minute timings. Try to keep your errors within 1/2 per minute.

3. Read the blocked instructions (blue print) at the top of page 291; then read the problems sketched for you in Tables 51, 52, 53, and 54. All data that you will need to produce the tables are specifically indicated, and you will want to re-read the instructions carefully before typing each table. Please hand in all the tables and related letters together.

Lessons 190-191

1. Warm up on paragraphs 190-A and B, page 293. Type each line twice. After you have proofread and circled your errors, practice any word which was difficult for you.

2. Read the contents of paragraph 190-C before you type it as a five-minute timing.

3. As you did in Lesson 189, read all the material on pages 294 and 295 to get a "bird's eye view" of the projects. Study the summary of guides for arranging a ruled table, page 295. There is a textbook error in the figures. Check the average. Can you find it? Re-read instructions accompanying each table and type Tables 55-61 accordingly. Hand in only when you have completed Table 61, page 295.

   NOTE: Be sure your vertical rulings are exactly perpendicular to the horizontal ones you make with the underscore key. Use BLACK ink.

Lessons 192-193

1. Type two perfect copies of each line in paragraph 192-A, page 296.

2. Follow the instructions (first) and type paragraph 192-B, page 296.

3. Read the situations discussed in Table 62, letter 102, and Table 63, page 297; then type them according to instructions. All of these problems will involve some thought on your part--you'll probably want to re-read carefully.

Lessons 194-195

1. Type each line in paragraph 194-A, page 298, three times. Strive for accuracy.

2. Read paragraph 194-B carefully. As you read, practice the manipulations described without typing.

3. Reproduce the illustration in the margin opposite paragraph 194-B.

4. Read paragraph 194-C and the marginal instructions. Type as Manuscript 65. Make one carbon copy.

5. Read paragraph 194-195-D; then type, as indicated, Manuscript 66 on a spirit master and Manuscript 67 on a stencil, pages 299-300. Run off eight copies of each on your machines. Even though most of the contents of these manuscripts are review, read them carefully.

Lessons 196-197

1. If you are not presently using an electric typewriter, ask your instructor if you may for this lesson. Type each line in paragraph 196-A, page 301, three times.

2. You have already been introduced to the electric typewriters, so some of the mechanics described in these lessons will be review. There is, however, some information discussed which might be new to you. Scan the entire lesson before you type it on an electric typewriter. Note carefully the marginal instructions, particularly the last one at the end of the manuscript on page 304.

Lessons 198-199

1. Follow marginal instructions when typing paragraph 198-A and B, page 304.

2. Type paragraph 198-C as a five-minute timed writing. If you don't finish the copy, read the remainder for content after you proofread.

3. Paragraph 198-199-D will be a review in line justification. Read the steps before you begin or refer to page 35 of this book. Make one carbon copy of your finished product.

4. Type Manuscript 70, page 306, according to instructions--except, don't make a carbon copy.

5. Type Manuscript 71, page 306. Make one carbon copy.

6. Scan the problems on page 307 for an overall idea of what you will do. Then, type Table 64, Letter 104, and Letter 105 carefully. Use WORKBOOK paper, pages 377-379. Hand in after you have completed Letter 105-Table 65.

7. WORKBOOK test, pages 381-382. General Information Test on Part VIII.

8. Proceed with the Progress Test on Part VIII, Lesson 200, pages 308-309. Use WORKBOOK paper, pages 383-386.

9. If your instructor has another test for you, ask for it now.

Before beginning Part IX, ask your instructor to help you evaluate your progress in order to determine which elements of typewriting you should emphasize during this refining period.

Lessons 201-202

1. Follow marginal instructions which accompany paragraph 201-A, page 311.

2. Read the instructions carefully and type paragraph 201-B accordingly.

3. Type each line in paragraph 201-C twice. Double space between each line group. Repeat, if you make more than two errors in a group.

4. Follow marginal instructions when typing paragraph 201-D.

5. Follow all marginal instructions for paragraphs 201-F and 202-E, pages 312-313.

6. If you have been typing steadily since you started this lesson (201), rest for a few minutes before taking a five-minute timing on paragraph 202-F, page 313.

Lessons 203-204 and 205-206, pages 314-318, are also skill drives. Evaluate your own skill level; then type these lessons. Follow all instructions carefully. When you have finished, you may want to ask your instructor for additional material to help you in refining your typing techniques.

Lessons 207-208

1. Warm up using the copy in paragraph 207-A, page 319.

2. Read the marginal instructions beside paragraph 207-B and type the exercise accordingly. Retype as Manuscript 73. Read the instructions carefully. This manuscript is part of the secretarial project which follows.

3. Paragraph 207-208-C, page 320, is a project simulating a realistic situation. For all the assignments, you will need to call on your best ability to follow instructions. No outside help (your teacher or classmates) can be enlisted--you're on your own! Use WORKBOOK paper, pages 389-398. Hand in when you have completed the entire project. You should complete the project in about one hour.

Lessons 209-210

1. Type each paragraph in 209-A, page 322, at least twice. If you make more than one error per paragraph, type each a third time.

2. Follow marginal instructions when typing paragraph 209-B.

3. Read all the material and instructions included in project B, pages 322-324. Make a "mental note" of the instructions that will require your close attention; such as, number of carbon copies, enclosures, etc. Your employer, Mr. Lawrence, wants all this material ready for distribution in about one hour. Begin timing yourself after you have scanned the material. You should finish all the assignments in an hour and fifteen minutes, at the most--so stop then. Mark your total time in the left, top corner of Form 75 and turn in your work. WORKBOOK paper, pages 399-404, is to be used according to instructions.

Lessons 211-212

1. Follow marginal instructions for paragraph 211-A and B, page 325.

2. Type the letter, paragraph 211-C, as a five-minute timed writing. Make corrections as you type. Repeat timing, trying to decrease your errors.

3. Do not preview Project C, pages 325-327. Read these general instructions and begin timing.

   a. Assemble your supplies: WORKBOOK paper, pages 405-410, carbon paper (several sheets), onion skin paper (several sheets), typewriter eraser and carbon eraser, black-ink pen, envelopes (large), plain bond paper. Be sure your work area is neat and supplies accessible.

   b. On the last (file) carbon copy type the names of all persons receiving blind carbon copies in the top left-hand corner. An additional "bcc" note should be shown on the file copy, too.

   c. Address envelopes where they are needed.

   d. Read all figures in tables to confirm totals.

   e. Ask only your instructor if you have questions as you proceed.

You should complete this project in 1¼ hours. Mark your time, and turn in your work.

Lessons 213-214

1. Ask your instructor for copy for a 10-minute timed writing; then warm up on paragraph 213-A, page 328. Type each paragraph twice.

2. Read paragraph 213-B carefully.

   NOTE: Project D is primarily an exercise in arrangements for a conference involving travel, hotel facilities, and material to be distributed. You do not have a time limit on this project, but certainly it should be completed within a reasonable time. Try not to have to "start over" on your assignments. Read all instructions carefully, especially those referring to distribution. Use WORKBOOK paper, pages 411-416.

Lessons 215-216, 217-218

1. Before beginning either of the projects (E and F) in these four lessons, warm up on the review lines at the beginning of each lesson. Follow marginal instructions.

2. Projects E and F, pages 331-337, will test further your mastery of typewriting techniques as well as your ability to follow instructions. Read all notations and instructions carefully and proceed with the projects. These are your last learning experiences--they should be your very best!

Ask your instructor for instructions before you begin the testing series in Lessons 220-225.

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for

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THINGS TO REMEMBER

1. Standard size typing paper is 8½ x 11. Government paper is 10½ x 8.
2. Pica print is the large print which has 10 spaces to an inch and 85 typing spaces across a standard size sheet of paper. Government paper has 80 spaces measuring across a pica scale.
3. Elite print is the small print which has 12 spaces to an inch and 102 typing spaces across a standard size sheet of paper. Government paper has 96 spaces measuring across an elite scale.
4. Standard typewriters provide 6 single spaced lines to an inch up and down the paper--this applies to both pica and elite print.
5. There are 66 lines up and down to a full sheet of standard size typing paper and 33 to a half sheet. Government paper has 63 lines up and down and 31 lines to a half sheet.

FINDING THE CENTER OF THE PAPER

Insert your paper so that the center comes at 50 on the printing scale. If your scale has fewer than 95 marked spaces, however, use 40 instead of 50 as the centering point for the paper, for setting the paper guide, and for planning margins.

Each typewriter has a paper guide that can be adjusted to guide paper into the machine so that the center of the paper will come at whatever point on the scale you wish. To adjust the paper guide so that it will center your paper at 50, take these steps:

1. Use the space bar or carriage release and set the carriage at 50.
2. Mark the center of the paper, at the top, by a pencil mark or crease.
3. Insert the paper.
4. Loosen the paper by depressing the paper release.
5. Check to see if the paper is straight--move it so that its center mark is at the printing point.
6. Restore paper release to normal.
7. Adjust the paper guide: Move it so that its blade edge is snugly against the left edge of the paper.

You may also find the center of your paper by placing your paper guide on zero. Then divide 2 into the total number of typing spaces across your paper. For example, if your paper reads 0 to 85 on the scale: Disregard the ½ and the center of your paper is 42--this also tells you your print is pica. If your paper had read from 0 to 102 on the scale, your center would be 50 or 51 to be exact, and you would have elite print.

$$\begin{array}{r} 42\tfrac{1}{2} \\ 2\overline{)85} \end{array} \qquad \begin{array}{r} 51 \\ 2\overline{)102} \end{array}$$

HORIZONTAL CENTERING

To center a line or word across your paper, follow these steps:

1. Clear tabs and set a tab stop at the center of your paper.

2. Place your carriage at the center of your paper. (40, 50, or whatever your center is).

3. Backspace once for every two strokes (beginning with the first) in the line you are to center--then type the full line. NOTE: Blank spaces count as a stroke.

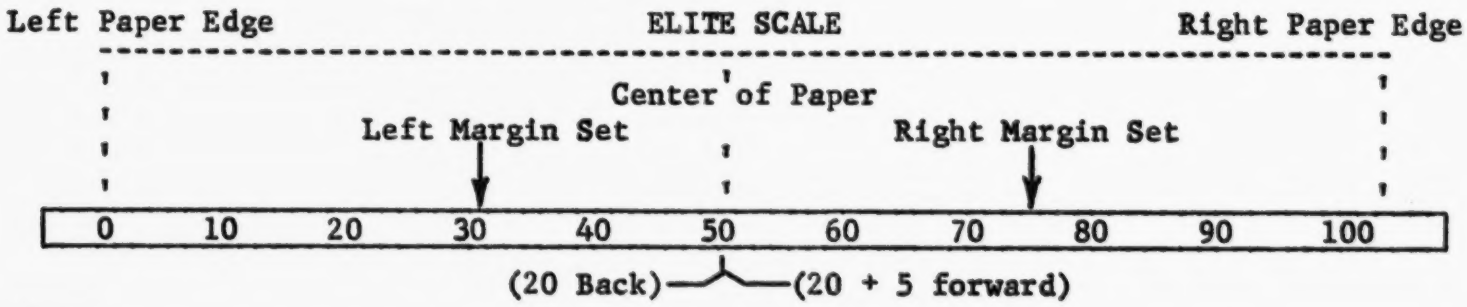
4. Place your carriage back at the center of the paper for the beginning of the next line, and again backspace once for every other stroke. For example:

Mary Adams (5) Backspaces

FIGURING A 40-SPACE LINE

Let's say the longest line in the drill you have been assigned to type will use up 40 spaces or strokes across your paper. These 40 spaces are referred to as a 40-space line and should be centered on the page according to the following steps:

1. Crease your paper in the center and place it in the typewriter so that its center comes at 50 on the printing scale. (Use 40 as the center only when you have fewer than 95 marked spaces on the scale.)
2. Divide 2 into the space line which we said was to be ◁40▷ . $2\overline{)40}$ (20)
   NOTE: If you put half of your 40-space line (½ of 40 = 20) to the left of the center of the paper, and half to the right, you should have a centered 40-space typing line. Do not forget to add 5 extra spaces to the right margin. This allows for variation in the length of the last word on each line. A warning bell will ring when the carriage is 7 or 8 spaces from the right margin. When the bell rings (1) finish a short word or divide a long word on a syllable: (2) return the carriage, and start the next line. Press the Margin Release, if necessary.



CHECK:

a.
```
  50  Center of Paper
- 20  ½ of 40-space line
  30  = Left Margin Set
```

b.
```
  50  Center of Paper
+ 20  ½ of 40-space line
  70
+  5  Spaces for Warning Bell
  75  = Right Margin Set
```

c.
```
  70  Right Margin before 5 extra spaces
- 30
= 40  Space Line
```

60-Space Line (◁60▷)
Use the same procedure to figure a 60-space line. Add and subtract 30 from 50 (center of paper) instead of the 20 used above because (½ of 60 = 30).

COMMON MARGIN SETTINGS
(With the paper centered at 50*)

Line Length Desired	Left Margin Stop At		Right Margin Stop At	
40 Spaces	50 - 20 =	30	50 + 20 + 5 =	75
50 Spaces	50 - 25 =	25	50 + 25 + 5 =	80
60 Spaces	50 - 30 =	20	50 + 30 + 5 =	85
70 Spaces	50 - 35 =	15	50 + 35 + 5 =	90

* With paper centered at 40, settings will be 10 lower than shown on this table.

CONVERTING INCHES TO SPACES
(When Planning Margin-Stop Settings)

Directions often indicate the length of typing line in terms of inches. When planning the setting of margin stops, the typist must translate these inches into spaces.

Number of Inches in the Line	Pica Print 10 Spaces = 1 Inch	Elite Print 12 Spaces = 1 Inch (Round Off)
4"	40-Space Line	50-Space Line
5"	50-Space Line	60-Space Line
6"	60-Space Line	70-Space Line

PICA or ELITE

1. If you have pica print (the large print, pronounced pie-ka), it takes 10 typing spaces measuring across your paper (horizontally) to equal one inch.

2. If you have elite print (the small print, pronounced ay-leet), it takes 12 typing spaces measuring across your paper (horizontally) to equal one inch.

3. To determine the difference between pica and elite print, follow these steps:

   a. Insert your paper in the typewriter so that the center of your paper will be either 40 or 50. In this example, we will use 50.

   b. Check to see where the left edge of your paper falls on the scale--now the right edge.

ROYAL TYPEWRITER PICA SCALE

Left Paper Edge — Right Paper Edge

8½ x 11 Paper

0	10	20	30	40	50	60	70	80	90	100

   c. Subtract the left paper edge (8) from the right paper edge (93).

```
----- 93
    - 8
      85
```

   d. If you are using standard size typing paper (8½ x 11), your answer is 85 for Pica Print Typewriters. This also means you have 85 typing spaces across your paper. To double check your answer, multiply the width of your paper (8½) times one pica inch which is (10). Remember, pica print takes 10 spaces to equal one inch so ($8\frac{1}{2} \times 10 = \frac{17}{2} \times 10 = 85$).

   e. If your same sheet of paper was inserted in an Elite Print Typewriter, it would read this way:

ROYAL TYPEWRITER ELITE SCALE

Left Paper Edge — Right Paper Edge

8½ x 11 Paper

0	10	20	30	40	50	60	70	80	90	100	110	120

   f. This time, the left edge of your paper is one space back from 0 and the right edge ends on 101. Add the left paper edge to the right paper edge.

```
  101
+   1
  102
```

   Your answer is 102 for Elite Print Typewriters. You also have 102 typing spaces across your paper. Check: 8½ (paper width) x 12 (one elite inch) = $\frac{17}{2} \times 12 = 102$.

   g. When setting margins on the older model Underwood Typewriters (illustrated in the drawing on p. ii in these job sheets) you will find the small numbers on the Carriage Position Scale control the left margin even though they appear on the right side, and the larger numbers control the right margin even though they appear on the left. This method of margin setting only applies to Underwood's older models since their most recent typewriters have the small numbers appearing on the left side of the Carriage Position Scale and the large numbers on the right. NOTE: 40 is the center of your paper on the scale below because your scale has fewer than 95 marked spaces. In order to make 40 the exact center, move your paper guide 2 spaces to the left of 0.

UNDERWOOD TYPEWRITER PICA SCALE

Left Paper Edge — Right Paper Edge

8½ x 11 Paper

90	80	70	60	50	40	30	20	10	0

TYPEWRITING CONTEST RULES

A. Rules for Correcting Papers

1. General Rule. Every word (including its following punctuation and spacing) omitted, inserted, misspelled or changed in any way from the test copy must be penalized. Only the one error may be charged in any word.

2. Errors in Printed Copy. Any error in the printed test copy may be copied exactly or corrected.

3. Punctuation and Horizontal Spacing. An otherwise correct word must be marked as an error if its following punctuation mark or spacing is omitted, incorrectly made, or changed from the copy.

4. Erasing. Erasing is not allowed, unless agreed upon prior to a specific test.

5. Transposition. Any transposition in any word or group of characters constitutes an error. Single words or groups of words that are transposed are penalized one error for the transposition, plus one error for each mistake in the transposed matter.

6. Rewritten Matter. Rewritten words, groups of words, or characters are charged one error for the rewriting, plus an error for each mistake in the rewritten matter.

7. Last Word. An error made in the last word typed, whether the word is completed or not, must be charged.

8. Crowding, Piling, and Misspacing. No word shall occupy other than its proper number of spaces. If a portion of another character extends into the space between words so that it would overlap a portion of any character that might be in that space, it is an error.

9. Word Division. A word incorrectly divided at the end of a line is penalized.

10. Faulty Shifting and Lightly Struck Characters. Unless the complete character is discernible, an error is charged.

11. Left-Hand Margin and Paragraph Indention. The first character on all lines, except those that begin paragraphs, must appear at the same point on the line scale--at the left margin. Each line not starting thus, and each paragraph indented other than 5 spaces will constitute errors.

12. Short and Long Lines. The last character typed on each line (other than the last line of a paragraph or of the test) must rest on same space. Margins must be as even as possible.

13. Line Spacing. Double spacing is required. Each line irregularly spaced is penalized one error.

14. Cut Characters. If any part of a character or word is cut off at the edge of the paper, it is an error.

OPERATING A GENERAL ELECTRIC INTERVAL TIMER CLOCK

Start off with both hands of the clock on 10--turn the hands counterclockwise and stop on "1" if the drill calls for a one minute timing. As soon as you pull the handle down, it will stay down, and the clock will begin ticking. It rings automatically when the one minute is up.

FIGURING YOUR WORDS A MINUTE (wam)

Always double space your timings and never erase on a timing. Type as much as you can while the clock is ticking. If you complete the paragraph before the clock stops, start back at the beginning. Be sure to stop though when the bell rings on the clock.

Example	Words	Score
If Mr. Quigley can have sixteen crews out by	9	25 words
the midlle of June, you can take the first prize.	19	-10 1 error
This prize is worth taking, too; it provides	28	15
a January excursion up to Quimby for all winners.	38	15 wam. 1/15

1	2	3	4	5	6	7	8	9	10

Each block represents 5 strokes--it takes 5 strokes to equal one average word. Blank spaces count as a stroke.

1. Let's say the bell rang after you typed the "t" in the word too (the first line in the second paragraph). Notice the number in the right margin. If you type the first two lines in one minute, you have typed 19 words--but you typed part of the third line also. Check to see what square in the block below the letter "t" falls in. You will notice it is in the 7 block. Normally you would add 7 + 19 to compute your total number of words, but the third line is the beginning of a new paragraph and is indented 5 spaces; so, subtract 1 from 7. The total number of typed words will be: 6 + 19 = 25.

2. Go back and circle errors. Remember, count only one error to a word. Typing contest authorities have set a penalty of minus 10 for each error, because they figured you would lose 10 words from the time it took you to correct that error until the time you started to type again. In the example above, there is one error--midlle.

   25 Words
   - 10 1 Err.
   15

3. Divide the time (one minute) into your score of 15 to get your correct words a minute (wam). If this had been a two minute timing, you would divide 15 ÷ 2 = 7 1/2 = 8 wam. If you have a half or more, count it as the next higher number.

   15 wam
   1/15

> The formula reads: WORDS minus ERRORS divided by the TIME = the correct WAM

SPEED SPRINTS

A speed sprint or 12 second timing is a short timing in which you try very hard to reach a new rate of typing for 12 seconds. Always pick as your goal a few words above your present top rate. For example, if you typed 15 wam on the Alphabet-Review Paragraphs in Lesson 13, then 20 or 25 would be a good goal on the 2 & 3-Letter Speed-Up drills in Lesson 11. When you are able to reach this new goal with no more than one error, raise your goal higher. Place your score in the right-hand margin beside each timing. You do not have to count off for errors because speed sprints are used only to boost speed.

VERTICAL CENTERING

When any material is centered exactly, it will seem to be a little low. If you want something to seem to be centered, you must raise it just a bit above what would be the perfect center. The bottom margin should be at least one or two lines wider than the top margin.

Typed material may be single, double, or triple spaced. When it is single spaced, typing appears on each line. In double spacing, typing appears on every other line with 1 blank line between the typed ones. In triple spacing, typing appears on every third line with 2 blank lines between the typed lines.

SINGLE SPACING

To center vertically (up and down), follow these steps: NOTE: There are 33 lines up and down to a half sheet of 8½ x 11 paper and 66 lines to a full sheet.

1. If you have 5 lines to be centered vertically on a half sheet using single spacing, subtract 5 from 33 to see how many blank lines you have left.

```
 33 lines to ½ sheet
- 5 typed lines
 28 blank lines left
```

Mary Adams
Harry Hale
John Monks
Ruth Smith
Ron Wilson

2. Now divide 2 into 28 to get equal top and bottom margins $2\overline{)28}$ = 14. Count down 14 lines from the top of your paper and begin typing on line 14.

3. Check your work as follows:

```
  13 blank lines at the top
+  5 typed lines
  15 blank lines at the bottom
= 33 total number of typing lines on a ½ sheet
```

DOUBLE SPACING

Figure the same 5 lines using double spacing--half sheet. For every double spaced line, count only one blank line because you actually type on the second line.

```
  5 typed lines
+ 4 total blank lines between typed lines
  9 = total number of lines you
      know will be used
```

```
  33
- 9
 24 blank lines left
```

$2\overline{)24}$ = 12 come down 12 lines from the top of your paper

Mary Adams

Harry Hale

John Monks

Ruth Smith

Ron Wilson

```
Check:  11
      +  9
        13
      = 33
```

TRIPLE SPACING

Figure the same 5 lines using triple spacing--half sheet. For every triple space, count only two blank lines in between the typed lines because you actually type on the third line.

```
  5 typed lines
+ 8 blank lines
 13 = total number of lines
      you know will be used
```

Mary Adams

Harry Hale

```
  33
- 13
  20 blank lines left
```

John Monks

Ruth Smith

$2\overline{)20}$ = 10

Ron Wilson

```
Check:  9
      + 13
        11
      = 33
```

TABULATING

If you are asked to tabulate columns and you prefer not to leave the usual 6 spaces between columns or you decide your copy would look better if you had more or less than 6 spaces between columns, then follow the steps below using this STATISTICAL REPORT as your guide.

STATISTICAL REPORT

States	Cities	Number	Date	Year
Alabama	Montgomery	10	September 5	1903
California	San Francisco	18	July 22	1905
Oregon	Eugene	21	August 23	1930
Louisiana	Lake Charles	23	April 26	1931
Virginia	Norfolk	25	January 18	1942
22 (L.Mar.)	41 (1st Tab)	63 (2nd)	78 (3rd Tab)	98 (4th)
(10) ....9....	(13) ....9....	(6) ....9....	(11) ....9....	(4)
California	San Francisco	Number	September 5	Year--KEY

1. Clear out any tab stops that may be set.

2. Check to see whether you have pica or elite print. Remember: Pica print has 85 available typing spaces measuring across the paper and elite print has 102 spaces across 8 1/2 x 11 paper.

3. Count the number of strokes in the longest word of each column and add them all together. You must consider individual headings above the columns in this calculation. For example: 10 + 13 + 6 + 11 + 4 = 44.

4. Subtract the figure you got in Step 3 from the total number of typing spaces on your paper. This is elite print so the paper has 102 available spaces across (horizontally). 102 - 44 = 58 blank spaces.

5. Divide 6 into 58 since you want all blank spaces to be equal. The number 6 represents the number of places you will leave blank spaces--this includes the left and right margins and the spaces between columns.

```
  9
6/58
  54
   4
```

Since there is a remainder of 4, it is necessary to place these 4 extra spaces somewhere. For better balance, add 2 of these 4 extra spaces to the left margin and 2 to the right margin. The left and right margins will each contain 11 blank spaces, and the number of blank spaces between each column will be 9.

NOTE: If (after dividing) there had been a remainder of 5, I would have added 1 extra space to the Left Margin and 1 extra to each of the first 4 blank spaces between the columns, leaving the Right Margin as is (with only 9 blank spaces).

6. Look at the left edge of your paper--what number on the Carriage Position Scale is the left edge of your paper on? In the example above, we will say the left edge of the paper is on the number 10. For example:

Left Edge of Paper ..... Right Edge of Paper

8 1/2 x 11 Paper

0	10	20	30	40	50	60	70	80	90	100	110	120

(Cont'd on the next page)

7. Count over 11 blank spaces from the left edge of your paper and set the left margin on the 12th space. In the example above, the edge of the paper is on 10, so space forward 11 blank spaces from 10 and set the left margin on the 12th space which is the number 22. Type or space out California, then space over 9 more strokes and set the 1st tab (which is column 2) and continue on across setting the other tab stops.
   NOTE: The word "number" is longer than the column of numbers centered under it. After the column headings are typed, you will want to eliminate the tab set for the word "Number" and reset this tab for the numbers.

8. You may check your work as follows:

21	41--(1st Tab)	63--(2nd Tab)	78--(3rd Tab)	98--(4th Tab)
+ 10	12	5	10	3
9	9	9	9	11
40	62	77	97	112

TABULATING

(Backspace-from-Center Method)

Another method of tabulating is illustrated below. When using this method, the standard rule is: Always put 6 spaces between columns.

SPELLING CONTEST WINNERS

Name	School	Grade
Mary Archer	Wilson	12
Bill Jennings	Wilson	11
Harry Flemming	Central	12
Janice Snyder	Central	11
Ruth Landers	Oak Grove	12
Joyce York	Oak Grove	11

KEY: Harry Flemming.....Oak Grove.....Grade

The basic steps in following this method are:

1. Clear the machine, move the margin stops to the ends of the lines and clear out any tab stops that may be set.

2. Position your carriage at the center of the paper.

3. Select the key items (longest line) in each column. The key items in the example above are: Harry Flemming, Oak Grove, and Grade.

4. From the center of the paper, backspace once for every 2 strokes in the longest line in each column, or its heading; and backspace once for every 2 blank spaces to be left between columns.

5. Set the left margin at the point to which you have backspaced.

6. To set the tab stops, start from the left margin and tap the space bar once for each stroke in the key item in column 1 and once for each of the 6 strokes in the blank area between the columns and set a tab stop at this point. Continue spacing forward in this manner until all tab stops have been set.

ESTIMATING LETTER SPACING

Method 1

Horizontal centering is controlled by setting the margin stops for:

Up to 100 words:	40 space (7 word) line
101 to 200 words:	50 space (9 word) line
201 to 250 words:	60 space (11 word) line
251 to 300 words:	65 space (12 word) line

Vertical centering is determined by computing the number of lines needed; then subtracting from 66 and dividing by 2 in the usual manner. The "lines needed" include:

1. Typed lines in the material
2. Blank lines in the material
3. Typed lines in the title
4. Blank lines after the title

To determine the number of typed lines, divide the total number of words by the number you can get on each typed line--by 7, 9, 11, or 12.

Example: Assume 248 words and a one line title, all to be centered on a full page & double spaced. You would use a 60-space (11 word) line.

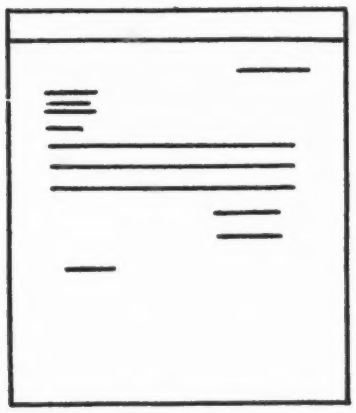
1.	Number of lines on a full page		66
2.	Number of lines of typing is 248 ÷ 11 = 22.6 or 23	23	
3.	Number of blank lines between 23 double spaced lines	22	
4.	Number of lines for the title	1	
5.	Number of blank lines after title	2	
6.	Total number of lines needed		48
7.	Difference between 66 and 48 is		18
8.	Divide by 2 to get starting line		9

Method 2--Estimating Length of Handwritten Copy

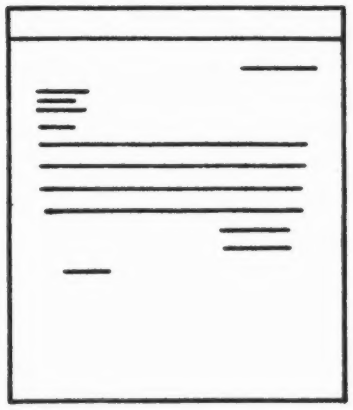
1. Select three full handwritten lines and count the number of words they contain. Divide this number by 3, to get the average number of words for each line of copy in the material.

2. Count the number of lines (including any short ones, too) and multiply the number of lines by the average number of words for each line. The result is the estimated number.

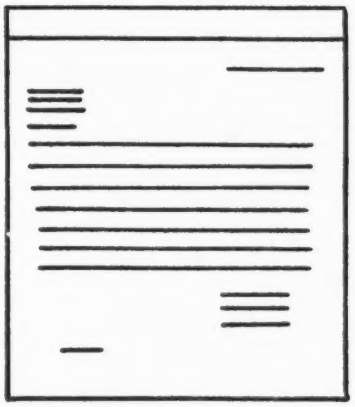
Method 3--Letter Placement



SHORT....under 100 words
Line...40 pica, 50 elite
Date.....on Line 16
Address.....6 lines down

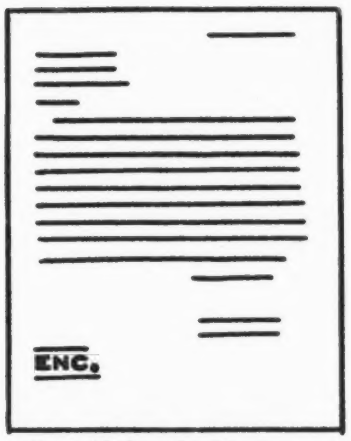


AVERAGE..100 to 199 words
Line....50 pica, 60 elite
Date.....on Line 15
Address.....5 lines down



LONG...200 to 300 words
Line..60 pica, 70 elite
Date.....on Line 14
Address....4 lines down

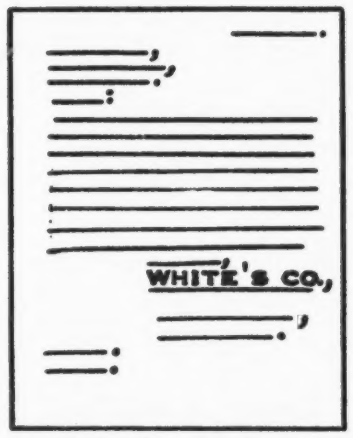
LETTER STYLES & PUNCTUATION



Semiblock Form

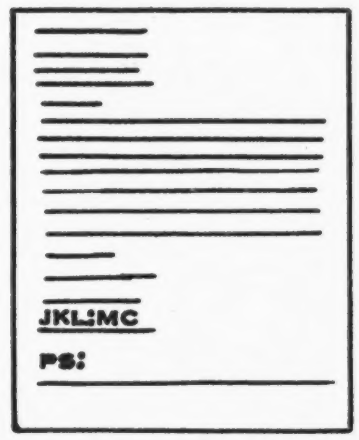
Extreme Open Punctuation--permits only a colon after the salutation and a comma after the complimentary closing. Any line that ends in an abbreviation is followed by the usual period.

Enclosure--means something extra is enclosed in the letter. It is typed below the reference symbols (either a single or double space).



Modified Block

Closed Punctuation--requires that a punctuation mark of some kind be used to "close" every line in the heading and closing. Company firm name is in all caps and a double space below the complimentary closing. Leave 3 blanks in between Co. name & typewritten signature.

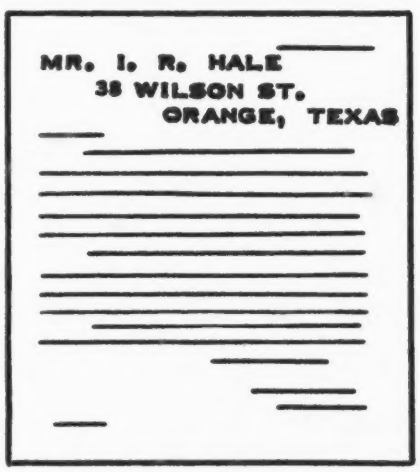


Extreme Block

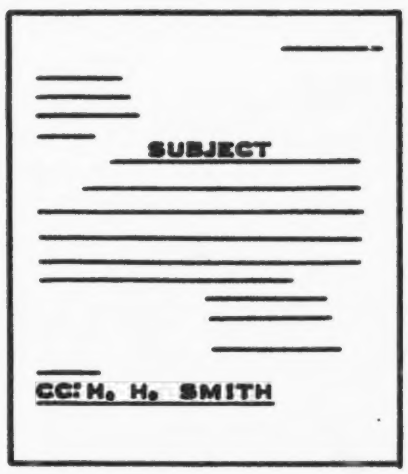
P.S. (Post Script) The Post Script is below the enclosure. You may indent or block the P.S.--most common form is PS:

Reference Symbols--indicate the person who dictated and the typist. Usually a double space below the typewritten signature, Examples are: REF:ld, RC/MC, rej/ek.

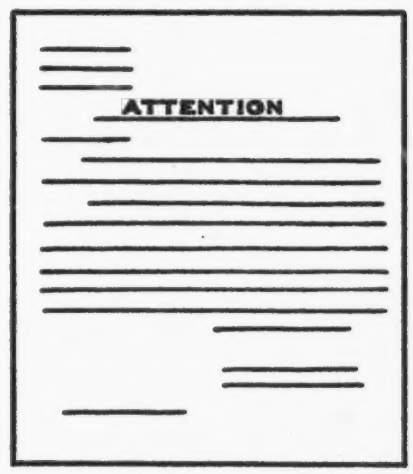
Indented Style



Subject Line



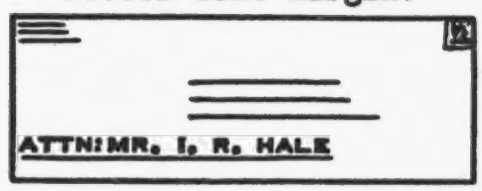
Attention Line



2nd Page Heading to Ltr. Above

cc: (Carbon Copy)--placed below the reference symbols. The SUBJECT line is placed between the salutation & the body of the letter. (May be blocked or centered. Example: SUBJECT:

The ATTENTION line is between the inside address & the salutation. Use the same style as you do for the SUBJECT line. The ATTN. line on an envelope is near the bottom left margin.



SAMPLE LETTER (Semiblock Form) 10-S

THE NATIONAL COMPANY

6 North Michigan Avenue Chicago 2, Illinois

February 25, 1958 --(DATE)

Zaner-Exeter & Company
926 St. Joseph's Place --(INSIDE ADDRESS)
Kalanta, Washington

1 DOUBLE SPACE

ATTENTION: Mr. Karl W. Fraser --(ATTENTION LINE)

1 DOUBLE SPACE

Gentlemen: --(SALUTATION)

1 DOUBLE SPACE

We have just received your order #123497, dated February 22.

1 DOUBLE SPACE

The prices on several of the items in the order have advanced since our latest catalog #10a was issued January 1. For quick reference, we give you the old and new prices on these items:

--(BODY OF LETTER)

Preserved Pineapple @ 45½¢ a pound;
3 *** Peaches, Melba Halves @ $1.68 doz., now $1.72;
Hand-dipped Chocolates (hard) @ 45¢, now 48½¢ a pound;
Gallon Cans Fountain Fruits (Alta Brand) 60¢, now 64½¢.

In your letter accompanying the order you wrote: "Rush this order! We are completely out of some of the items; stock on the others is very low."

Because of your urgent need, we are taking the liberty of shipping the entire order, including these items which have advanced in price. We expect further advances of from 5% to 10% immediately on all fountain supplies. We urge you to complete your stock at this time.

You will find B/L enclosed. Goods were shipped by S. P. R. R., car #219864.

May we send you a copy of our company's new catalog?

1 DOUBLE SPACE

Very truly yours, --(COMPLIMENTARY CLOSING)

1 DOUBLE SPACE

THE NATIONAL COMPANY --(FIRM NAME)

Joe H. Doaks 3 BLANK LINES

Sales Manager --(TYPED TITLE OR SIGNATURE)

1 DOUBLE SPACE

WLB/crf --(REFERENCE SYMBOLS)

1 DOUBLE SPACE

Enc.

To Erase Neatly:

a. Be sure your hands and eraser are clean. To clean eraser, rub it briskly on clean paper or on a fine-grained sandpaper.
b. Move the carriage to the extreme right or left so that eraser crumbs will not fall into the type basket. Whenever necessary, depress the margin release key.
c. Roll the paper up so that the error to be corrected is on top of the roll. Hold the paper firmly by pressing it against the roll with your finger tips.
d. Erase the error with a light, short, circular motion, blowing very lightly to keep the dust out of the machine. Do not scrub or press hard.
e. Return the paper to the writing position and type the correction carefully. Strike the key lightly; then backspace and strike it again until the corrected letter is exactly as dark as other letters on the page.

CROWDING AND SPREADING

A high per cent of typing errors involve a space problem (that is, a letter was left out, in which case you must squeeze it in; or an extra letter or space was inserted, in which case you must find a way to conceal the extra space). There are several different ways to manage the spreading or squeezing. All methods require your erasing the whole word that is to be corrected and then your making the correction half a space to the left, for a squeeze; or half a space to the right, for a spread. In just one detail do the methods vary: how you go about moving the correction half a space.

Manual Typewriters

When crowding and spreading, hold the backspace key half way down, place the ribbon indicator on white, and strike the key desired. If the key strikes the correct place, just flip your ribbon indicator back on blue and strike the letter again. If you must reinsert the paper to make the correction, slide the paper a half space horizontally.

Electric Typewriters

Brace your hand against the left end of the carriage to keep it from spacing in the usual way. You push the carriage half a space and hold it at that position long enough to hit the next letter; you do this pushing and holding for each space in the correction. Also place your ribbon indicator on white when making corrections on the electric typewriters.

Examples of Spreading	Examples of Crowding
How will they go? How c a n they go?	How can they go? How will they go?
How could they go? How c a n they go?	How can they go? How could they go?

In the first example under Examples of Spreading, the word can should have been typed on the page instead of the word will; so the word will is erased and the word can is spread out to fill up the space that will was using.

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STATE DEPARTMENT OF EDUCATION OF LOUISIANA

1967

TOUR GUIDE TRAINING CONFERENCE LEADER'S GUIDE ADULT SERIES

VT 022254

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STATE DEPARTMENT OF EDUCATION

OF LOUISIANA

1967

TOUR GUIDE TRAINING

CONFERENCE LEADER'S GUIDE

ADULT SERIES,

Prepared by

Vocational Education Division
William E. Johnson, Assistant Superintendent

Distributive Education Section
H. E. Ruppert, Director

Issued by

STATE DEPARTMENT OF PUBLIC EDUCATION

William J. Dodd, Superintendent

MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) Lloyd Ponder, Director (Agency) Vocational Curriculum Developmen and Research Center

(Address) P. O. Box 657 Natchitoches, La. 71457

DATE: June 5, 1967

RE: (Author, Title, Publisher, Date) Tour Guide Training. Conference Leader's Guide, Adult Series. Natchitoches, La. : Vocational Curriculum Development and Research Center. 1967.

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(3) Utilization of Material:
Appropriate School Setting Trade school or extension school
Type of Program Adult for up-grade training.
Occupational Focus Specific job as a licensed Tour Guide.
Geographic Adaptability New Orleans, La.
Uses of Material Course planning and Lesson planning
Users of Material Instructor

(4) Requirements for Using Material:
Teacher Competency Skill in teaching adults, and a knowledge of subject matter.
Student Selection Criteria Mature adult who is in need of additional training as a Tour Guide in order to secure his license.
Time Allotment 30 classroom hours

Supplemental Media --
Necessary P
Desirable
(Check Which)

Describe

Source (agency)
(address)

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INTRODUCTION

OVERALL OBJECTIVES

The purpose of this course is to help the trainee acquire or reinforce the basic (a) skills, (b) attitudes, and (c) knowledge which a tour-guide needs in order to conduct sight-seeing tours in a dignified, entertaining, and informative manner.

A. The basic skills include:

1. Fluency: the ability to deliver a consistent and coherent commentary.

2. Salesmanship and Tact; the ability to:

   a. anticipate and cater to the client's needs and expectations.

   b. promote the interests of the employer and the industry as a whole.

   c. convey to the client a favorable impression of the community.

3. Practical Scholarship: the ability to carry on simple library reference, research and effective reading.

B. The basic attitudes include:

1. A sense of civic responsibility, based primarily on an

acceptance of tourism as an economic asset to the community as a whole.

2. A sense of community pride, manifested by a fundamental respect for the community's cultural and social values.

3. A sense of job importance; which is both implied by, and implicit in:

   a. a conviction that tour-guiding is a dignified and useful occupation.
   b. an inherent interest in community lore.
   c. a desire for broader knowledge and general self-improvement.

C. The basic information includes:

1. A grasp of the social and economic principles underlying the tourism industry.

2. Sufficient factual data to discuss intelligently

   a. the architecture
   b. the customs and traditions
   c. the economy
   d. the geography
   e. the history and
   f. the recreational and cultural offerings of the area

3. A fund of local legend and anecdote, humorous and otherwise.

THE TRAINEE

The course, as outlined, is intended to up-grade the person who has had a little practical experience as a guide, usually on a sight-seeing tour bus. The idea for the course originated, in fact, because of an Ordinance passed by the City of New Orleans requiring Tour Guides to be licensed. Under the Ordinance, guides with more than two years' experience were certified automatically; those with less experience than that were required to pass a qualifying examination. It was this latter group for which the pilot course was designed. However, it should serve the purposes of the beginner equally well.

The nature of both course and trainee will be discussed in greater detail in Section V, "General Suggestions to Instructors."

IMPORTANCE OF THE PROGRAM

One aspect of the course's occupational importance is implicit in its relationship to the licensing procedure, mentioned above. Still another is the incontestable fact that the tour guide who has heretofore been trained under a sort of apprentice system (explained later), is not properly prepared for his job. The New Orleans sightseeing companies have been aware of this for some time, as

have municipal authorities and civic and cultural organizations. Official and quasi-official agencies which promote tourism have pointed out the economic importance of the tourist trade and have lobbied for improvement in existing tour guide services. Their interest is understandable because in 1965 the tourist trade brought an estimated $175,000,000 into the city of New Orleans.

Thus the course, even if it is no more than moderately successful, will make an important contribution, not only to individual employment but to the economic assets of the community.

DURATION OF THE COURSE

The course is designed to run two nights a week, two hours a night, for approximately eight weeks or 30 classroom hours.

It will be noted that no specific training activities have been specified for the last three hours of classroom time. The omission has been made in view of the volume of material which has been planned for the first thirteen sessions plus the fact that no time has been set aside for lectures by authoritative guest speakers in the outline. As indicated previously, the instructor must have considerable latitude in revising the order in which the units are scheduled and making other desirable adjustments in content or procedure.

INFORMATION FOR THE CONFERENCE LEADER

The person for whom this course is designed is a mature individual who has been working at the business for some time.

If he is typical, he has already acquired enough basic information (and unfortunately misinformation) to conduct a standard bus tour for a sightseeing company. He has probably served his apprenticeship as a driver of a bus and acquired his "education" by listening to the regular guide.

By the nature of both his present assignment and his training, his functions are limited to delivering a commentary which is superficially convincing but lacking in both depth and accuracy. As a consequence he is not prepared to guide smaller groups who are at liberty to ask direct questions and to expect direct answers.

On the plus side he is alert, intelligent, interested in his business and anxious to learn more about it. But he lacks the know-how and skill necessary for practical research and effective reading. Furthermore, he is without the knowledge required to select, organize and impart information in a manner which will be both informative and satisfying to his client. Finally he tends to rely too heavily upon apocryphal anecdote and irrelevant humor, some of which is not

always in the best taste. But whatever his shortcomings, he is not a beginner, and this course of study is therefore intended to upgrade rather than initiate.

This is not to say however that the approach used here is unsuited to the novice. On the contrary, it should prove as effective for the novice as for the veteran. Nor should it be assumed that the "apprenticeship" system of training tour guides is inherently bad, excepting insofar as it tends to perpetuate inaccuracy. The learning of dry historical dates and economic data, particularly when these have not been organized into some sort of meaningful pattern, is at best a dull business and the technique which manages to instruct with the least effort on the part of the learner and teacher alike is a kind of sustained, hypnotic repetition. Listening to the same commentary day after day has just such an effect.

SUBJECT MATTER AND APPROACH

Information acquired by rote tends to be given back in a like manner; nevertheless, periodic reiteration is essential to the learning of details and a thirty-hour course can hope to do little more than introduce the learner to the process and encourage him to continue it on his own.

In consequence, this outline is primarily intended not to impart facts and dates but to develop a sense of values and inculcate learning techniques. The effort is therefore made to present only the essential facts, in the form of a basic framework, either

logical or chronological in order, and to encourage the student to commit them to memory, gradually filling in the gaps with such supporting detail, anecdote and personal observations as he may think appropriate. If he can manage this, then his training course has fulfilled its intended purpose.

In the outline and note sheets which follow, the liberal use of terms from the social sciences may give the impression that the material is too highly theoretical for the average man. This is not the case, however; the material is not only important to a mastery of the tour guide's understanding and appreciation of his business, but will prove to be both interesting and assimilable if it is presented in the form and manner proposed. The writer is prepared to affirm this from personal experience; he has effectively used the psycho-sociological approach as the basis for supervisory training, foremanship training, sales training and human relations courses in the past, with groups of adults whose backgrounds ranged from eighth grade through the university.

MECHANICS OF PRESENTATION

This outline envisages the employment of five major teaching techniques, namely:

(a) Lecture-discussion sessions, conducted by the instructor.
(b) Use of the voluntary services of guest lecturers who are authorities in their respective fields.

(c) Use of selected film, slides, maps, etc.

(d) Use of duplicated outlines which set forth some of the facts and information required by the tour guide

(e) Encouragement of outside reading and reference.

CLASS PROCEDURE

The course is divided into two sections. The first of these, comprising Units One through Five, deals with the philosophy and the mechanics of the business. The second section, comprising Units Six through Fifteen, helps the student to unearth and organize the essential facts and information which the guide purveys to his clients. The first section is perhaps the more important because it covers a subject matter area which the guide is unlikely and probably unequipped to explore on his own initiative.

Under ideal conditions it would be desirable to present the first five units consecutively. There are two conditions which might render this unwise, however. The first is the difficulty of procuring guest lecturers and/or appropriate films on the date which would render the presentation most effective from the educational standpoint. The second is the fact that the trainee's expectations usually run to the acquiring of material for a glib commentary and he is likely to become impatient with so much apparently irrelevant matter. The teacher must therefore adapt his plans to the

exigencies of the situation. He may find it necessary to interrupt the consecutive presentation of Units One to Five; hence these have been planned and subdivided with that possibility in mind. No serious disadvantage will be incurred as long as the units are presented (a) in order, (b) not too far removed in time from one another and (c) with a brief recapitulation of the last unit preceding the discussion of the next. As for Units Six through Fifteen, there would appear to be no inherently logical sequence, excepting that Units Six, Seven and Eight should probably precede the others, in order.

As a final suggestion, and to repeat, neither teacher nor student should entertain the hope that the course will impart all the factual data needed by the guide. The research of the German psychologist Ebbinghaus, fifty years ago, and the subsequent findings of the Gestalt school point to the futility of such a hope. (An adaptation of Ebbinghaus' principles of learning forms the basis of Unit Five: Acquiring, Selecting, Organizing, and Presenting Information.)

Pamphlets should play an important part in the training program. It is probably best that these be procured (assuming they are available at no cost) by the instructor and distributed to the trainees. Individual copies of the Tour Guide Note Sheets should also be given each trainee for review purposes. Library reference

and reading from books listed in the bibliography should be encouraged. Recommendations of appropriate films will appear in the individual lesson outlines.

The literature on the subject of New Orleans and Louisiana is formidable, and only those works which the writer considers basic for guides are included in the bibliography. Each trainee should have them all in his personal library; in any case, he must own, or have unlimited access to those marked with an asterisk (*) in order to participate in the course as it is outlined herein.

UNIT ONE

COURSE ORIENTATION

I. AIMS AND OBJECTIVES OF THIS UNIT

A. To prepare the student for participation in the course by explaining:

1. What he may expect to get from the course.
2. What is expected of him.

B. To acquaint him with the kind of subject matter to be covered.

C. To make known to him the means and facilities available to him for self-improvement.

II. GENERAL OUTLINE OF THIS UNIT

A. Opening formalities

B. Terms of reference

C. Preliminary review of course content

D. Preliminary review of resources

E. Methods of evaluation

F. Introduction to tourism

G. The psychology of tourism

III. MATERIALS AND TEACHING AIDS NEEDED FOR THIS UNIT

A. Chalk board

B. Chalk

C. Tour Guide Note Sheet--Unit One

D. Sample pamphlets

E. Film (optional; in case needed)

UNIT ONE

ORIENTATION

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
I. OPENING FORMALITIES	
A. Roll Call	
B. Teacher introduces self and guests	Have each student say a few words about himself, his work, etc.
C. Students introduce selves	
II. TERMS OF REFERENCE	
A. Course objectives	Begin by inviting student comment on what they expect to get from the course.
B. Method of approach	
C. Rules and procedures to be followed.	Teacher materials for this section will be found in Foreword preceding
III. PRELIMINARY REVIEW OF COURSE CONTENT	
A. Brief comment on major divisions of course, namely:	
1. Basic concepts	
2. Basic occupational information	See Foreword
3. Basic information for tour guide commentaries	
B. Discussion of purpose and importance of each division	Attempt to bring students into the discussion. (The earlier they get used to sharing experience the better.

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
IV. PRELIMINARY REVIEW OF RESOURCES	Give a general comment only. Each point here will be discussed in greater detail later.
A. Duplicated Note Sheets, their purpose and use.	Explained in Foreword. Stress (a) "Have to know" (b) "Ought to know" (c) "Nice to know" Pass out Tour Guide Note Sheet - Unit One
B. Bibliographies.	
C. Local library facilities and special collections; location and accessibility	N. O. Public Library, Louisiana Room, Howard Tilton Library, Tulane Library, etc.
D. Comparing notes with colleagues and competitors	Try to discourage "trade secrets": stress mutual advantage of sharing knowledge freely. "You can't eliminate competition, therefore encourage <u>clean</u> competition."
E. Pamphlets, information sheets - by local groups, etc.	Pass out one sample--Chamber of Commerce "Brief Summary" for example
V. METHODS OF EVALUATION USED	
A. Periodic tests	
B. Self-evaluation	Explain purpose and use of both techniques.

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
VI. INTRODUCTION TO TOURISM	
A. What is Tourism	Invite definitions from class. (Indicate inadequacy of definitions as compared to factor analysis.)
B. The ingredients of Tourism	
1. The tourist	One who seeks new experiences, willing to spend time, money, and effort.
2. The tourist attraction	The physical factor or combination of factors which induces the new experience.
3. The tour guide organization	The person and/or company which brings the first two ingredients together.
	(Compare with moving picture show:)
	Tourist = Theater patron
	Attraction = Film (second hand experience)
	Sight-seeing organization (company, guide, buses, etc.) = show owner, theater, projector, theater staff.
C. The Tourist Attraction	Examples: Shrines (Fatima); Buildings (Taj Mahal); Natural features (Grand Canyon); Sports (Indianapolis races); Festivals (Mardi Gras), etc.
1. Specific-interest attractions	Call on class to complete list Write on chalk board.

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
2. Diversified-interest attractions	Resort areas (Florida Coast) Historic Cities (Philadelphia) The Modern Metropolis (New York)
D. What do New Orleans and South Louisiana offer in the way of	Have class suggest. Write lists on chalk board, side by side simultaneously
1. Tourist attractions?	
2. Tourist facilities?	
E. What is "Local Atmosphere"	Tour Guide Note Sheets - Unit One

TOUR GUIDE NOTE SHEET - UNIT ONE

I. INTRODUCTION:

The tourist's interest is by no means limited to history, buildings, and scenery. Tourists are also interested in people. Furthermore, tourists are people. This gives the tour guide two good reasons to learn all he can about people and "what makes them tick," both as individuals and as a community.

In the first place, a knowledge of how people think and act as individuals should help the tour guide to handle clients--to give them what they want and send them away happy.

In the second place, a knowledge of how people think and act as a community should help him to explain his own city's "way of life" to his client. This is more important than the average guide realizes because it has a lot to do with something called "atmosphere."

II. WHAT IS ATMOSPHERE?

The tourist is very fond of "atmosphere." He is seldom clear as to what it is--it is something he "feels" but "can't put his finger on."

Actually it is not hard to explain "atmosphere." Part of it, of course, is history, architecture and "local color." But its most important ingredient is the local people themselves--the way they feel, act and think as a group; the way they work, play and live. If a community is a little different from other towns in these respects, it has "atmosphere" and it therefore has a strong attraction for tourists.

The guide who can "play up" local atmosphere, who can help his client to identify and understand the unique character of his own community, is helping to build the reputation of his city as a tourist center. At the same time he is rendering the client a useful service.

In order to do this properly the guide should understand some basic principles of sociology, one of the Sciences which explains "What makes people tick."

III. SOCIOLOGY? WHY NOT?

This subject is not as "way out" as the name suggests because most intelligent people who "get around the city" have already learned something about it from their own day-to-day experience and observation.

However, the sociologist does a few things with his knowledge which men-about-town usually don't bother to do with theirs. For example:

1. He looks for the reasons behind the things he notices.
2. He also looks for "the reason behind the reason." He likes to go deep.)
3. He tries and usually succeeds in distinguishing between causes and effects. (The untrained observer often confuses the two.)
4. He has organized his knowledge in such a way that it can be used in a business-like manner for practical purposes (e.g. predicting public reactions).

Much of what the sociologist has learned is of interest only to other sociologists. But some of his knowledge is of direct practical value to the tour guide. The next lesson will present this knowledge to you in a brief and simple form.

UNIT TWO

BASIC CONCEPTS OF TOURISM

I. AIMS AND OBJECTIVES OF THIS UNIT

A. To deepen and broaden the guide's appreciation of his job by giving him

1. a basic understanding of the social structure of an American city.
2. the nature, needs and expectations of the typical American tourist.

B. To arouse an interest in the guide which will motivate further inquiry into the deeper implications of his work; to give direction and momentum to this inquiry.

II. GENERAL OUTLINE OF THIS UNIT

A. What is the typical tourist like?

B. What is he seeking?

C. What does he bring to the process?

D. What is the sociological background of tourism?

III. MATERIALS AND TEACHING AIDS NEEDED FOR THIS UNIT

A. Chalk board

B. Chalk

C. Tourguide Note sheet--Unit II

UNIT TWO

BASIC CONCEPTS OF TOURISM

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
I. TOURIST PSYCHOLOGY	
A. The Typical Tourist 1. Most common age group 2. Income bracket 3. Other characteristics a. Singles? Couples? Families: in groups? b. Race, place of origin, etc.	(Refer back to Section I, c). Point out fallacy of "Average tourist" but show need of developing a "tourist type" for purposes of study and operating. Get working guides in class to contribute information.
B. What is he seeking? 1. New experiences. 2. Help in acquiring them.	
C. What does he bring to the process? 1. General interest 2. Education and social background, (pre-conceived ideas, prejudices, etc.) 3. Expectations in regard to the treatment he gets from the guides.	Merely enumerate 1, 2, and 3. Make brief comment. Detailed discussion follows immediately.

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
D. The nature of his interest	
1. Usually diffuse, general (although some have special objectives).	Have class suggest some special interests (e.g. night clubs, architecture).
2. Determined by his own character, upbringing, education, etc.	
3. Differs from person to person.	
4. Requires stimulation, guidance in most cases.	More about this under "Tour Guide Performance" following.
II. SOCIAL CLASS AND TOURISM	
A. Socio-economic status	If at this point the class appears to be capable of dealing with the material in Note Sheets, Unit Two, discuss it. Otherwise, present the final summary only.
1. Preconceived ideas and prejudices; moral attitudes	
2. Effect on tourist's expectations of his trip.	
B. Application of this information to the guide's work.	Repeat importance of interpreting the local way of life to the tourist. Ask class to contribute illustrations from their experience.
III. SUMMARY	

TOUR GUIDE NOTE SHEETS - UNIT TWO

I. INTRODUCTION

We said earlier that a town had to be "different" in order to attract tourists. We also said that the guide should be able to explain how New Orleans is "different" from other cities in America if he wants to do a good job.

But before he can do this he has to understand the ways in which all big towns are similar.

The following discussion attempts to help him understand the points in which American communities resemble one another.

II. POLITICAL CONCEPTS:

A. A country's political system depends on the kind of beliefs which are shared by the majority of its people (Such "shared beliefs" are called values by sociologists.)

America is no exception to this rule.

1. Some of the values of a society are written into its laws. Here are a few examples in modern America.
   a. Equality of everyone in the eyes of the law.
   b. Trial by jury and the right of appeal.
   c. Everybody is innocent until proven guilty.

2. Other values are embodied in "unwritten laws" which the majority of people accept without question and which influence their behavior without their realizing it. Here are some examples of America's "unwritten laws."

   a. Everybody has to stand on his own two feet.

   b. The underdog deserves sympathy and support.

   c. Everybody deserves a chance to show what he can do.

B. Political values are what transforms a "population" into a "nation."

1. Almost 200-million Americans are welded together into a united people primarily by the political beliefs which they share.

2. This unity is noticeably mostly in times of national crisis, war, etc. (Remember Pearl Harbor?) Otherwise people seldom think about it.

C. A nation's total set of political values is one of the factors which gives the nation's citizens their distinctive national character. For example, French political ideas help to make the French people look, think, and act like Frenchmen.

D. However, it is a narrower, more specialized set of social values which gives a community its distinctive character (e.g. which makes a native New Orleanian different from a Philadelphian). In order to understand these social values it is necessary to go a little further into the science of sociology.

III. SOCIAL CONCEPTS

A. Politically, America is democratic. This is to say that the government does not officially recognize "classes" or special "class privileges."

B. Socially, however, Americans tend to divide themselves into classes without knowing that they are doing it. The combined classes add up to a social system, or structure.

C. Two important principles are basic to an understanding of social structure:

1. Social classes are informal organizations. This is to say that

   a. They do not have a charter and/or officers, etc., nor a conscious objective.

   b. The vast majority of the "members" don't even know that the "organization" exists, much less that they "belong" to it.

2. But social classes are very much like formal organizations (i.e. clubs, sports teams, religious sects, etc.) in several important respects, namely:
   a. They are "held together" by similar values: that is to say, by
      1) Shared purposes, ambitions and aspirations
      2) Shared likes and dislikes
   b. They give the "members" a sense of "belonging" and security. (People are always more comfortable with "their own kind.")

D. We are far more conscious of social class, and far more influenced by it than we realize. For example
   1. An individual's social class usually determines his customary manner of
      a. speech
      b. dress
      c. behavior
      d. thinking

      "Class will tell" in little things like (1) the way a man "relaxes" or (2) the way he gives a "tip."
   2. When a person is "sizing up" or "placing" other people he is unconsciously trying to decide in which "class" they belong.
   3. Furthermore, most of us are sizing up the other fellow constantly, and without realizing that we are doing it.

IV. SOCIAL CLASS IN AMERICA

A. Some additional principles regarding social class are as follows:

1. The same basic social structure is found in practically every American city. The differences are far less important than the similarities (except to the tourist business of course).
2. A man's social position in any city ranges from "high class" (i.e. desirable), to "low class" (undesirable).
3. Generally speaking the "height" of a man's social position is determined by the number of people who "look up to him."

   In practice, unfortunately, it is also indicated by the kind and number of people who are resentful or jealous of him.
4. Specifically a person's social position is determined by how he stacks up when looked at from the standpoints of:

a. Wealth	d. Education
b. Birth, family	e. Occupation
c. Influence, connections	f. Personal accomplishments

5. Just looking at the preceding list, you can see that a person's social status is influenced by economic factors (i.e. occupation, income, property ownership, etc). For this reason sociologists prefer to use the term socio-economic status in talking about social class.

B. Social classes are not very clear-cut in America. There is too much overlapping, for reasons which will be discussed very shortly. However, sociologists have come up with a classification system which is based on three major classes and several sub-classes.

The chart on the following page is like the one the sociologists have devised; but it has been modified somewhat so that it will be more useful to tour guides. Study it carefully, and see if you recognize anybody you know.

However, remember that nobody fits exactly in any one of these classes. Classes deal with the average man, but there is no such thing (e.g. the newly-rich oil man who still dresses, acts and talks like a cowboy).

VI. SUMMARY

We all think of America as a "classless" society with everybody equal. This is true politically but socially people "divide" themselves into classes.

B. Bases of this division are

   a. Wealth and influence

   b. Occupation, accomplishments

   c. Religious and moral beliefs

C. Membership in a social class is noticed in a lot of little things like

   a. Speech, accent

   b. Clothing, personal accessories

   c. Behavior--ways of treating others, spending money, relaxing, etc.

D. You can "place" a person by observing the things mentioned above.

E. You can also usually tell how he expects to be treated.

F. However, in America people do not fit neatly into patterns; low-class manners sometimes accompany upper-class wealth and vice versa.

G. The importance of all of this to the guide will be further discussed in the next lesson.

CLASS STRUCTURE IN AMERICA

CLASS	MONEY AND INFLUENCE	RELIGIOUS, MORAL ATTITUDES	EDUCATION	PUBLIC ACTIVITIES	TYPICAL EMPLOYMENT
I. UPPER					
A.	Rich for several generations. Blue chip investors. Internationally influential.	Usually belong to fashionable churches. Either very moral or very discreet. Marriage more or less stable; divorce kept quiet.	Ivy-league	Civic activity usually "behind the scenes." Publicity avoided. Mingle professionally with "B" group but not socially.	Corporation presidents, Board members, etc. (Seldom have to work)
B.	Rich but comparatively recently. Nationally	Same as above but less exclusive, less reserved about personal matters.	Exclusive schools and Universities	Same as above but less averse to publicity and public prominence	Upper level corporation officers,
II. MIDDLE					
A.	Well-to-do. Modest investments. Influential locally	Church goers, but not active workers. Divorce not uncommon, family life not close	Private Universities	Prominent citizens. Usually "front" for upper class on civic committees. Women usually active in civic and political movements.	Leading business men and executives; prominent professional men, etc.
B.	Financially solvent; "get along-O.K." Have savings accounts, small investments, Little influence	Active church goers; divorce uncommon; family life close. Believe in "doing the right thing." Very ambitious for children to do better than I did."	State Universities or High schools	Active in fraternal and "service" organizations (e.g. Kiwanis). Women are garden-clubbers, Friendlier, "noiser" than above	Foremen, supervisors, small businessmen. Better-paid technicians and white collar workers. Teachers, ministers, some doctors, lawyers, etc.
C.	Poor but honest, Hardworking and thrifty, but little savings or investments.	"Backbone of society"; very stable. Good church goers. Divorce uncommon. Family ties very close.	Usually less than high school	Little or none	Junior white-collar workers retail salespeople, craftsmen, better-paid service occupations. (Seldom self-employed).

CLASS STRUCTURE IN AMERICA

	CLASS	MONEY AND INFLUENCE	RELIGIOUS, MORAL ATTITUDES	EDUCATION	PUBLIC ACTIVITIES	TYPICAL EMPLOYMENT
III.	LOWER					
	A.	Live from day to day; no savings (victims of loan sharks and installment buying at high interest rates)	Usually religious but not regular church goers. Family ties loose, common law marriages and illegitimacy general	Barely literate	None	Common labor, menial occupations
	B.	No financial stability; no possessions	Moral standards non-existent. Crime, drug addiction, etc. common. Family life non-existent.	Illiterate	Anti-social; Society is the "enemy."	Odd jobs, if any; petty criminals, public charges, etc.

UNIT THREE

BASIC CONCEPTS (CONTINUED)

I. AIMS AND OBJECTIVES OF THIS UNIT

A. To help the guide understand "local atmosphere" and the factors which produce it.

B. To show him how he can use this knowledge in performing his job.

II. GENERAL OUTLINE OF THIS UNIT

A. What makes a city

B. The city dweller's environment

C. Institutions; customs, traditions, etc.; their origin and function.

D. Natural and physical environmental factors: their effect on cities and their people

III. MATERIALS AND TEACHING AIDS NEEDED FOR THIS UNIT

A. Chalk board

B. Chalk

C. Tour guide Note Sheet--Unit III

UNIT THREE

BASIC CONCEPTS (CONTINUED)

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
I. REVIEW	Brief summary of material from preceding session
II. WHAT MAKES A CITY	
A. Difference between urban and primitive life	Use Tour-Guide Note Sheets, Unit Three as basis of this discussion. Do not distribute until end of class.
B. Effect of cities on people	
III. THE CITY DWELLER'S ENVIRONMENT	
A. Cultural	
1. Tangible	
2. Intangible	
B. Physical and natural	
IV. INSTITUTIONS	
A. Their origin and purpose	
B. Their effect	
C. Their relation to tourism	
V. NATURAL AND PHYSICAL FACTORS	

TOUR GUIDE NOTE SHEET--UNIT THREE

I. WHAT MAKES A CITY?

A. The factors which make up any concentrated population center may be studied under three major headings as follows:

1. The people
2. Their cultural environment
3. Their physical environment

It is hard to separate these three groups of factors because they all work together. However, for study purposes we must try to examine each one as if it were independent and then analyze the part it plays in making a city what it is.

B. The primary difference between primitive life and city life, besides size, is found in:

1. Uniformity in the case of tribe members. People think, dress and act in much the same way.
2. Variety, in the case of the city. Wide differences in:

a. Education

b. Occupation

c. Racial origin

d. National origin

e. Moral beliefs

f. Religious beliefs

g. Political beliefs

C. Result: infinite variety, no single individual having very much in common with any other.

> "The city is large enough to contain all ... human variations and is sufficiently diversified so that there is room for all types. Urban populations are socially heterogeneous and so diverse that every human wish, whim, and impulse can be satisfied."
>
> (Reissman, The Urban Process, p. 5)

> "The city has more wealth than the country, more skill, more erudition within its bounds, more initiative, more philanthropy, more science, more divorces, more births, and deaths, more accidents, more rich, more poor, more wise men and more fools. It is characteristic of city life that all sorts of people meet and mingle without in the least understanding one another."
>
> (Munro, quoted by Reissman, p. 7)

D. It is clear that the variety implies contradictions. For example, cities are distinguished by the following inconsistent conditions:

1. Privacy in the midst of a crowd: Individuals

"lead their own lives." Not like rural societies where "social pressure" restricts the individual's actions severely.

2. Conflict and cooperation

   a. People living close together are thrown into competition with one another for living space, money, love, prestige, etc.

   b. At the same time congested conditions make it necessary that people work together. (If everybody were in complete cut-throat competition with his neighbor, nobody would get any part of what he wanted.)

   This leads to another contradiction, namely,

3. Freedom and regulation: The individual cannot enjoy freedom unless his neighbors are prevented from interfering with him. (The more people are crowded together, the harder it is for them to keep from stepping on each other's toes.)

E. SUMMARY:

1. When people live closely together the individual must be able to depend on certain kinds of behavior from his neighbors and vice versa.

2. Everybody must therefore accept certain restraints and restrictions on the free exercise of his will.

3. The result is the evolving of institutions, laws, rules, customs, etc. (More on this later)

II. THE CULTURAL ENVIRONMENT

The man-made part of the world is the next factor to be considered in studying "what makes a city tick." It is called Culture. (College Outline Series; Principles of Sociology, p. 114)

(Note that "culture" is also used in a narrower sense to mean "The theater, art, music, etc.")

A. Culture breaks down into two divisions

1. Material things: (things you can see and touch)

   a. Buildings, roads, dams

   b. Machines, tools, appliances, clothes, furniture, gadgets, vehicles, planes, etc.

   c. Works of art: pictures, ornaments, etc.

   d. Others

2. Immaterial things: (things which can't be seen, touched, bought and sold, etc.)

   a. Beliefs (religion, philosophy)
   b. Knowledge (science, etc.)
   c. Institutions, laws, etc. (rules which govern the way men treat one another).
   d. Others

B. Man develops all these things but they turn around and help to develop <u>him</u>.

1. Think how T.V., air conditioning, deep freezers, washing machines, etc., have changed <u>your</u> life.
2. Think also how these gadgets tend to standardize Americans as a whole. (The Frigidaire is the same in Detroit and New Orleans and has about the same effect on the people in both cities. This is bad for tourism. Who is going to spend two weeks and $600 to go and see a carbon copy of the very place he wants to get away from, just for a change?)

(No, a tourist center must have something <u>different</u> to offer the tourist. And that difference lies mainly in the way that the natives think and feel about their work, their play and their lives.

Old buildings, and history are not enough by themselves. Who would dream of spending more than one day at Williamsburg?)

III. INSTITUTIONS:

These may be defined as "established practices, laws, and customs, etc." (Websters Collegiate Dictionary, 5th edition) Their purpose is to regulate man's dealings with his fellowman.

(In other contexts the word has a narrower meaning, e.g. organizations, schools, prisons, hospitals, etc.)

A. Under the general head of "Institutions" may be listed laws, established practices and customs.

1. Laws

   a. Put formal restrictions on man's conduct.

   b. Prescribe punishment for violations

   c. Set up and direct legislative, enforcement and service agencies (i.e. police, fire departments, courts of law, legislative assemblies).

2. Established practices: span, and to some extent overlap laws on one hand and customs on the other.

They include all "Unwritten laws" which govern men's dealings with one another. They include, among many other things:

a. Religious Organizations

b. Home, family, marriage

c. Buying and selling

d. Property rights

e. Living up to your word

f. Minding your own business, etc.

3. Customs: These, like practices, are not written laws. They are accepted by habit and the only penalty for violating them is the disapproval of other people. Here are a few examples.

a. General

1) Ladies first

2) Age before beauty

b. Religious

1) St. Joseph Altars

2) Attending nine churches on Good Friday

c. Local

1) Red beans and rice on Monday

2) French bread, poor-boys, etc.

IV. SUMMARY

A. The Institutions of a community have a number of common characteristics which are worth thinking about. For example:

1. They are evolved, more or less unconsciously by the people themselves.

2. They are accepted without question by young children, challenged by adolescents and youths, but defended by old people.

   (How else can you explain the fact that for thousands of years old people have always been sure the young adults were going to the dogs?)

3. They are intended to make the individual behave in a way that the majority of the people (i.e. the older group) think is right and proper.

B. The Institutions of a community and the behavior of its people are constantly reacting on one another (like a man on a trampoline).

C. An understanding of the institutions (e.g. practices, laws and customs) of a community helps you to understand the "way of life" of its people.

V. PHYSICAL ENVIRONMENT

A. The factors which "make cities what they are" can be studied under three headings:

1. People
2. Their cultural environment, and
3. Their physical environment.

We have already looked at the first two. Now we look at the third, namely the physical environment. This includes both man's natural world and the additions he has made to it. (i.e. buildings, bridges, roads, etc.)

The sociologist would object that these last are part of the <u>cultural</u> environment. We would agree, but would add that for the tour guide it makes more sense to lump man-made things which are of tourist interest with those which are natural (land, trees, lakes, rivers, etc.).

B. For present purposes we will think of the natural environment as <u>ecological</u> and tangible, man-made things as <u>cultural</u>.

1. <u>Ecological Factors</u> are important determinants of the "way people think and act." The list of ecological factors is something like this:

   a. Location of the city's site.

   b. The topography of the site and its environs

   Both of the above affect

      1) Transportation; therefore they govern

      2) Access to non-local raw materials and tend to determine

      3) Architecture: the size, height, design and also the materials involved in buildings, etc.

   c. The kind of raw materials grown or found in the area.

      1) Agricultural

      2) Mineral, (including a fresh water supply)

      These are determined in part by (a) and (b) above. But they are also determined by the following factor, namely:

   d. Climate

      Climate also has some effect on

1) The temperament

2) The energy and

3) The will to work among the people.

This in turn has a bearing on the next factor, which is

e. Available manpower

The amount and type of labor in the area determines the balance which is reached between agriculture, manufacturing, distribution, (i.e. commerce and business, etc.)

1. Cultural Factors (physical)

Some cultural factors which have an influence on how the people think and feel are as follows:

a. The major businesses, industries, etc. in the area. How do the following affect the "flavor" of a town?

1) A new oil field

2) A big seaport

3) A military camp?

b. Modern structures:

1) Skyscrapers

2) Stadiums

3) Big bridges

4) Freeways, causeways, etc.

c. The evidence of a historic past

1) Old buildings

2) Statues

3) Ancient parks, trees, etc.

(What effect do these have on the way local people think?)

d. Cultural advantages

1) Modern parks and gardens

2) Universities, schools

3) Museums, opera houses, etc.

e. Organized recreational activities: These often exploit natural features (e.g. fishing, and boating, which exploit lakes and rivers; also hunting, golf, etc.).

VI SUMMARY

A. A people's surroundings (i.e. environment) tend to make them a little different from other peoples who live in a different setting.

B. But it works both ways, because people tend to change the environment in which they live; for example, they drain swamps, construct buildings, bridges, dams, roads, etc.

C. The kind of a city a people build is the one which they think is best suited to the kind of life they lead.

D. If the city is different from others (i.e. if it is quaint, picturesque, has local color, or offers unusual entertainment and recreational opportunities) it is a tourist city.

E. The guide is urged to read this material over several times, then think about it and talk about it with his colleagues. The more he does this the better will be his appreciation and understanding of his job.

UNIT FOUR

TOURISM AS A BUSINESS

I. AIMS AND OBJECTIVES OF THIS UNIT

A. To help the student understand the economic importance of Tourism to the community

B. To help him appreciate the dignity and importance of his job.

C. To present to him the basic operating principles of his job.

II. GENERAL OUTLINE OF THIS UNIT

A. Advantages offered to tourists by the New Orleans area

B. Benefits of Tourism to the community

C. Local organizations and activities promoting tourism.

D. The relationship between the sight-seeing company and its employees

E. The tour guides' relationship to the client and to the community in which he lives

F. Operating principles for tour guides

III. MATERIALS AND TEACHING AIDS NEEDED FOR THIS UNIT

A. Chalk board

B. Chalk

C. Tour guide note sheet--Unit four

UNIT FOUR

TOURISM AS A BUSINESS

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
I. THE ECONOMICS OF TOURISM	
A. Advantages offered to tourists by New Orleans and environs	
1. Good climate 2. Natural scenic appeal 3. Historical interest 4. Night life 5. Side trips 6. Restaurants, hotels 7. Sports a. Spectator b. Participant c. Field and Stream 8. Good transportation 9. Good airline and rail service	Get students to contribute ideas; write them on chalk board.
B. Benefits of tourism to the community	
1. Who benefits directly	Have students suggest list
2. Indirect benefits to local economy	Quote figures from note sheet Unit Four
C. Local organizations and activities promoting tourism	See note sheet Unit Four

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
II. THE SIGHT-SEEING COMPANY	
A. General policies	Point up a. Profit motive b. Importance of good will c. Sole contact with customer through guide
B. What they expect of their employees	
C. What their employees can expect of them.	
III. THE TOUR GUIDES' JOB	
A. What is expected of guide by 1. The local people 2. The city government 3. The client	See note sheet Unit Four, also draw on class experience.
B. What the guide can expect in return	
C. Operating principles for guides	

TOUR GUIDE NOTE SHEET - UNIT FOUR

I. TOURISM STATISTICS

(The following estimates for the year 1965 were furnished by the New Orleans Tourist Commission).

A. Total number of visitors - 1.5 million

B. Total amount spent here - 175 million

C. Correspondence handled by Commission

1. 500,000 brochures sent

2. 30,000 letters of inquiry handled

D. Conventions and meetings in New Orleans

1. 172 in 1961

2. 375 in 1965

a. Total delegates - 120,000

b. Spent by delegates - 22.6 million

E. Number of hotel rooms in New Orleans, 10,000

II. ORGANIZATIONS PROMOTING TOURISM

A. Direct, full time promotion.

1. Louisiana Tourist Development Commission

a. Supported by state government

b. Head office Baton Rouge; local office in Jackson Square

2. Greater New Orleans Convention Commission

a. Privately supported; some money from city.

b. Head office, 400 Royal Street

B. Indirect and/or part-time

1. Chamber of Commerce

2. International House

3. Hotels and motels

4. Air lines and other transportation companies

5. The following periodicals

a. This Week in New Orleans

b. Tourist Greeters Guide

c. New Orleans Guide for Visitors

6. Mid-winter Sports Association

III. THE TOUR GUIDES' JOB

A. The people of New Orleans and the city government both expect the tour guide to leave the tourist with a good impression of New Orleans and the desire to return in the future.

B. The city authorities expect in addition, that the information given the tourist be reasonably accurate.

C. The sight-seeing company's expectations are the same as those above.

The company expects in addition that the tourist be encouraged to take additional tours before he leaves the city.

The company expects that the tourist will have the inclination to employ the same sight-seeing company on his next visit; also to recommend the company to his friends back home.

D. The client's expectations of the guide will be discussed in connection with the guide's conduct, immediately following.

IV. THE TYPICAL TOURIST

A. There is no such thing as a typical tourist. As indicated previously everybody is different. However, so are life insurance risks, but the life insurance underwriters have to "play the averages." This means that they have to assume uniformity in all of their clients.

This is a good start for the guide. But it is only a start, as will be pointed out in the next few paragraphs.

This writer knows of no study as to what the typical tourist is like. His idea is as follows: (You may wish to correct it from your own experience).

1. Age - Late 30's to late 50's (usually married couples).
2. Middle class - probably saved all year for the vacation. Comfortable but not very well off.
3. Probably church goers - probably like an occasional risqué joke, but not "out in the open," and not in mixed company.
4. Looking to save money - a little bit afraid of being taken, but also afraid of being regarded as "cheapskates"; consistent but not heavy tippers.
5. Do not expect the guide to "kowtow" to them but want to be treated as ladies and gentlemen when on their vacation; usually enjoying luxury which they are not used to at home.

6. Anxious to tell their friends back home about their trip and to show them their films.

V. TOUR GUIDE CONDUCT

A. It is not possible to tell the guide how he should act. The way he acts is a function of his personality. (You can no more expect another man to pattern his behavior on yours than you could lend him your suit and expect it to fit him and look good on him.)

B. Nevertheless there are a few rules and prohibitions that every guide should bear in mind, even if he does not follow them to the letter. Here are some of them.

1. A neat clean appearance is essential. (shave, haircut, shoeshine, clean shirt, etc.).
2. A quiet, natural speaking voice is desirable. (Avoid a "barker" approach).
3. Deal with clients in a respectable, but dignified way. This calls for

a. <u>Avoiding personal contact</u> (when helping ladies on or off the bus take her elbow).

b. Avoiding personal remarks (even something as harmless as "that's a sharp pair of shoes you are wearing," might be resented. Why take the chance?).

European hotel, restaurant and tourist employees even avoid the use of the word "you." It is resented by the customer on the grounds that it is a "foot in the door" for familiarity. Examples are as follows:

1) European: perhaps the gentleman would like to stop for lunch?
2) Familiar American: How about something to eat?

The European method of address is artificial and unnecessary by American standards of professional hospitality, but the familiar approach is also likely to be distasteful to the ordinary American tourist who is on vacation and rather likes to be "treated like a gentleman" for two weeks.

C. The tour-guide should study his client

1. With individual tours or with small groups encourage the client to talk. This is to help in trying to guess how he wants to be treated.

   If the clients are a unified group (e.g. a convention tour) try to find out something about them before setting out (you handle a group of churchmen altogether differently from a group of oil field equipment salesmen). Convention groups are often more interested in socializing than being shown the sights.

D. Avoid controversial or touchy subjects as far as possible. Some touchy subjects are as follows:

   1. Sex
   2. Politics
   3. Race relations
   4. Religion

E. Avoid any kind of profanity and racy slang

F. Laugh with people, not at them. Don't make fun of anything or anybody. As sure as you make a joke about stuttering for example, there will be somebody on the bus with the same affliction.

G. If there is a grumbler on the bus who feels he is not getting his money's worth give him a little special attention. It will probably bring him around.

H. The person who wants to hold up the tour while he takes a picture or explores a patio must be handled politely but firmly.

1. Point out tactfully that you work on a schedule and that other people in the bus will be delayed and inconvenienced if you accommodate him.
2. Offer to take him around in a cab later when he can spend all the time he wants at his own expense.

I. Sales promotion.

1. Always leave the client with the thought that there is still very much to see in New Orleans; if not this trip then next year, "when you come back" (not "if").

2. Mention other tours which are available to him later on.
3. Use the "soft sell." Avoid high pressuring.

a. The tourist usually expects to be "taken" and high pressuring immediately puts him on the defensive. He probably is worrying about how much the trip is costing.

b. Remember the old proverb: "When going on a vacation, take half as many clothes as you think you are going to need and twice as much money."

4. Don't "recommend" a restaurant or night club, etc., unless asked. The client will assume that you are getting a kick back and that the place is therefore a "clip joint."

   If asked, mention two or three and give a few facts about each. Let the client choose; he is going to anyway and he likes it better that way.

VI. SUMMARY

A. Personal neatness is the first thing for the tour guide to think about.

B. He should handle the clients in a respectful, dignified and impersonal manner, to be on the safe side.

C. He should study his client, bearing in mind the following:

1. The client is probably on the alert for dishonesty.
2. The client has certain fixed attitudes, moral values, prejudices, etc.; he expects the guide to know these and to respect them.

D. The guide has the following obligations:

1. He owes the client a comfortable satisfying experience at a reasonable cost.

   a. He owes the company a reasonable expectation that the client will speak well of its services in his own home town.

   b. He owes the community a reasonable assurance that the tourist leaves with a good impression of it.

2. He owes himself the feeling of assurance that he has maintained his own dignity and that of his profession.

E. The successful host, professional or otherwise, is the one who is

1. Always on the alert for any signs of discomfort, annoyance, or embarrassment on the part of his guests.
2. Able to remove the cause of such conditions smoothly and without attracting attention.

The ability to do this can be acquired, but only through observation, study and practice.

UNIT FIVE

ACQUIRING, SELECTING, ORGANIZING AND PRESENTING INFORMATION

I. AIMS AND OBJECTIVES OF THIS UNIT

A. To familiarize the student with the principles involved in acquiring and imparting information.

B. To show how these principles apply to the guide's operation.

II. GENERAL OUTLINE OF THIS UNIT

A. The guide as a student

B. The guide as a teacher

C. Composing and delivering the commentary

D. Answering questions

E. Summary

III. MATERIALS AND TEACHING AIDS NEEDED FOR THIS UNIT

A. Chalk board and chalk

B. Tour Guide Note Sheets--Unit V

UNIT FIVE

ACQUIRING, SELECTING, ORGANIZING AND PRESENTING INFORMATION

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
I. THE GUIDE AS A STUDENT	
A. How to read effectively	Use "Note Sheets - Unit Five" as basis of this discussion
B. Evaluating information	
C. Organizing information	
II. THE GUIDE AS A TEACHER	
A. Maintaining interest	
B. Simplifying instruction	
III. COMPOSING AND DELIVERING THE COMMENTARY	
A. Selecting information	
B. Jokes and anecdotes	
C. Presentation	
IV. ANSWERING QUESTIONS	
V. SUMMARY	

TOUR GUIDE NOTE SHEETS

UNIT FIVE

A. INTRODUCTION

By the nature of his work, the tour guide is both a student and a teacher. As such, he should understand and be able to apply the basic principles of teaching and learning which have been discovered by the educational psychologist.

Teaching and learning are two names for the same process, seen from different points of view. Thus all the rules which apply to studying also apply to instructing.

B. HOW TO STUDY

1. Four-fifths of the average person's knowledge has been acquired through his eyes. Less than one-fifth comes to him through his ears. Learning-through-listening requires less effort on the learner's part, but it is not nearly as effective as observation and reading.

2. However, most people read inefficiently. Reading is a skill; and like any other skill it must be practiced regularly and correctly, otherwise it is soon lost.

3. Even though you are not a good reader you can make your reading more effective by following a few simple rules.

a. Do not try to remember everything you read. That is an impossibility. At best you are going to remember only the most important facts. Train yourself to be looking out for these facts and don't pay much attention to minor details on the first go 'round.

b. Read in units. The unit may be a paragraph, or it may be a chapter.

c. After you read through the unit rapidly, go back and read it again more carefully and slowly.

d. When you come to a fact you want to remember, write it down in the form of a note. The mere act of putting the idea in your own words and writing it down will help you to remember it. (Keep a pack of 3 x 5 file cards and a pencil at your side for the purpose.)

   You will usually find that there is only one important idea in a paragraph and you may even have to read several pages before you find anything that is important enough to commit to memory.

e. When you have finished your reading, reassess your notes. Study them and ask yourself again whether all of them are important enough to remember. Discard those which are not.

f. Arrange your cards in a logical order of some kind. In the case of a history book, the logical order is a chronological one, (i.e. the order in which the events took place).

There are many different "logical" arrangements, and it is hard to explain all the possibilities. However, an example will help.

Here are two paragraphs which contain the same information. The first one has no order whatever.

> Mary is John's sister. Mary looks like her mother. John is about 25. He looks like his father. Mary is plump. John has curly red hair. Mary is short and blond. Mary's eyes are blue. John is tall and thin. Mary's hair is long. John's eyes are brown.

The second is arranged logically.

> John, who is about 25, is tall and thin, with curly red hair and brown eyes. He resembles his father. Mary, his sister, is short and plump with blue eyes and long blond hair. She looks like her mother.

You don't have to be a psychologist to know which of the paragraphs presents the information in a manner which is meaningful, and will therefore stick with the reader.

g. Read your notes over repeatedly. Information is best memorized through short periods of review at frequent intervals.

h. Avoid long sessions of reading or studying. One half-hour of study every night for a week is much more effective than a single, three-and-one-half hour study session in one day.

i. Learn general things first and worry about specific details afterwards. The details usually take care of themselves in time; besides you will remember general information far longer than specific.

You probably remember what your history book said about the cause of the Revolution, but have forgotten the date of the Boston Tea Party.

j. In studying, try to associate what you are learning with something that you already know. For example, you are less liable to forget that a certain thing took place in 1803 if you remind yourself that it happened in the same year the Louisiana Purchase was concluded.

C. SUMMARY

Details, facts and figures are easiest learned and longest remembered if

a. they are acquired a few at a time

b. they are reviewed regularly

c. the review periods are brief and not too far apart and

d. the details are related to one another or to some more important fact or occurrence which you already know.

D. HOW TO TEACH (OR INFORM)

In this section we think of the tour guide as the teacher and his client as the student. The major principles of teaching are as follows:

1. There is no learning without attention and no attention without interest. If the student is not interested in what his teacher has to say he will not hear it and the teacher must somehow arouse his interest.
2. Fortunately, the client has a ready-made interest, otherwise he would not have paid to take the tour.
3. Holding his interest, once you have it, is another thing however. Some rules regarding this are as follows:

   a. <u>Strive for variety</u>: Do not be afraid to be quiet for 30 seconds if you have nothing appropriate to say. It is a mistake to assume that an uninterrupted commentary maintains interest. Most people tend to

"tune out" continuous chatter without realizing that they are doing it. Mix it up. Tell them something interesting and then give them a little while to let it sink in.

b. With a little practice you can introduce variety in the tone and the intensity of your voice. It is easy for the guide to fall into monotonous sing-song, particularly when he is giving the same story day after day. Learn to change both volume and pitch on occasion.

3. Keep your dates and statistics general. Round figures are more easily understood and remembered longer. Here are examples:

a. This took place on the afternoon of Thursday, November 12, 1932.

b. This took place in early November, 1932.

The first example gives more detail than the average listener is able to take in at one hearing; besides the detail is unnecessary. For general purposes, the second example is much better.

Facts and dates should be given with reference to some other, more important date or occurrence as mentioned previously.

c. This took place in November, 1932, right after Roosevelt's first election to office.

This statement is probably the best of the three.

4. Remember that the good teacher is constantly watching his class for signs of boredom, annoyance or discomfort. These give clues as to how well the teacher is "coming over" and whether or not he should "change his pace."

E. THE COMMENTARY

In the case of regularly scheduled sightseeing runs the information involved and the order in which it is presented is determined largely by the itinerary. You simply talk about the points of interest as you approach them.

However, time also determines the am unt you can say about any one thing, so a certain amount of selection is necessary. Here are some rules to follow:

1. Try to stick to general information (for reasons which have already been discussed).
2. Present the information in a logical order.
3. Bring in anecdotes about personalities wherever they apply. Dates and events are only the framework of history. The people of the same era, the common man, as well as

The people of the same era, the common man, as well as the great men, are the really interesting and important things to the tourist.

(A brief history of the Pontalba Buildings and Jackson Square will be considerably livened-up by mentioning the legendary love interest between the Baroness and General Jackson. The clients, especially the honeymoon couples, will remember it long after they have forgotten everything else.)

4. Make it clear when you are stating historical fact and when you are repeating a legend. Otherwise, some amateur historian (and there is one on every bus) will be sure to challenge you.

   For the same reason, try to avoid having to give very specific dates. Even historians don't agree on these. So why risk an argument?

5. Wherever possible, quote your source. (Examples: "According to Lyle Saxon ..." or "Herbert Asbury's book says that ...")

6. Remember that brevity has its charm. Make your commentary thorough, but avoid telling your clients "more than they want to know."

7. Finally, bear in mind that you are a guide, not a comedian. Your gags, if any, should be somehow related to the matter you are talking about.

F. HOW TO ANSWER QUESTIONS

The following are a few rules to be followed in dealing with the questions of clients.

1. Never hesitate to say "I don't know," or "I am not sure." The average man is shrewd enough to know when you are evading and a frank admission of ignorance leaves a better impression than a bluff.

   (Of course, you will want to find the answer to that question as soon as possible, because if it has been asked once it will probably be asked again in the future.)

2. Answer questions as directly as possible. If a "Yes, sir," or "no, sir" will suffice, leave it at that.

3. Listen carefully to the question and think about it before you answer. Often people ask one thing when they really want to know something else. An important part of the teaching art is to listen to the questions being asked and then figure out exactly what the person would ask if he knew how.

UNIT SIX

GENERAL INFORMATION - NEW ORLEANS AND ENVIRONS

I. AIMS AND OBJECTIVES OF THIS UNIT

A. To help the trainee acquire a fund of general information about New Orleans and the surrounding area.

B. To show him the method of acquiring such information.

II. GENERAL OUTLINE OF THIS UNIT

A. Study and discussion of the contents and arrangement of the Chamber of Commerce Information Sheet.

B. Study and discussion of a format for collecting and organizing this information.

C. Supervised practice in simple fact gathering and organizing.

III. MATERIALS AND TEACHING AIDS NEEDED FOR THIS UNIT

A. Chamber of Commerce release, "Brief Summary of Information about New Orleans" (latest revision).

B. Tour Guide Note Sheet - Unit Six

C. Textbook - New Orleans City Guide

D. Film on New Orleans - Listing No. 14 in Bibliography.

E. Film on Louisiana's Minerals - Listing No. 13 in Bibliography.

F. 16 mm projector and screen.

UNIT SIX

GENERAL INFORMATION - NEW ORLEANS AND ENVIRONS

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
I. STUDY AND DISCUSSION OF BRIEF SURVEY OF INFORMATION ABOUT NEW ORLEANS	Furnish each trainee with a copy.
A. Content	Conduct the class on a "Guided Tour" of the pamphlet.
B. Arrangement	Comment on arrangement, subject headings, etc.
C. Application	
D. Limitations	Indicate pertinent sections in New Orleans City Guide.
II. SURVEY AND DISCUSSION OF TOUR GUIDE NOTE SHEETS - UNIT SIX	Same as above
III. FILM EXHIBITION	
A. Listing No. 14, (30 min.)	
B. Listing No. 13, (13 min.)	
IV. COOPERATIVE CLASS RESEARCH	
A. Demographic Data	Instruct class to search in Brief Survey and City Guide for information required by Note Sheet.
B. Geographic Data	Ask first finder to report location of information.
C. Natural Features	Read to class and discuss as needed.
	Have class record own answers on sheets, cards or notebooks.

TOUR GUIDE NOTE SHEETS

UNIT SIX

I. GENERAL

A. Population Statistics (in round figures)

1. City limits:

2. Metropolitan area:

a. Percentage distribution

1) By race

2) By religion

3) By national origin

b. Recent trends in regard to above figures

3. General characteristics of people

a. Hospitable

b. Tolerant

c. Fun-loving

Mediterranean traditions

Carnival parades

B. Geographic features:

1. Area covered

2. Boundaries

3. Topography

a. Elevation with reference to:

1) Gulf

2) Lake

3) Mean river level

b. Drainage

1) Water table

2) Canal system

Artificial fall

Pumping station

Wood screw pump

c. Terrain, soil

1) Plant life

2) Animal life

4. Interesting geological trivia (if any)

5. Climate

a. Rainfall

b. Temperature

1) Winter mean: low and high-

2) Summer mean: low and high-

3) Record low and high, with dates

c. Snowfall

d. Hurricanes

1) Record winds

2) Dates (stress rarity)

C. <u>The River</u>

1. The Watershed

   a. Source

   b. Tributaries

      Major rivers

      Area drained

2. Statistics

   a. Length

   b. Breadth and depth at New Orleans

   c. High and low stages

      1) Volume of flow at each

3. Flood control system

   a Past floods (stress rarity)

   b. Details about levees

   c. Spillways

4. General importance of river to:

   a. Literature and folklore

   b. Agriculture

   c. Industry

   d. Commerce

D. The Lake

1. Statistics

   a. Length and breadth

   b. Area

   c. Average depth

2. The environs

   a. Tributaries and distributaries

   b. Nature of shores

      1) Terrain

      2) Vegetation

      3) Animal life

3. Importance to area

   a. Historical

   b. Recreational

   c. Economic (former)

E. The Bayous

1. Historical importance

2. Past economic importance (see D, 3, c above)

   a. The Old Basin Canal

   b. The New Basin Canal

F. The Industrial Canal

(see port)

II. THE ECONOMY OF THE AREA

A. <u>Inherent advantages for business and industry</u>

1. The Mississippi

a. Plentiful supply of fresh water

b. Deep-water port facilities

2. Natural resources

a. Proximity or availability of:

1) Oil and gas

2) Certain other minerals

3) Timber and other building materials

3. Mild climate

a. Uninterrupted operation year-round

b. Lower fuel, construction and maintenance costs

4. Minimum of civil strife or unrest

a. Racial tolerance

b. Well-established but conservative unions

5. Availability of land, tax benefits, etc.

B. <u>Industry of the area</u>

1. Extractive

a. Oil and gas wells

1) Proximity to New Orleans

2) Other interesting trivia

b. Salt

1) Information on domes, etc.

c. Sulphur, etc.

1) Information on mining, shipping in liquid form, etc.

2. Processing

a. Oil refining

b. Other petrochemical operations in area

c. Kaiser Aluminum

3. Manufacturing

a. Heavy

1) Shipyards

2) NASA

b. Light

1) Celotex

2) Others

C. <u>Agriculture</u>

1. General information

a. Soil, climate, rainfall

b. Corps, animal and vegetable

2. The sugar industry

a. Methods of cultivation

b. Methods of refining

c. By-products

1) Molasses

2) Cattle feed

3) By-products

3. The rice industry

a. Methods of cultivation

b. Methods of refining

c. By-products

4. Cotton

5. Specialties

a. Pecans

b. Perique

c. Tabasco

D. Fisheries

1. Shrimp

2. Oysters

3. Crayfish

4. Fish

a. Major catches

b. By-products

5. Related specialties

a. Turtles

b. Furs, etc.

III. THE PORT

A. Access to the Sea

1. The Passes

a. The Eads Jetties

1) Statistics

Width

Depth over sill

Other trivia

2) Purpose served

3) History

b. The pilot systems

2. The Gulf Ship Canal

a. Statistics

Width, length, etc.

b. Related trivia

3. Bridges

a. Dates, history of each

b. Statistics

1) Clearances

2) Lengths of main spans

3) Other unique features

B. <u>The Harbor</u>

1. General

a. Jurisdiction

1) United States Engineers

2) Coast Guard

3) Dock Board

b. Regulation and protection

1) Dock Board Police

2) "Deluge"

c. Ferries

d. "Good Neighbor"

e. "President"

2. Statistics

a. Depth of water at docks

b. Number of miles of wharf

c. Tonnage, compared with other ports

d. Principal countries represented

e. Principal exports

f. Principal imports

3. Special Features

a. Banana conveyors

b. Cranes

c. Grain elevators

d. Shipyard

e. Inner Harbor Canal

UNIT SEVEN

GENERAL INFORMATION, ETC. (CONTINUED)

I. AIMS AND OBJECTIVES OF THIS UNIT

To give the student further experience in locating and organizing data.

II. GENERAL OUTLINE OF THIS UNIT

A. Supervised practice in fact-gathering (continued)

B. Introduction to Library Research Materials

III. MATERIALS AND TEACHING AIDS NEEDED FOR THIS UNIT

A. Chamber of Commerce release, "Brief Summary of Information about New Orleans." (latest revision)

B. Tour Guide Note Sheet - Unit Seven

C. Textbook - New Orleans City Guide

D. Reference book - Louisiana - A Guide to the State

E. Film on Louisiana Opportunities - Listing No. 12

F. Film on the River - Listing No. 17

G. 16 mm projector and screen

H. 35 mm Slide film projector

I. The Library Series (Film strip)

J. How to Use the Library (Pamphlet)

UNIT SEVEN

GENERAL INFORMATION, ETC. (CONTINUED)

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
I. FILM(S)	
A. Listing No. 12 (3o min.)	
B. Listing No. 17 (32 min.)	
II. COOPERATIVE CLASS RESEARCH (CONTINUED)	Proceed as of last session
A. The Economy 1. Industry 2. Agriculture 3. Commerce and trade B. The Port	Point out "logical organization" of topic headings in Note Sheets - Units Six and Seven. Indicate other printed sources of information which might apply to present project. Indicate agencies (i.e. Weather Bureau, Wildlife Commission, Sewerage and Water Board, City Archives, etc.) who may fill in the blanks.
III. INTRODUCTION TO LIBRARY RESEARCH METHODS 1. Card catalogues 2. Indexes 3. Reference works	Explain purposes, arrangement and use of each. Review book list furnished by New Orleans Public Library, reproduced in Note Sheets - Unit Seven Announce field trip to inspect local library. Suggest that class be prepared with research problems or topics. Instruct class also to bring file cards (or notebook) and pencil. Use film strips and pamphlets.

TOUR GUIDE NOTE SHEET:

UNIT SEVEN

Here is a book list furnished by the New Orleans Public Library. It represents but a small part of the library's Louisiana Collection.

All books listed may be found and used in the Louisiana Room. In the case of those with an asterisk (*) next to the classification number, copies are also available for circulation.

The list also gives a general idea of the book's contents. Study it over, and refer to it from time to time. And when you have an hour or two free, go to the library and leaf through the books for a better idea of what they contain.

917.631* Arthur, Stanley C.
A 7902 Old New Orleans; a history of the Vieux Carre, its ancient and historical buildings. 1944.
Is arranged for convenient walking tours.

976.31* Asbury, Herbert
A 79 The French Quarter; an informal history of the New Orleans Underworld. 1936.

917.631* Basso, Etolia S.
B 32 The World from Jackson Square; a New Orleans Reader. 1948.
Social life and customs.

976.31* Castellanos, Henry C.
C 34n3 New Orleans As It Was. Episodes in Louisiana life. 1905, republished in 1961.

976.31* Chase, John C.
C 48f Frenchmen, Desire, Good Children, and Other Streets of New Orleans. 1960.
History of the City through its street names.

917.631 Cohn, David L.
C 61 New Orleans and Its living Past; photographs by Clarence J. Laughlin. 1941.

917.631 Curtis, Nathaniel C.
C 97 New Orleans, Its old Houses, Shops and Public Buildings. 1933.

917.631* Davey, Mary and Don
D 22 Mary and Don Davey's Companion Guide to the Colorful French Quarter; an Up-to-the Minute Guide to the Quarter's Most Outstanding Restaurants, Shops, Nighteries, and Historical Landmarks, Including a Complete Walking Tour, Nite Life Tour, Map, Diner's Dictionary, Facts, Figures and Selected Gourmet Recipes. 1964.

917.631* Delcroix, Eugene A.
D 34 Patios, Stairways and Iron Lace Balconies of Old New Orleans; a series of photographs. 1938.

917.631* Early, Eleanor
E 12 New Orleans Holiday. 1947. Story of New Orleans, her people and her customs.

917.631* Evans, Oliver W.
E 93 New Orleans. 1959. Includes the most stimulating points of interest, both old and new.

917.631* Federal Writer's Project.
F 29m New Orleans City Guide. 1952.

917.631* Fossier, Albert E.
F 75 New Orleans, the Glamour Period, 1800-1840; a history of the Conflicts of Nationalities, Languages, Religion, Morals, Cultures, Politics, and Economics during the Formative Period of New Orleans, 1957.

917.631* Griffin, Thomas K.
G 85n New Orleans: A guide to America's most interesting city. 1961.

917.63* Herrin, M. H.
H 56 The Creole Aristocracy: A Study of the Creole of Southern Louisiana, His Origin, His Accomplishments, His Contributions to the American Way of Life. 1952.

917.631* Kane, Harnett T.
K 16 Queen New Orleans, City by the River. 1949. Characterization of this languorous, exciting City on the Mississippi.

976.31* King, Grace E.
K 52 New Orleans; the Place and the People. 1907. Informal history of New Orleans, its culture and traditions.

917.631* Lester, John S.
L 64 I'll take New Orleans. 1948. A collection of newspaper articles that appeared in the New Orleans Item.

917.631 Lynn, Stuart M.
L 98 New Orleans. 1949. Collection of photographs of the architecture, courtyards, ironwork and cemeteries with detailed captions.

917.631 Ricciuti, Italo W.
R 49 New Orleans and its Environs; the Domestic Architecture; 1729-1870. 1938.

917.631* Robinson, Lura
R 65 It's an Old New Orleans Custom. 1948.

976.31 Samuel, Ray
S 19 "... to a Point Called Chef Menteur ...;" The story of the Property known today as New Orleans East, Inc. 1959.

917.631* Saxon, Lyle
S 27f3 Fabulous New Orleans. 1950. Contains the history and description of the Crescent City.

917.631* Tallant, Robert
T 14r The Romantic New Orleanians. 1950. Presents the City in all of its turbulence, beauty, romance and fun.

917.631* Thompson, Ray M.
T 47 New Orleans from A to Z; Questions you'll ask about this city of charm and its Famous French Quarter, alphabetically arranged. 1951.

976.31* Tinker, Edward L.
% 58 Creole City: its past and its people. 1953.

UNIT EIGHT

PRACTICE IN LIBRARY RESEARCH

I. AIMS AND OBJECTIVES OF THIS UNIT

A. To introduce the student to the local library resources pertinent to his job.

B. To give him actual experience in using the Library's facilities.

C. To encourage him to use these resources and facilities regularly and systematically.

II. GENERAL OUTLINE OF THIS UNIT

A. A field trip

III. MATERIALS AND TEACHING AIDS NEEDED FOR THIS UNIT

A. Note Sheets - Unit Six

B. Note Sheets - Unit Seven

C. Miscellaneous Reference questions

D. File cards or notebook and pencils

E. <u>How to use the Library</u>

UNIT EIGHT

PRACTICE IN LIBRARY RESEARCH

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
I. USE OF THE LIBRARY (FIELD TRIP)	Follow arrangements previously made with library personnel for conducting the session
A. Familiarization with	Encourage students to make application for borrower's cards immediately
1. Physical arrangement	
2. Catalogues	
3. Book collections	
4. Services available	
B. Projects	Assign one or more specific, simple reference questions to each student

UNIT NINE

HIGHLIGHTS OF HISTORY

I. AIMS AND OBJECTIVES OF THIS UNIT

To help the student acquire a basic knowledge of Louisiana history and a fund of supporting detail and anecdote.

II. GENERAL OUTLINE OF THIS UNIT

A. Reviewing, evaluating and selecting facts for a chronological framework.

B. Selecting personalities for commentary material.

C. Acquiring a fund of pertinent lore and legend.

III. MATERIALS AND TEACHING AIDS NEEDED FOR THIS UNIT

A. Large map of New Orleans

B. Large map of Louisiana

C. New Orleans City Guide

D. Louisiana - A Guide to the State

E. Film listing No. 2

F. Film listing No. 23

G. 16 mm projector and screen

UNIT NINE

HIGHLIGHTS OF HISTORY

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
I. DEVELOPING A BRIEF CHRONOLOGY	Handle this as a cooperative, class project, as before.
A. Reviewing, evaluating and selecting facts for a chronological commentary	Have class read through, discuss and select major items from "Chronology," New Orleans Guide, (pp. 399-402.) Add your own items, selected from "Chronology," Louisiana - A Guide to the State, (pp. 693-703.)
B. Selecting personalities to be included in commentary	Repeat class activity, above, using "Checklist of Noted Personalities," New Orleans Guide, (pp. 397-398.)
II. ACQUIRING A FUND OF SUPPORTING DETAIL	
A. Films	
1. Listing No. 2, (24 min)	
2. Listing No. 23, (14 min)	
B. Discussion and evaluation	Class assignment: Write an outline for a fifteen minute lecture summarizing New Orleans history.

UNIT TEN

THE ARCHITECTURE OF NEW ORLEANS AND LOUISIANA

I. AIMS AND OBJECTIVES OF THIS UNIT

A. To help the student develop an appreciation of the architecture of the area.

B. To help him acquire the information needed for a typical commentary.

II. GENERAL OUTLINE OF THIS UNIT

A. Historical summary (concluded)

B. The architecture of "Old City"

C. The architecture of the "Garden District" and "Uptown."

D. Nearby plantation architecture

E. The cemeteries.

III. MATERIALS AND TEACHING AIDS NEEDED FOR THIS UNIT

A. New Orleans City Guide

B. State Guide

C. Wilson, A Guide to Architecture of New Orleans

D. Samuel, The Great Days of the Garden District

E. Film Listing No. 9

F. 16 mm projector and screen

UNIT TEN

THE ARCHITECTURE OF NEW ORLEANS AND LOUISIANA

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
I. HISTORICAL SUMMARY (CONCLUDED)	
A. Film: Listing No. 9 (30 min.)	
B. Discussion	
II. THE "OLD CITY"	Point out the caption "Architecture" in the indexes of the City Guide and the State Guide.
A. Architects	Review and comment on Wilson's book A Guide to Architecture of New Orleans.
B. Architectural Styles	
C. Selected Buildings	Have class make selection of houses to study.
1. Description	Have class select essential facts for a brief commentary on each one.
2. Historical association	
III. THE GARDEN DISTRICT AND UPTOWN	
A. Architects	
B. Architectural Styles	
C. Selected Buildings	
1. Description	
2. Historical association	
IV. NEARBY PLANTATION HOMES	

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
V. CEMETERIES	
A. Discussion of above ground burial	Refer to: Wilson's Guide, p. 48
B. Cemeteries of most interest	New Orleans City Guide Index (p. 419)
1. Historical	
2. General	

UNIT ELEVEN

THE PEOPLE, TRADITIONS AND CUSTOMS

I. AIMS AND OBJECTIVES OF THIS UNIT

A. To help the student develop a knowledge of the national and ethnic groups of the area, past and present.

B. To reinforce his understanding and appreciation of local custom and folkways.

C. To help him organize his information into material useful for a commentary.

II. GENERAL OUTLINE OF THIS UNIT

A. Review of migration waves since 1800

B. Characteristics and unique customs of each national group.

C. Contributions of each to local industry and culture

D. Review and discussion of customs unique to the area.

III. MATERIALS AND TEACHING AIDS NEEDED FOR THIS UNIT

A. City Guide

B. State Guide

C. Kane, Deep Delta Country

D. Saxon et als., Gumbo Ya-Ya

E. Film: Listings Nos. 6, 7, 10 and 15

F. 16 mm projector and screen

UNIT ELEVEN

THE PEOPLE, TRADITIONS AND CUSTOMS

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
I. FOREIGN MINORITY GROUPS	
A. Brief review of migration waves since 1800	
B. Characteristics and unique customs of each	
1. German	State Guide, (p. 528-529)
2. "Tacko"	Kane, Deep Delta Country, Chapters 8 and 9, (p. 92-118)
3. Italian	
4. Irish	
5. Other	
C. Contributions of each to local industry and culture.	
II. FILMS	
A. Listing No. 6 (12 min.)	For leads and suggestions Refer also to Saxon et als., Gumbo Ya-ya.
B. Listing No. 7 (11 min.)	
C. Listing No. 10 (12 min.)	
D. Listing No. 15 (22 min.)	

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
III. LOCAL CUSTOMS	Have class develop a list of local customs, religious observances, etc.
A. Religious	
B. Food	Refer to the chapters on "Folkways" in City Guide (pp. 57-60) and State Guide (pp. 90-101)
C. Other	Refer also to "Glossary," City Guide (pp. 407-410), State Guide (pp. 685-692). For suggestion.

UNIT TWELVE

STREETS AND NEIGHBORHOODS

I. AIMS AND OBJECTIVES OF THIS UNIT

A. To acquaint the student with the lore associated with the physical growth of New Orleans.

B. To acquaint him with the origin of local street names and their historic associations.

II. GENERAL OUTLINE OF THIS UNIT

A. The developmental history of New Orleans' neighborhoods

1. Uptown
2. Carrollton
3. Downtown
4. Modern subdivisions

B. Cooperative class research

III. MATERIALS AND TEACHING AIDS NEEDED FOR THIS UNIT

A. Tour Guide Note Sheets - Unit 12

B. Frenchmen, Desire, Goodchildren

C. City Guide

UNIT TWELVE

STREETS AND NEIGHBORHOODS

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
I. DEVELOPMENTAL HISTORY OF NEW ORLEANS NEIGHBORHOODS	Lecture and discussion
A. General	This section is outlined in Note Sheets - Unit Twelve
B. The Faubourgs	Refer to Chase, Frenchmen, Desire, Good Children.
C. Carrollton	See also Samuel, Great Days, etc.
D. Downtown	
E. Lakefront	
F. New Orleans East	
II. COOPERATIVE CLASS RESEARCH	
A. Find origin of various street names. Examples:	Demonstrate the procedure, using the three examples. Employ indexes of City Guide and Chase's book.
1. Ulloa	Have class suggest other names for research.
2. Onzaga	Encourage again the use of file cards and notebooks.
3. Paul Morphy	

TOUR GUIDE NOTE SHEET

GENERAL:

Much of New Orleans history is the direct result of its low elevation and the prevalence of water--swamps, lakes, bayous, etc. Some of the lore related to this phenomenon is as follows.

Banquette is the local name for "sidewalk." It is a French word which means "bench," "footway," or "towing-path."

Due to standing water, many New Orleans sidewalks were long, raised wooden boardwalks (hence "benches"). Others were just the tops of the mud banks thrown up on either side of a ditch (hence "towing-path").

Some early roadways were "plank roads," for example, Carrollton Avenue.

There was plenty of wood, and planks made a good, cheap, solid roadbed over the marshy ground.

Bayou means a small natural stream with a sluggish current. It comes from the Indian word "bayuk."

Metairie Road is built along one bank of an extinct bayou, named Bayou Metairie.

Metairie is French for "small farm leased by the owner to the farmer on a profit-sharing agreement."

The lagoon in Metairie Cemetery and the parts of the City Park lagoon along the avenue are remnants of this bayou.

Gentilly Road (Highway 90) is also built along one bank of a dead bayou, Bayou Sauvage (means "savage" in French).

Gentilly was named after a suburb of Paris by the Dreux Brothers who founded their plantation in the area and gave it the name of their old home town in France.

The other bank of Bayou Sauvage is Crete Street (Crete is the French word for "crest").

Bayou St. John is believed not to be a normally developed stream, but is thought to be the result of an earthquake fault (i.e. crack).

This is based on the fact that it has no levees and not even a sluggish current.

Chef Menteur is thought to have been formed in the same way.

The name means "chief liar" in French. It is believed to have been so called by the Indians because of its treacherous and deceptive currents, which often change directions.

Neutral Ground is the local name for the median strip in the center of a boulevard.

It gets its name from the fact that the wide strip which is now Canal Street was a no-man's-land between the French and American cities during the early 1800's.

A drunk died there and lay there for three days before anything was done about him.

Later "Neutral Grounds" resulted from the need of wide drainage canals to carry off rainfall.

The canals are now under the neutral grounds. Examples: Orleans, Broad, Claiborne.

Perhaps the greater part of Modern New Orleans was under water a few hundred years ago, examples:

Broadmoor was a lake.

Carrollton, back from the river, was a swamp, called "Crawfish town"

Delgado site, 200 yards back from City Park Avenue, was a swamp.

That which is now Lake Vista and Lake Shore Drive was built up by dredging mud, sand and shells out of the lake bottom and throwing it back of a bulkhead.

THE FAUBOURGS

Early New Orleans grew as the result of consecutive real estate developments (cf. Modern Lake Vista, Terrytown, etc.).

The subdivisions were known as Faubourgs.

This is a French word meaning "suburb" or "outskirts." (It also means "The working class who live in the Faubourgs.").

Locally it appears also to have meant "plantation."

The first settlement was the Vieux Carre

This is the French phrase meaning "old square." The word square, as used here, appears to mean an enclosure or a garden plot. The phrase does not mean "Old city" in the literal sense.

Piecemeal, unorganized and consecutive development of the Faubourgs is the reason why the streets of New Orleans often fail to continue and in places follow a crazy-quilt pattern.

Faubourg Ste. Marie was the first of the suburban developments. It was set off by the first of the great fires (1788). It was called Ville Gravier after the first owner and rechristened Faubourg Ste. Marie by Bertrand, the developer.

It began at Tchoupitoulas and included Magazine, where the Graviers lived. It was flanked by Common Street and Gravier and went back to Camp Street.

Magazine means "warehouse" in French. Kentucky tobacco and other goods were stored in warehouses along there.

Two men named Poydras and Girod were also interested in Gravier's real estate. Both men had streets named after them.

The streets were paved with planks from flatboats which came down from Kentucky.

The boats could not be pushed back upstream so they were disassembled (this was the very early 1800's).

The so-called "Americans" from up the river moved into this section and took it over. The "Neutral Grounds" on Canal Street separated the two groups. The groups were also separated by custom, tradition and a mutual dislike and misunderstanding.

The American Section became the city's commercial center.

The Faubourgs of Delord, Soulet, LaCourse and Annunciation were subdivided by Lafon between 1806 and 1810.
Lafon, however, saw to it that the streets which he built lined up with those of Ste. Marie.
Lafon, a surveyor, facilitated future growth by developing the wheel-and-spoke pattern of streets uptown.

Educated men in those days knew Latin and Greek, hence the many classical street names. For example the streets in the Terpsichore and Melpomene area are named after the Greek Muses, a sort of patron saints of the arts. (Examples: Terpsichore is the Muse of dancing.)

The city of Lafayette, which now includes the Garden District, was the next Faubourg going up stream. It included four smaller ones called Nuns, Wiltz, Livaudais and Delasize. (See Chase, p. 137 for map.)

THE "NAPOLEON" STREETS

An interesting point has to do with Faubourg Bouligny, which is divided approximately in two by Napoleon Avenue.

Many streets in this area were named for Napoleon's victorious battles, or other Napoleonic associations. (i.e. Milan, Cadiz, etc.)

Two of these, Berlin and Austerlitz, were changed to General Taylor and General Pershing during World War I, on patriotic grounds.

CARROLLTON

Two possible explanations for the name are as follows:

1. It was named for Charles Carroll of Carrollton, a signer of the Declaration of Independence.

2. It was named for William Carroll, General and Governor of Tennessee who brought 25,000 men to help Jackson at the Battle of New Orleans. His army camped on the Macarty Plantation which later became Carrollton. (This explanation seems to be the most likely one.)

Carrollton and the rest of uptown New Orleans, was helped by the construction of the New Orleans and Carrollton Railroad (begun in 1835).

It began at Poydras and Baronne and went to the intersection of St. Charles and Carrollton, following the same right-of-way now used by the St. Charles streetcars.

It is reputed to be third oldest railroad in the United States.

It used "canned steam." The steam was pumped into storage tanks on the engine at each terminal.

DOWNTOWN

Faubourg Marigny was developed at about the same time as Faubourg Ste. Marie, the American section. It began at Esplanade Avenue and extended back and down along the river.

All the streets in this area were laid out at 50-degree variance with Pauger's original city layout for the Vieux Carre. In 1808 it was a separate community with different street names.

Marigny was a wealthy but wasteful young man who was sent to Paris to study. All he learned was a game called "Hazard," like the modern game of dice.

According to legend, dice got to be called "craps" because Marigny who introduced the game was a Frenchman.

The American called Frenchmen "Frogs."

One French word for frog is "crapaud." The game was called "The crapaud's game" and shortened to Craps." (This is legend, not fact.)

UNIT THIRTEEN

THE DELTA COUNTRY

I. AIMS AND OBJECTIVES OF THIS UNIT

A. To broaden the student's understanding and appreciation of Bayou Culture.

B. To furnish related materials for commentaries

II. GENERAL OUTLINE OF THIS UNIT

A. Film Exhibition, "Evangeline Land"

B. The Evangeline Legend

C. The Cajun people

D. Film exhibition, "Shrimp, please"

III. MATERIALS AND TEACHING AIDS NEEDED FOR THIS UNIT

A. Kane, Deep Delta Country

B. Kane, The Bayous of Louisiana

C. LeBlanc, The True Story of the Acadians

D. Note Sheets - Unit Thirteen

E. 16 mm projector and screen

F. Large map of Louisiana

UNIT THIRTEEN

THE DELTA COUNTRY

INSTRUCTIONAL OUTLINE	SUGGESTIONS TO INSTRUCTORS
I. FILM EXHIBITION Listing No. 3 (30 min.) "Evangeline Land"	Use Note Sheets - Unit Thirteen two ways: 1. As a class exercise in rearranging facts in proper order. 2. As means of learning historical background.
II. EVANGELINE LAND A. The Evangeline Legend B. The Cajun People 1. "National" traits 2. Way of life 3. Unique customs and traditions	See Kane, Deep Delta Country, Chapter 7, (pp. 77-91) See LeBlanc, The True Story of the Acadians See Kane, The Bayous of Louisiana "Pattern - In Water and People" (pp. 3-22) also "Time and the Teche" (pp. 256-259).
III. FILM EXHIBITION Listing No. 20 (12 min.) Listing No. 11 (10 min.)	

TOUR GUIDE NOTE SHEETS

UNIT THIRTEEN

ACADIANS OF LOUISIANA AND LONGFELLOW'S EVANGELINE

Louisiana is the home of the French-speaking Americans who trace their ancestry back to the earliest white settlers on the North American continent. Often called "Cajuns" locally, they cherish the language and traditions of the Acadians of French Canada, who were expelled by the English from Nova Scotia beginning in 1755 because they did not assimilate readily with their conquerors.

Their French ancestors are supposed to have settled Ste. Croix in 1604, three years before Jamestown, and Port Royal in 1610. Fighting between English and French in Europe caused the settlements to be raided frequently. In 1627 the English named the land Nova Scotia, or New Scotland. The French returned, but in 1706 the English, with colonial help, captured the French Fort of Port Royal. In 1713 the treaty of Utrecht gave Nova Scotia to the English.

The English wished the Acadians to take an oath of allegiance, but they refused if it meant bearing arms against the French. Then the English conceded this reservation, but during the Seven Years War the English determined to get rid of the "stubborn" Acadians. Beginning in 1755 they dispossessed them of lands and livestock and moved them to towns on the Atlantic Seaboard, from Boston down to Savannah.

The Acadians kept moving to French territory and in 1756 the earliest emigres arrived in St. James Parish, Louisiana. In 1765 the French Commissaire at New Orleans recorded the arrival of 193 Acadians from Santo Domingo. They went to the Poste des Arrakapas on the Bayou Teche. This is the black-earth delta country, where sugar cane is grown, timber is cut and great live oaks stand bearded with Spanish moss. There were 4,000 Acadian settlers by 1790, and now over 50,000 persons trace their descent from them.

In 1847 Henry Wadsworth Longfellow based his long poem, Evangeline, on the legend of two Acadian lovers, parted in Nova Scotia, reunited in Louisiana just before death. The story was suggested to him by Nathaniel Hawthorne. It may have been based on the actual search conducted by Emmaline Labiche for her lover Louis Arceneaux. When she found him at Poste des Attakapas on the Bayou Teche, he was married to another woman, and the shock killed her. She was buried in the ancient cemetery at Poste des Attakapas, now St. Martinville. Her grave is marked by a statue of Evangeline, posed by Delores Del Rio, who played the role in a motion picture and donated the monument. The legendary spot where Longfellow's heroine met her lover also is commemorated by the Evangeline Oak, an ancient tree on the waterfront.

Located in a wooded area near St. Martinville is the Longfellow-Evangeline Memorial Park, where the state maintains a museum of Acadian relics in an old Acadian farmhouse. There are canals, rustic bridges and tourist shelters.

UNITS FOURTEEN AND FIFTEEN

No work has been planned for these two units to allow latitude in the employment of guest lecturers. (It will be noted that the individual lesson outlines make no time provision for such lectures.)

In the event that this time is still available by the fourteenth session it is recommended that it be employed for general review and the exhibition of Film Listing No. 11, (77 min.) on Life Through the Eyes of a Bayou Boy.

BIBLIOGRAPHY

PRINTED MATERIALS:

The literature on New Orleans and Louisiana is so voluminous as to render the presentation of an adequate bibliography impractical in this outline. Accordingly, only those books which bear directly on activities prescribed in the course outline are listed herein. Further listings will be found in "Tour Guide Note Sheets--Unit Seven," preceding.

For more detailed bibliographical information the student is referred to the catalogues of the New Orleans Public Library and the Louisiana State University Libraries.

FILMS:

A representative selection of films which are applicable to the course are also listed in the following pages. They have been selected on the basis of the description found in the "Educator's Guide to Free Films"; these descriptions are summarized briefly following each listing. The instructor is advised to preview these films wherever possible in order to confirm their applicability to his particular situation.

Those films suggested for inclusion in course activities are marked by an asterisk (*). Sources from which these films may

be obtained are indicated by code symbols inclosed in parenthesis. The significance of some of the symbols are as follows:

EGFF - Educator's Guide to Free Films

Jeff - Jefferson Parish Library

LACI - Louisiana Department of Commerce and Industry

LSL - Louisiana State Library

LSUAG - Louisiana State University Agricultural Division

NOPS - New Orleans Public Schools

TU - Tulane University

BOOKS

* American Guide Series. New Orleans City Guide. Boston: Houghton Mifflin Co., 1938 (Reprinted 1952).

* Louisiana - A Guide to the State. New York: Hastings House, 1941 (Reprinted 1947).

Chase, John. Frenchmen, Desire, Good Children and Other Streets of New Orleans. New Orleans: Robert L. Crager and Co., 1949.

LeBlanc, Dudley J. The True Story of the Acadians. (Privately printed) 1932.

Louisiana Writer's Project. Gumbo Ya-ya. Boston: Houghton Mifflin Co., 1945.

Kane, Harnett T. The Bayous of Louisiana. New York: William Morrow and Co., 1943.

Deep Delta Country. New York: Duell, Sloan and Pearce, 1944.

Lemann, Bernard. The Vieux Carré - A General Statement. New Orleans: Tulane School of Architecture, 1966.

* Samuel, Martha Ann Brett and Ray. The Great Days of the Garden District and The Old City of Lafayette. New Orleans: The Parents' League of Louise S. MaGee School, 1961.

* Wilson, Samuel, Jr. Louisiana Landmarks Society Edition - 1960. Reinhold Publishing Corporation, 1959.

PAMPHLETS

* Chamber of Commerce of the New Orleans area. Brief Summary of Information. (Mimeo) New Orleans, 1966

How to Use the Library, Syracuse, 1959.

FILMS

1. Cajuns of the Teche, 16 mm, sound, B&W, 10 min. (LSL), (Life on the Bayous)

* 2. Echo of Empires, 16 mm, sound, color, 24 min. (LSL), Four centuries of history of Louisiana; Spanish, French, Civil War, Reconstruction, 1900's.

* 3. Evangeline Land, 16 mm, sound, color, 30 min. (LSL) (Louisiana Lowlands History)

4. Huey Long, 16 mm, sound, color, 26 min. (LSL), David L. Wolper Productions, Biography of "Kingfish."

5. Industry on Parade No. 145, 16 mm, sound, B&W, 14 min. (LSL), (McIlhenny Tabasco Sauce)

* 6. Introduction to Jazz, 16 mm, sound, B&W, 12 min. (LSL), (Evolution of Jazz, beginnings in New Orleans).

* 7. Life in Old Louisiana, 16 mm, sound, B&W, 11 min. (Jeff) (Louisiana Society and Economy in 1830's)

8. Louisiana Ahead, 16 mm, sound, (Jeff), (Highlights of the State)

* 9. Louisiana: The First Chapter, 16 mm, sound, color, 30 min. (LACT) (Founding, growth of Louisiana)

* 10. Louisiana's Marshes of the Mississippi, 16 mm, sound, color, 12 min. (LSL), (Work of Mississippi River and Trappers)

11. Louisiana Story, 16 mm, sound, B&W, 77 min. (Jeff), (Louisiana Bayou Life thru eyes of a boy).

* 12. Louisiana Unlimited, 16 mm, sound, B&W, 30 min. (NOPS) State Department, (Activities of State and where unlimited opportunities for expansion lie.)

* 13. Marsh Treasures, 16 mm, sound, color, 12½ min. (LSL), (Gulf deposits yield minerals, salt, sulphur, and oil).

* 14. New Orleans, The International City, 16 mm, sound, color, 30 min. (Chamber of Commerce, Greater New Orleans area). (Story of New Orleans, History, Description and Industries)

* 15. People Along the Mississippi, 16 mm, sound, B&W, 22 min. (LSL), (Peoples and Heritages brought to Mississippi Valley)

16. Pirogue Maker, 16 mm, sound, color, 13 min. p. 178 EGFF, Modern Talking Pictures, (Making Pirogues by Acadians)

* 17. The River, 16 mm, sound, B&W, 32 min. (LSL), (Documentary of Mississippi River).

18. Sugarcane, 16 mm, sound, B&W, 21 min. (LSUAG).

19. Sesquicentennial of Louisiana Purchase 1953, 16 mm, sound, color, 30 min, (LSL) (Record of celebration of 150th anniversary).

* 20. Shrimp Please, 16 mm, sound, color, 21 min. (Jeff), (Shrimping in Louisiana)

21. Shrimp Tip from New Orleans, 16 mm, sound, color, 14 min. (Jeff) Shrimp recipes showing influence of foreign countries on New Orleans)

22. Tulane Story, 16 mm, sound, 19 min. (TU), (Story of Tulane University).

* 23. U. S. Expansion: Louisiana Purchase, 16 mm, sound, B&W, 14 min. (LSL), (History of Louisiana Purchase)

FILM STRIPS

The Library Series: 35mm f/s, McGraw-Hill Text-Films, Inc. (6 strips).

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PRODUCING HIGH CORN YIELDS

May-67

1. When Should I Plant Corn?
2. How Thick Should Corn Be Planted?
3. How Deep Should I Plant?
4. What Row Width Should I Use?
5. Should Corn Be Drilled or Hill Dropped?
6. Should I Use Fertilizer at Planting Time?
7. Should I Apply Insecticides at Planting Time?
8. Should I Apply Herbicides at Planting Time?

Corn is the leading crop in Illinois, accounting for about one-half of the value of all harvested crops. Illinois ranks second in corn acreage, being surpassed only by Iowa. About one-half of the corn produced is sold as grain off the farm. Less than 5 percent of the corn acreage is harvested for silage.

In early times, corn yields were rather low and remained fairly constant, except for yearly changes due to weather. However, as farmers applied the knowledge gained from agricultural research, corn yields have steadily increased. From 1940 to 1950, hybrid seed corn probably caused the greatest increase in yield (Fig. 1). Since then, more fertilizer; better weed, insect and disease control; thicker planting; and more timely operations (made possible by more and better machinery) have accelerated the rate of increase.

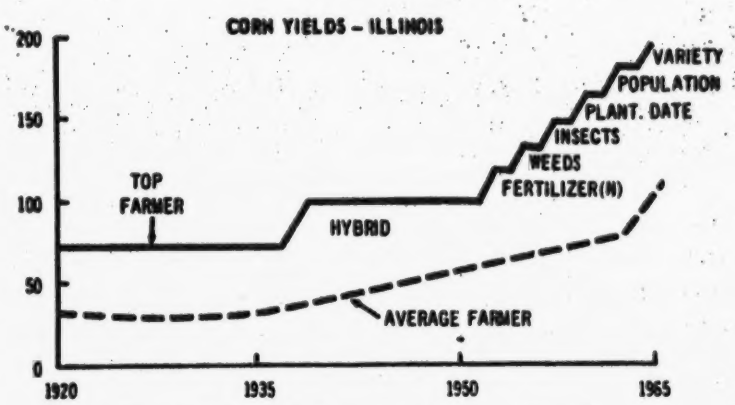

Fig. 1. Trend of corn yields in Illinois

1. WHEN SHOULD I PLANT CORN?

Planting corn early has paid off in higher yields in recent tests in Illinois and many other states. The question of when to plant corn is not new by any means. Earlier tests conducted at Urbana for nine years indicated that the yields were about the same for all plantings made before the third week in May. In these tests the top yields were approximately 110 bushels. If you are producing at a medium level for your soil, the results of these tests are probably still valid. However, if you are pushing for higher corn yields, early planting can mean more bushels in the bin at harvest. This, however, may not mean extra corn unless you are using other good growing practices. Remember that any one poorly planned or poorly executed practice can hold down your yield.

If you are following this new practice of early planting, plant corn when the soil temperature reaches 50° to 55° F. This is usually about the first of May in the northern half of the state and 10 days to 2 weeks earlier in the southern part of the state. Current research indicates a loss of 1 bushel per day for each day you delay planting after the optimum planting date. The rate of planting should also be increased about 20 percent because of the higher "mortality rate" in cool soils.

Planting corn early is one way you can increase the odds of getting more favorable weather at tasseling, the most critical time in the life of the corn plant. The nearer to June 22 you can get ear filling, pollination, and the corn to tassel, the more daylight you

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will have and thus usually the most favorable light conditions. Studies of long-time weather conditions indicate that the probability of receiving an inch or more of rainfall is 30 to 35 percent during any week prior to July 10. Between July 10 and August 10, the probability drops to 20 to 25 percent. If we can get corn to tassel in early July, you will have a better chance of getting rain and also a shorter period of hot weather to accelerate surface evaporation of water. Early planting also means early shading and a reduction of soil water evaporation. Sunlight provides the energy to keep the corn plant factory going, and the peak demand is at tasseling and immediately thereafter. Hence, early planted corn has a better chance for favorable moisture at tasseling. When you add all the weather factors, you find that early planted corn has a better chance for favorable weather at tasseling and thus a greater chance of achieving maximum yields.

There are other advantages for early plantings. The plants will be shorter, will have lower ears, and therefore will stand better. The grain will be drier, and harvest can begin earlier.

Table 1 shows the results of one experiment conducted to determine the effect of time of planting and moisture content. Note that the later-planted corn contained more moisture and had fewer erect plants at harvest.

Another hidden bonus for early corn plantings will come from the earlier planted soybeans on the same farms. Although soybeans are not as responsive as corn to planting date, yields of full-season adapted varieties generally trend downward.

A grower's requirements for early planting of corn are a brave heart, optimism, and a great deal of planning. You must partly accept the concept of minimum tillage and gear up accordingly. Although the seedbed in the row is important, there is no need for a "lettuce bed" between the rows. A great amount of research in Illinois and other states shows that yields from minimum tillage plots are equal and sometimes superior to those from traditional finely pulverized seedbeds. Fall plowing of level land will allow you to plant early in the spring. This is especially important on heavy, high clay content soils. Sandy soils usually dry out earlier and warm up sooner than finer-textured clay soils; therefore, planting can usually be started earlier on the sandy soils than on the finer-textured soils.

Early hybrids will seldom if ever outyield adapted full-season hybrids when both are planted early. Although they will permit harvest to begin earlier in the fall, only in unusual seasons or very late plantings are early hybrids likely to yield as well as medium or late hybrids. Fig. 2 shows the response of an early and late hybrid to planting date at DeKalb, Illinois, at a population of 18,000 plants per acre. Table 2 presents yield data collected in an extremely good growing season (1965) at Urbana, Illinois, at a plant population of 24,000.

Because of cold soils often encountered in early plantings, the following cultural practices are necessary for a maximum yield bonus: (1) Overplanting the desired final plant population by 15-20 percent, (2) planting

Table 1. Effect of Date of Planting on Corn at Harvesting Time (Av. for 5 different years) Urbana

Average date of planting	Yield of grain	Moisture in grain at harvest	Plants erect when harvested
	bu./A	perct.	perct.
May 4	112	18.3	80.4
May 12	108	19.5	79.5
May 19	111	20.7	78.4
May 27	110	21.5	69.6
June 3	101	23.5	66.6
June 12	89	25.5	54.0

MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) J. W. Matthews (Agency) Vocational Agriculture Service

(Address) 434 Mumford Hall, Urbana, Illinois 61801

DATE: June 6, 1967

RE: (Author, Title, Publisher, Date) Producing High Corn Yields. VAS 4039a. Urbana, Illinois: Vocational Agriculture Service, University of Illinois. 12p. 1967.

Supplementary Information on Instructional Material

Provide information below which is not included in the publication. Mark N/A in each blank for which information is not available or not applicable. Mark P when information is included in the publication. See reverse side for further instructions.

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Agency Vocational Agriculture Service
Address 434 Mumford Hall, Urbana, Illinois 61801
Limitation on Available Copies no limit Price/Unit $.15
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(2) Means Used to Develop Material:
Development Group Individual authorship, approval of subject-matter department
Level of Group State; R. L. Courson, Asst. Prof. of Voc. Agriculture
Method of Design, Testing, and Trial Designed by subject-matter specialists, teacher educators, supervisors, and advisory committee of teachers.

(3) Utilization of Material:
Appropriate School Setting High school, post-high school institution
Type of Program High school, adult
Occupational Focus Production agriculture
Geographic Adaptability Not limited
Uses of Material Student text and reference
Users of Material Students

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Teacher Competency General agriculture
Student Selection Criteria Age 14 - up, both sexes, grade 9 to adult, average ability, agricultural interest and occupational objective
Time Allotment 1 - 4 clock hours

Supplemental Media -- N/A
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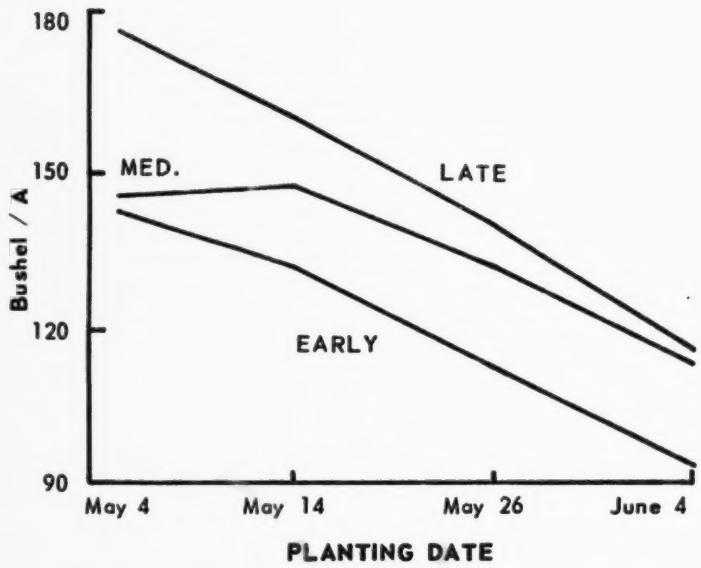

Fig. 2. Effect of planting date on grain yields of three hybrids at DeKalb, Illinois, 1964-65.

shallow, (3) using small amounts of row fertilizer, and (4) controlling weed and soil insect pests by using pre-emergence herbicides and soil insecticides.

New, modern hybrids with proper seed care and seed treatment have a lot of "get up and grow." However, as the trend toward earlier planting continues, corn breeders will need to screen germ plasm more closely for uniform germination and growth under cold, unfavorable growing conditions and for frost tolerance. Plant physiologists will also need to meet this challenge by initiating basic studies toward understanding these phenomena. This two-front attack might permit corn to be planted much earlier than we now assume possible.

Table 2. Effect of planting date on grain yields of two hybrids (30-inch rows, 24,000 plant population, Urbana, Ill.).

Planted	Early Variety	Late Variety	Average
April 19	184	217	201
April 30	192	213	202
May 14	160	195	177
May 31	141	162	151

2. HOW THICK SHOULD CORN BE PLANTED?

A high yield cannot be attained without a high corn-plant population, but a large number of plants per acre is no guarantee of a high yield. As the number of plants increases, the amount of grain produced per plant is decreased, but up to a certain limit the total yield will be greater due to more plants. The proper rate of planting will depend largely on soil productivity and weather conditions. Planting rates aiming at 12,000 to 16,000 plants per acre were commonly recommended a few years ago for the average farmer. Today planting rates are being increased on farms capable of producing 125 or more bushels of corn per acre.

The practice of recommending a plant population on the conservative side of the yield plateau was influenced by (1) drought, (2) standability, and (3) harvestability. The latter two do not carry the importance they once did because of the advent of earlier harvest and better standing hybrids. Drought, however, still remains a real threat to heavy plant populations. Yet, early plantings, coupled with improved hybrids and fertility practices, have not shown the drastic yield reductions for droughty periods that previously occurred.

Although it is true that increasing plant population will do little to increase yields at the 75- to 125-bushel yield level, this statement does not hold for soils capable of producing really high yield levels. In fact, this production practice of low planting rates may be one of the limiting factors insofar as future high corn yields are concerned. Improved hybrids have changed our concepts of stands. There is some trend toward higher plant population already. According to a 1965 survey by the Illinois Cooperative Crop Reporting Service, the average spacing of drilled corn in the row was 9.1 inches, as compared to 10.6 inches in a similar survey three years earlier (1962), and 11.3 inches apart in 1959.

Numerous studies are underway to correlate plant populations with yields. However, to obtain the maximum yield of corn for a specific fertility level and soil type, it is important to plant the proper number of ker-

nels per acre. Plant at a rate, which, in normal years, will produce ears averaging about one-half pound (Fig. 3). The population at harvest is often less than the number of kernels planted (or assumed to have been planted). Therefore, planting rates should be adjusted accordingly. Table 3 may be used as a guide to determine the number of kernels to plant from the desired number of stalks per acre at harvest.

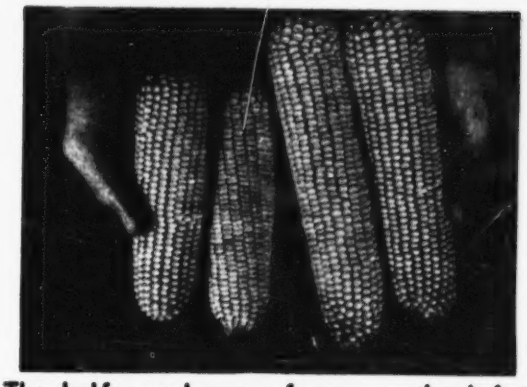

Fig. 3. The half-pound ears of corn on the left indicate good balance of stand with soil productivity. The ears on the right, with average weights of 0.8 pound, indicate that the stand could have been increased profitably by 5,000 to 6,000 plants per acre.

Table 3. Select the Proper Population for the Fertility Level

Expected yield per acre	Kernels planted per acre	Stalks at harvest per acre
75 bushels	13,300	12,000
100 bushels	16,500	14,000
125 bushels	20,000	17,000
150 bushels	25,000	20,000

When striving for high yields, a planting rate of 18,000 to 20,000 kernels per acre is commonly recommended for soils with good water holding capacity. Rates of 20,000 or more are recommended on good soils when the row width is reduced to 30-inches or less.

Since the proper planting rate is essential for high yields, be sure to select planter plates recommended for the grade of corn used and adjust the planter to drop at the desired rate (Fig. 4). During the planting operation, be sure to dig out several kernels along the row and make an estimate of the average kernel spacing as a final field check (See Appendix). By checking this spacing with the desired rate, you can determine the accuracy of your calibration and make whatever adjustments are necessary on your planter.

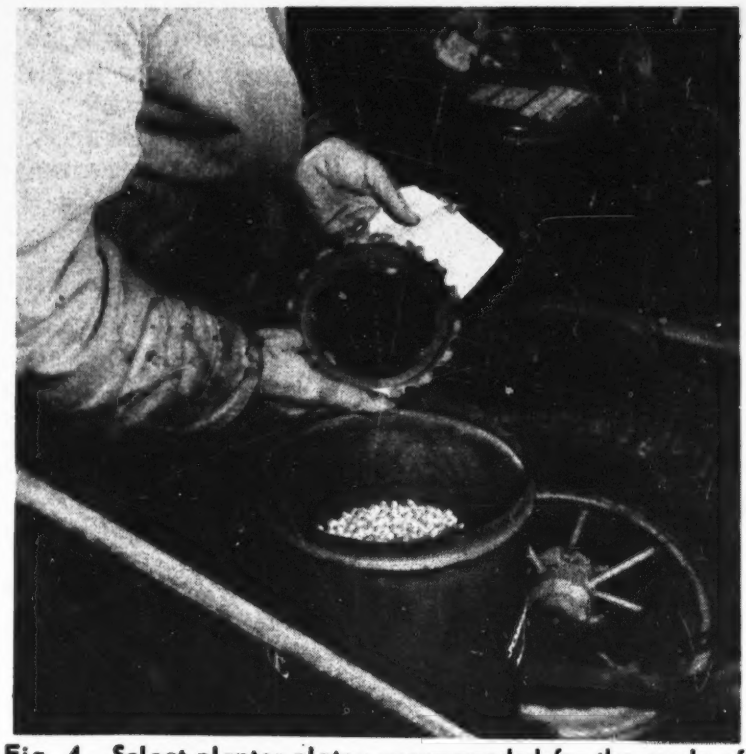

Fig. 4. Select planter plates recommended for the grade of corn you plan to use.

3. HOW DEEP SHOULD I PLANT?

When planting corn, place the seed deep enough in the soil so that it is in close contact with warm, moist soil and has enough covering for reasonable protection against birds, rodents, and surface drying. Quick germination and seedling emergence mean less trouble from soil insects and disease pests or from crusted soil.

A good general rule to follow is to put the corn deep enough to be in moist soil and no deeper. For wet, heavy soils, shallow planting is usually best, especially early in the season. In the lighter, sandy soils where low moisture

rather than low temperature slows germination, it may be necessary to plant the seed 3 inches deep or more to reach moisture (Fig. 5). Remember that the seed is not [illegible]d, so don't bury it--plant it.

If the soil is moist from the surface on down, one inch is deep enough to plant. The depth of the permanent root system is not increased by planting deeper than one inch.

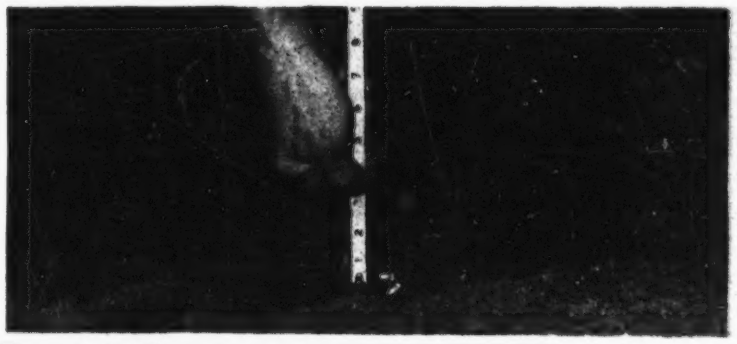

Fig. 5. Plant corn deep enough to be in moist soil.

4. WHAT WIDTH OF ROW SHOULD I USE?

Prior to 1960, corn row spacing had become standardized at about 40-inches, along with the standardization of row-crop equipment. However, since that time many farmers have been considering narrower rows. According to a survey by the Illinois Cooperative Crop Reporting Service, almost half of the 9.7 million acres of corn in 1965 were planted in rows less than 40 inches. Approximately two percent was planted in 30-inch rows. While the latter figure is not very great, this was the first year that commercial machinery could be purchased in these dimensions (narrow row widths).

Agronomists at Illinois and surrounding states have been evaluating various corn row spacings. Their reports show yields for narrow rows that vary from little or no increase up to 25 percent.

Experimental results at Illinois indicated at high yield levels, corn yields increase about 5 percent by narrowing rows from 40-inch to 30-inch widths. This difference is small and it is sometimes difficult to measure on the farm or in experimental plots. Sometimes the tests showed yield increases of 15 bushels and occasionally they showed no difference. However, so far, no experiments have been reported where 30-inch corn rows yielded lower than 40-inch rows.

Narrow rows simply permit a more even plant distribution and a reduction in interplant competition for moisture, nutrients, and light. This lessening of competition permits greater economic use of increased planting rates. Such plantings also shade the ground sooner and thereby reduce weed growth and soil moisture evaporation.

You are most likely to benefit from narrow rows when the following situations occur:

1. Your total acreage of corn and soybeans is large.

2. Your yields in recent years have surpassed 125 bushels.

3. Your plant population exceeds 20,000. You have a high fertility program, good weed control, and practice early harvests.

4. Your present corn growing and harvest equipment is worn and needs replacement.

With most midwest farmers at present, the big question is "Can I afford to convert to narrow rows?" As your present equipment wears out and if your farming operation already includes the first three situations listed above, then your next question may be, "Can I afford not to convert to narrow rows?"

A change to narrow rows will benefit soybeans more than corn in the North Central States. Research results with this crop show yield increases of 10 to 20 percent by narrowing rows. Grain sorghums also respond similarly. The same equipment used for narrow row corn can also be used for soybeans. Therefore, you should consider the benefits from both corn and soybeans when deciding if narrow rows can be justified.

If you decide to go to narrow rows, you may ask, "Why not go to 20-inch rows?" In corn the greatest yield increase seems to come in narrowing from 40-inches down to 30-inch row spacings. It is extremely doubtful if the same increment of difference will be recovered between 30- and 20-inch rows. A preliminary 2-year study at Illinois (Table 4) questions the desirability of going "all the way" to 20-inch rows at the present time. In addition, several machinery companies now have equipment on the market that will allow a farmer to standardize all row crops at about 30-inch spacings.

Table 4. Grain yields from three row spacings at three plant populations (Urbana, Ill., 2-year average).

Plant Population at Harvest	Row Spacing		
	40-inch	30-inch	20-inch
	Bu./A.	15.5% moisture	
16,000	136	135	135
24,000	146	157	151
32,000	146	154	150

If you do change to a narrow row system, remember that high population and narrow rows will increase the tendency for lodging or stalk breakage. Thus, you should choose hybrids adapted to high planting rates with excellent stalk quality. Research results indicate that the shorter, earlier hybrids will do better in narrow rows than tall late varieties. Early planting also seems to favor narrow rows.

Like most management decisions on the farm, the decision to convert to narrow rows is primarily an economic one and thus, varies with the individual operator.

5. SHOULD CORN BE DRILLED OR HILL DROPPED?

Development of herbicides and improved tillage equipment for weed control has largely ruled out any advantage of check-row planting. Today less than one percent of the corn is planted by this method. The 1965 Crop Reporting Service survey indicates that 48 percent of the corn is drilled, 51 percent is hill-dropped, and 1 percent other; however, the trend seems to be toward drilling in recent years. When drilling, the planter drops one seed at a time and the plants grow singly spaced. Hill-dropping consists of dropping two or more kernels in one spot at regular intervals in the row in hills.

Plant population shows a greater effect on yield than the planting pattern within rows. However, many experiments have been conducted to compare drilled and hill-dropped corn. Most of these show a small difference favoring the drilled pattern. Yield differences have ranged from 0 to 13 percent.

Early studies at Illinois indicate that under favorable weather conditions, drilled corn gave a greater yield than hill-dropped. The greatest advantage of drilled was obtained at relatively high plant populations. When dry weather occurred during July and August, hill-dropped corn produced just as high yields as drilled corn. On the other hand, in seasons with ample rainfall, drilled corn produced a larger yield than hill planted corn.

Even though drilling is apparently best for producing grain under ideal moisture conditions, this method has some disadvantages. Lodging (broken stalks) is worse than in hill-dropped plantings even though the diameter of the stalks is larger. Early studies showed lodging averaged 36.1 percent for drilled and 31.9 percent for hill-drop planting in Illinois. Although this percent of lodging was only slightly different, it was statistically significant. Drilled corn will also sucker or tiller more than those hill-dropped. However, these two factors will not be so important in the future as they have been in the past. Corn breeders have systematically improved hybrids, eliminated heavy-suckering varieties, and the trend toward faster and earlier harvesting may reduce lodging.

You may wonder how narrow-row corn will effect plant distribution in the row. Table 5 presents the information on this subject ob-

tained at Urbana, Illinois, in 1965 with three single cross commercial hybrids in 30-inch rows at a final stand of 24,000 plants per acre.

All three hybrids performed best when distributed in the row. An average yield difference of 11, 12, and 23 bushels was noted for single plants versus 2, 3, and 4 plants per hill respectively.

Table 5. Effect of plant distribution in 30-inch rows at high productivity level on grain yield—Bu./A.

Spacings	Hybrid A	Hybrid B	Hybrid C	Average
1 plant every 8.7 inches	194.7	204.8	209.2	202.9
2 plants every 17.4 inches	181.2	191.6	204.0	192.3
3 plants every 26.1 inches	185.0	187.1	201.9	191.0
4 plants every 34.8 inches	169.4	178.7	190.0	179.7

6. SHOULD I USE FERTILIZER AT PLANTING TIME?

Whether or not you use fertilizer at planting time will depend upon the fertility program on your farm. If your basic build-up requirements have been met, soil-improving legumes and manures have been added, and maintenance amounts of fertilizer applied at other times during the rotation, you may receive very little, if any, benefit from adding fertilizer at planting time. On most soils, however, the corn crop will benefit from at least a small amount of fertilizer applied at planting time.

Applying 80 to 150 pounds per acre of a fertilizer containing a small amount of nitrogen, a larger percentage of P_2O_5, and an intermediate amount of K_2O at planting time will usually help corn get a vigorous start (Fig. 6). Apply the fertilizer in one or two bands about 2 inches to the side and 2 inches deeper than the seed (Fig. 7). When drilling corn, make the bands continuous. When checking or hill dropping, drop the fertilizer about 6 to 8 inches along the side of the hills.

Fig. 6. Fertilizer applied at planting time can help give young plants a vigorous start.

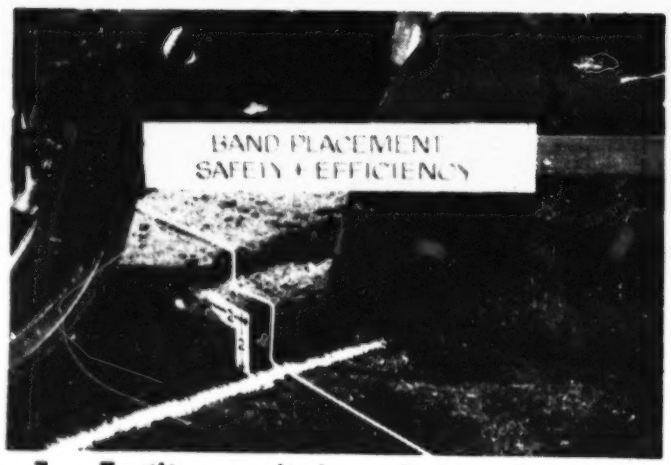

Fig. 7. Fertilizer applied at planting time should be placed to the side of and below the seed (courtesy Velsicol Chemical Corp.).

Some planters are equipped to apply liquid fertilizer (Fig. 8). Liquid fertilizer may be easier to handle and is just as good as dry fertilizer providing equivalent amounts of actual fertilizer are used.

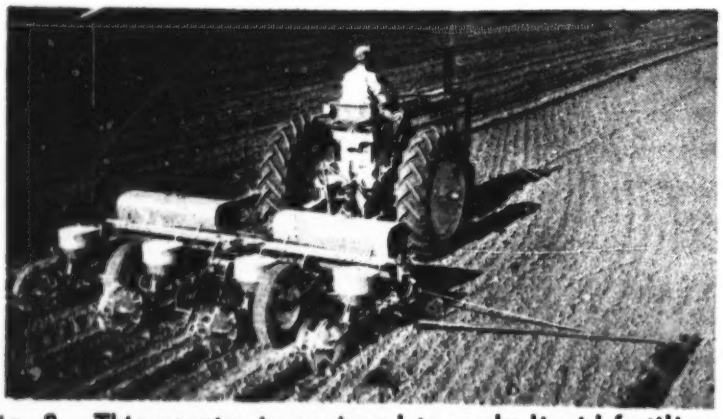

Fig. 8. This planter is equipped to apply liquid fertilizer at planting time (courtesy Deere and Co.).

7. SHOULD I APPLY INSECTICIDES AT PLANTING TIME?

Wireworms, grape colaspis, root worms of various kinds, grubs, seed-corn beetles, and seed-corn maggots are some of the more common stand-destroying and root-pruning insects which can damage corn yields if not controlled. Reports indicate that farmers lose 5 to 6 bushels of corn per acre to these hidden pests.

Many of these insects may be controlled and yields increased by applying such insecticides as aldrin or heptachlor to the soil. They may be worked into the soil before planting, applied with fertilizer, or applied with a special planter attachment (Fig. 9). To get maximum benefits, use 1 1/2 pounds of actual aldrin or heptachlor per acre when broadcast and 1 pound of either per acre when used as a row treatment.

Fig. 9. Insecticides may be applied at planting time by using a special attachment on the planter.

Aldrin, heptachlor, or dieldrin applied to the seed at planting time can also help to give protection against some insects.

You have probably noticed that most seed corn is treated before it is sold to the farmer. This treatment is usually a fungicide for controlling plant diseases rather than insects.

8. SHOULD I APPLY HERBICIDES AT PLANTING TIME?

A herbicide is a chemical used to kill or prevent the growth of some plants but not others. A pre-emergence herbicide is one which is applied before the crop has emerged or come through the ground.

A pre-emergence herbicide may be applied at planting time or shortly after to help control weeds as they germinate. The material may be applied by mounting equipment on the planter so that the spray or dry granules fall in a band over the row behind the planter press wheels (Fig. 10) or broadcast application may be made within a few days after planting. Some herbicides are available which help control both grass-type and broadleaf weeds.

Fig. 10. This farmer is applying a pre-emergence herbicide over the row behind his planter to help control weeds.

The use of herbicides to control a serious weed infestation can be a good investment. For example, research shows that 50 giant foxtail plants per foot in the corn or soybean row can reduce yields by 25 to 30 percent. Most people are willing to invest $5.00 per acre if more than the amount invested is returned in increased yields.

Most pre-emergence herbicides cost $2.00 to $5.00 per acre for band application. If you can achieve economical and satisfactory weed control without pre-emergence herbicides, you probably would be wise to invest the money for other needs, such as fertilizer. In some years, however, a pre-emergence herbicide

does not give satisfactory weed control and you may not have a suitable return on your investment.

Using pre-emergence herbicides is an economical practice about three years out of four. One of the main reasons for failure is lack of adequate rain to activate the herbicide. However, on the other hand, pre-emergence herbicides are sometimes called "wet weather insurance." It is during the wet years when weeds grow best and cultivation may be delayed that you really need help and that is when pre-emergence herbicides often work best. When it is dry for a few weeks after planting, the herbicide may not be very effective, but weeds are usually not very serious then either and cultivation can be timely. If you could predict the weather, there would be no need to buy "pre-emergence insurance" in the dry years.

For those of you who have changed to narrow rows, it is a common belief that narrow rows give more shade between the rows and thus improve weed control. If, however, you still do use a pre-emergence herbicide, the change from 40- to 30-inch rows means a band application of herbicide on nearly half rather than only a third of the actual area. Band application still costs less than broadcasting in terms of herbicide, but with narrow rows the difference between banding and broadcasting decreases. With narrow rows the cost of two cultivations may still be less than the cost of applying the herbicide between the rows. However, you must consider the price you are willing to put on weed control during a wet period, when labor is short, or on being able to eliminate a cultivation when time is at a premium.

CHEMICAL WEED CONTROL FOR CORN

CROP	CHEMICAL*	REMARKS
CORN, pre-emergence	**ATRAZINE (2 to 3 lb.)**	Controls annual grass weeds and broad-leaved weeds. Adjust rate for soil type. Performs best on low organic matter soils. Injury to spring oats and soybeans has sometimes occurred the following year.
	RAMROD (4 lb.)	Controls annual grass weeds, pigweed, and lambsquarter. Best adapted to dark soils, but better than Randox on light-colored soils. Control lasts a little longer than with Randox. Less irritating than Randox, but use care to avoid irritation. Do not feed forage to livestock.
	RANDOX (4 lb.)	Controls annual grass weeds and pigweed. Do not use on sandy soils. Performs best on soils moderate to high in organic matter. Use appropriate precautions to avoid irritation to skin and eyes.
	RAMROD plus ATRAZINE (3 lb. Ramrod plus 1 to 1½ lb. Atrazine)	**Trial use.** For spray application. This combination appears promising for obtaining a broader spectrum of weed control under a wide variety of soil and climatic conditions. The reduced rate of atrazine reduces the possibility of residue problems. Federal registration has been applied for. Handle with care to avoid irritation.
	ATRAZINE plus LOROX (Adjust rate for soil type)	Performs better on light, low organic matter soils than on the moderately dark to dark soils. Crabgrass and panicum control may be better than with atrazine alone. Reduced rate of atrazine reduces possibility of residue problem.
The following pre-emergence herbicides have label clearance for corn but, because of lower crop tolerance or less weed control, are not considered as satisfactory as the above.		
	RANDOX-T (see label)	Controls annual grass weeds and broad-leaved weeds. Use precautions to avoid irritation to skin and eyes. Do not use on sandy soils. Corn tolerance not as good as with Randox. Soybeans and some vegetable crops planted the year following application have sometimes been injured.
	ROUNDUP (3 lb. Ramrod plus 1 lb. 2,4-D)	**Trial use.** The addition of 2,4-D to Ramrod improves control of broad-leaved weeds. However, a preferred alternative would be a pre-emergence application of Ramrod followed by an early post-emergence application of 2,4-D. Available in granular form. Handle with care to avoid irritation.
	KNOXWEED (2 lb. Eptam plus 1 lb. 2,4-D)	Controls annual grass weeds and broad-leaved weeds. Corn injury possible, but less likely than with Eptam alone.
	2,4-D ESTER (1½ lb. liquid or 2 lb. gran.)	For control of broad-leaved weeds. May give some control of annual grass weeds. Some hazard to corn if heavy rains occur soon after treatment. Do not use on sandy soils. Do not use amine form for pre-emergence.

* Rates indicate active ingredient or acid equivalent per acre broadcast unless otherwise indicated. Rates for Dowpon refer to pounds of commercial product per acre broadcast.

APPENDIX

Table 1. Kernel spacing to obtain various plant populations in different row widths in a Drilled Planting Pattern. A 10% stand loss is calculated into each rate.

	Kernel spacing					
Plants/acre	40" rows	38" rows	36" rows	32" rows	30" rows	28" rows
12,000	11.8	12.4	13.1	14.7	15.7	16.8
13,000	10.9	11.4	12.1	13.6	14.5	15.5
14,000	10.1	10.6	11.2	12.6	13.4	14.4
15,000	9.4	9.9	10.5	11.8	12.5	13.4
16,000	8.8	9.3	9.8	11.0	11.8	12.6
17,000	8.3	8.7	9.2	10.4	11.1	11.9
18,000	7.8	8.3	8.7	9.8	10.5	11.2
19,000	7.4	7.8	8.3	9.3	9.9	10.6
20,000	7.0	7.4	7.8	8.8	9.4	10.1
21,000	6.7	7.0	7.5	8.4	9.0	9.6
22,000	6.4	6.8	7.1	8.0	8.6	9.2
23,000	6.1	6.5	6.8	7.6	8.2	8.8
24,000	5.8	6.2	6.5	7.3	7.8	8.4
25,000	5.6	5.9	6.3	7.0	7.5	8.1
26,000	5.4	5.7	6.0	6.8	7.2	7.8
27,000	5.2	5.5	5.8	6.5	7.0	7.5
28,000	5.0	5.3	5.5	6.3	6.7	7.2
29,000	4.8	5.1	5.4	6.1	6.5	7.0
30,000	4.7	5.0	5.2	5.9	6.3	6.7
31,000	4.6	4.8	5.1	5.7	6.1	6.5
32,000	4.4	4.6	4.9	5.5	5.9	6.3

Table 2. Spacing to obtain various plant populations in different row spacings when hill dropped, 2 kernels per hill. A 10% stand loss is calculated into each rate.

	Kernel spacing					
Plants/acre	40" rows	38" rows	36" rows	32" rows	30" rows	28" rows
12,000	23.6	24.8	26.1	29.4	31.4	33.6
13,000	21.8	22.8	24.1	27.1	29.0	31.0
14,000	20.2	21.2	22.4	25.2	26.9	28.8
15,000	18.8	19.8	20.9	23.5	25.1	26.9
16,000	17.6	18.6	19.6	22.0	23.5	25.2
17,000	16.6	17.5	18.4	20.8	22.1	23.7
18,000	15.6	16.5	17.4	19.6	20.9	22.4
19,000	14.8	15.6	16.5	18.6	19.8	21.2
20,000	14.0	14.8	15.7	17.6	18.8	20.2
21,000	13.4	14.2	14.9	16.8	18.0	19.2
22,000	12.8	13.5	14.2	16.0	17.1	18.3
23,000	12.2	12.9	13.6	15.3	16.4	17.5
24,000	11.6	12.4	13.0	14.6	15.7	16.8
25,000	11.2	11.9	12.5	14.1	15.1	16.1
26,000	10.8	11.4	12.0	13.6	14.5	15.5
27,000	10.4	10.9	11.6	13.0	14.0	15.0
28,000	10.1	10.6	11.2	12.6	13.4	14.4
29,000	9.6	10.2	10.8	12.2	13.0	13.9
30,000	9.4	9.9	10.4	11.8	12.5	13.4
31,000	9.1	9.6	10.1	11.4	12.1	13.0
32,000	8.8	9.3	9.8	11.0	11.8	12.6

Table 3. Spacing to obtain various plant populations in different row spacings when hill dropped, 3 kernels per hill. A 10% stand loss is calculated into each rate.

	Kernel spacing					
Plants/acre	40" rows	38" rows	36" rows	32" rows	30" rows	28" rows
12,000	35.4	37.1	39.2	44.1	47.1	50.4
13,000	32.7	33.6	36.2	40.7	43.5	46.5
14,000	30.3	31.8	33.6	37.8	40.3	43.2
15,000	28.2	29.7	31.4	35.3	37.6	40.3
16,000	26.4	27.9	29.4	33.0	35.3	37.8
17,000	24.9	26.2	27.7	31.1	33.2	35.6
18,000	23.4	24.8	26.1	29.4	31.5	33.6
19,000	22.2	23.4	24.8	27.9	29.7	31.8
20,000	21.0	22.3	23.5	26.4	28.2	30.2
21,000	20.1	21.1	22.4	25.2	27.0	28.8
22,000	19.2	20.3	21.4	24.0	25.7	27.7
23,000	18.3	19.4	20.5	22.9	24.5	26.3
24,000	17.5	18.6	19.5	22.0	23.5	25.2
25,000	16.8	17.8	18.8	21.2	22.6	24.2
26,000	16.2	17.1	18.0	20.4	21.7	23.3
27,000	15.6	16.4	17.4	19.5	20.9	22.4
28,000	15.1	15.9	16.7	18.9	20.1	21.6
29,000	14.4	15.3	16.2	18.2	19.5	20.9
30,000	13.8	14.9	15.7	17.6	18.8	20.2
31,000	13.7	14.4	15.2	17.1	18.2	19.5
32,000	13.2	13.9	14.7	16.5	17.6	18.9

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TRANSPLANTING SHADE TREES

1. How Should I Prepare a Tree for Moving?
2. How Should I Plant a Tree?
3. How Should I Protect the Tree?

Sep-67

1. HOW SHOULD I PREPARE A TREE FOR MOVING?

Careful attention to recommended practices—including predigging preparations, methods of digging, and protection of roots—is good insurance for your success in getting a tree off to a good start after it is moved.

Tying-in branches, marking orientation

Tying-in the branches of low-branched or bushy plants will help avoid injury and facilitate digging. Heavy twine is usually used for tying-in branches, but burlap strips or 1/4-inch rope may also be used. To tie-in the branches, attach the twine or other suitable material to a branch at the base of the tree and then wind it spirally around the plant to the top and tie it in a loop (Fig. 1).

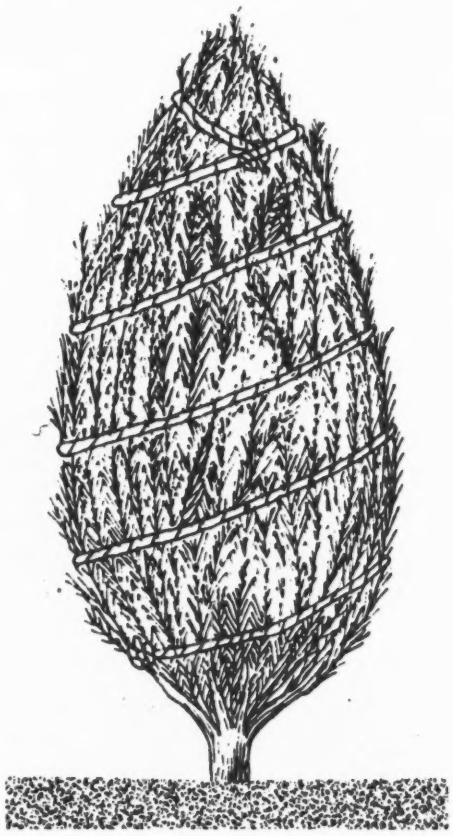

Fig. 1. To prevent unnecessary injury, tie-in with rope or strips of burlap.

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Before digging the tree, mark a branch that faces north (or any other direction) so the tree can be properly reoriented when planted.

Digging the tree

After the branches are tied-in, the tree is ready for digging. Deciduous trees under 2 1/2 to 3 inches in trunk diameter, measured 1 foot above the ground, are usually moved with bare roots. "Bare root" means that most or all of the soil is removed from the roots when the tree is dug. Thus, a tree can be dug with a larger root system than if it is taken with a ball of soil.

The digging operation consists of trenching around the tree and removing the soil from around the roots. Dig the trench far enough from the tree to preserve a large proportion of the fibrous roots. This distance is usually 6 inches for each inch of diameter of the trunk. Thus, for a tree with a 3-inch trunk, the trench would be 18 inches from the trunk. Make the trench deep enough to extend below the level of the lateral roots; the depth may vary from 12 to 18 inches (Fig. 2).

After digging the trench, remove the soil from around the roots. It may be shaken off if the tree is small or it can be loosened and combed out of the fibrous roots with a spading fork. Special care is required to keep root injury to a minimum. This is accomplished by working inward from the trench with the spading fork. Greater root protection is obtained if the tree is moved with "semibare" roots—some soil is left clinging to the fibrous roots. This added protection will help the tree recover more rapidly.

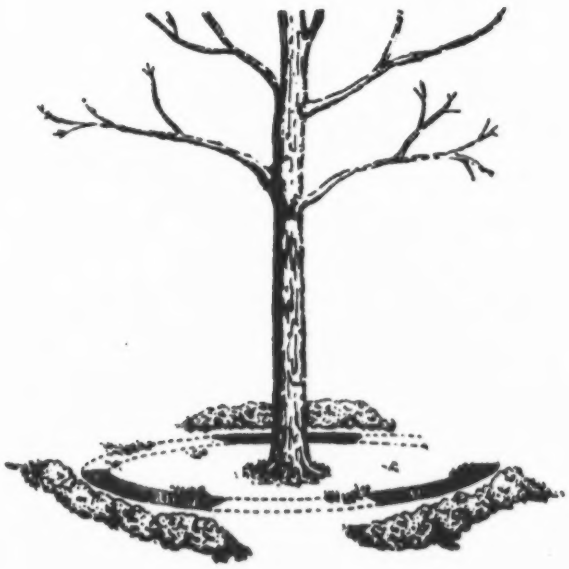

Fig. 2. Dig the trench deep enough to extend below the main lateral roots and far enough from the tree to preserve a large proportion of the fibrous roots (courtesy National Park Service).

After the lateral roots are free of soil, tip the tree to remove the soil from under the plant. Tip the tree very gradually to avoid straining or breaking the roots and loosening the bark near the base of the trunk. Cut any anchor roots or tap roots that still hold at a depth of 14 to 18 inches. To lift the tree out of the hole, grasp it at the junction of the roots and trunk. Pack the exposed roots in some moisture-holding material, such as straw, sphagnum, peat moss, sawdust, shingle tow, or wood chips, and wrap in burlap to protect against drying and mechanical injury (Fig. 3).

"Balled and burlapped" means that the soil is not removed from the roots when the tree is dug. This is referred to as a B&B tree by the nursery trade. Deciduous trees 2 1/2 to 3 inches and larger in trunk diameter, measured 1 foot above the ground, and evergreens are usually moved and planted with balls of soil covering their roots. The size of the ball will depend on the size and species of the tree and the type of soil in which the tree is growing. Trees that are difficult to move, such as beech, hickory, hornbeam, sassafras, sweet gum, tupelo, walnut, and white oak, need larger balls than trees that are easy to move. Trees growing in loose, well-drained soil, such as a sandy soil, will have more extensive or spreading root systems than trees growing in a hard, poorly drained soil like a tight clay.

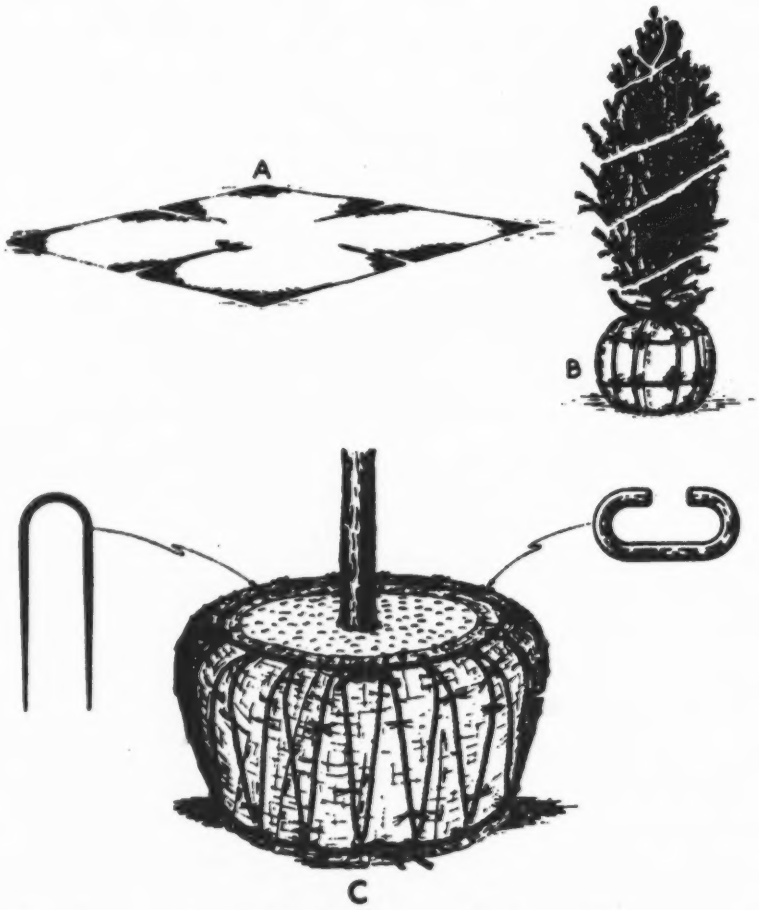

Fig. 3. Trees can be "balled and burlapped" for transplanting. (A) Burlap cut for wrapping small tree, (B) Small evergreen properly wrapped, and (C) Strips of burlap are used on larger trees (courtesy National Park Service).

In general a ball for deciduous trees is approximately 10 inches in diameter for each inch of trunk diameter 1 foot above ground. Therefore, a tree with a trunk 3 inches in diameter needs a ball 30 inches in diameter. If a ball is too large, the roots will be inadequate to hold the soil together and the ball may break apart when the tree is moved.

The ball of soil for evergreens is determined by the height of the plant rather than by the diameter of the trunk. Evergreens 1 1/2 to 2 feet high need a ball 12 inches in diameter. For each additional foot in height, up to 10 feet, the ball diameter is increased 2 inches. For each additional foot in height above 10 feet the diameter is increased 1 1/2 inches.

Before digging is started, remove any loose soil above the roots. Then make a circle around the plant approximately 6 inches beyond the anticipated diameter of the finished ball. Cut the roots to a depth of approximately

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12 inches by inserting a spade at the marked circle with the back side of the spade toward the tree. Using a sharp spade will result in clean cuts which heal rapidly. Next, dig a trench outside and adjacent to the marked circle and about three-fourths the desired depth of the ball, which is usually 10 to 16 inches.

Trim the ball to proper size and shape with the spade, keeping the back side of the spade toward the tree. Round off the trimmed ball at the top edge and taper it inward toward the base (Fig. 4). Avoid loosening the soil

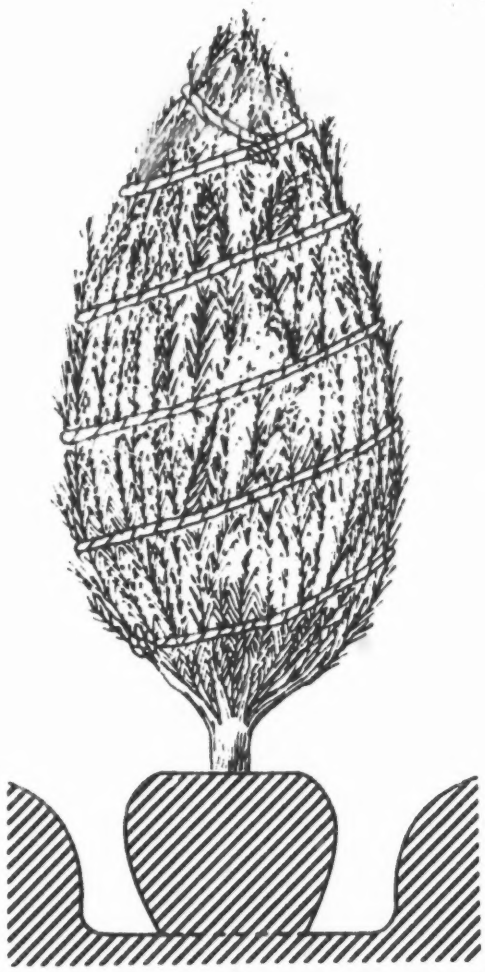

Fig. 4. Dig the trench approximately three-fourths of the desired depth of the ball, then under-cut and trim it to proper shape.

around the roots by cutting small roots with a sharp spade and large roots with hand or lopping shears. Next, undercut the ball of soil at an angle of about 45 degrees to sever any remaining roots and to loosen the ball from the soil beneath.

To prevent drying, cracking, and crumbling of soil wrap the ball tightly with burlap. Balls up to 15 inches in diameter can be completely covered with burlap. One method is to tip the ball and place a piece of rolled burlap under half of the ball. Then tip the ball in the opposite direction and pull the burlap under the other half. Pull the burlap up around the ball and tie the diagonal corners at the top. Wrap loose folds of burlap tightly around the ball and pin the burlap in place with sixpenny or eightpenny balling nails.

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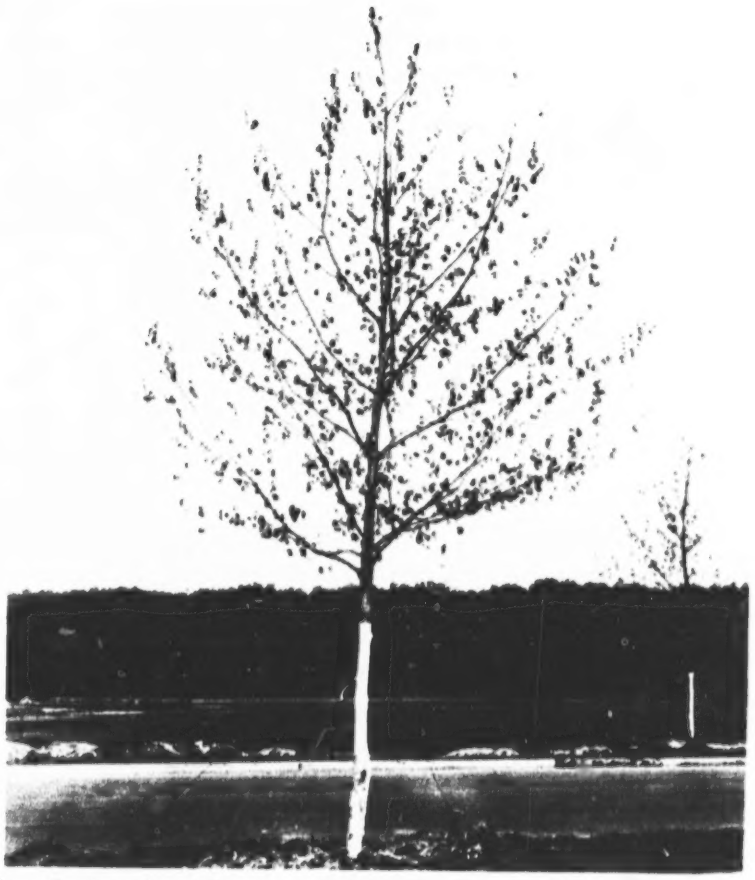

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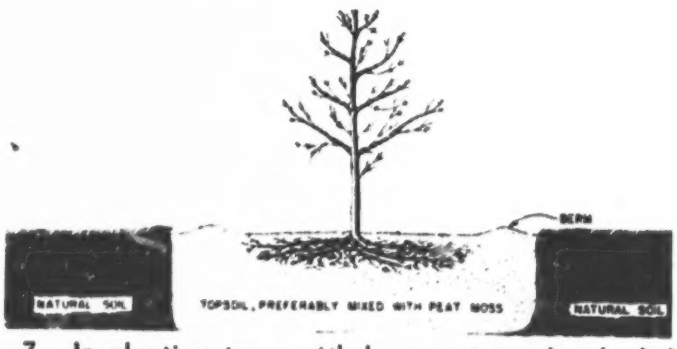

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Fig. 8. This twisted and lopsided root system resulted from improper planting. Such root systems frequently do not supply adequate nutrients and water for normal tree growth.

Improperly arranged roots may result in retarded growth or even death of entire trees after a few years. Balled trees need a hole 2 to 3 feet wider than the soil ball (Fig. 9). This allows for a trench 1 to 1 1/2 feet wide around the ball to be filled with good soil. The hole should be deep enough so the tree can be planted at the same depth as it was before it was dug. Some arborists prefer to set a tree slightly higher than it was in its original position. This allows for settling of the tree.

Fig. 9. Balled trees need a hole 2 to 3 feet wider than the soil ball.

Providing drainage. Adequate drainage is essential for the survival of newly planted trees, and any hole in soil that will not drain readily should have drainage provided. If clay or hardpan at the bottom of a hole is underlaid by gravel, you can provide adequate drainage with holes made by a soil auger or through fissures made by compressed air or dynamite. Fill holes made by a soil auger with gravel.

It is advisable to tile-drain holes for large trees. In clay soil, a single 3- or 4-inch standard agricultural tile drain across the bottom of the hole is adequate if the hole is not over 6 feet in diameter (Fig. 10). For larger

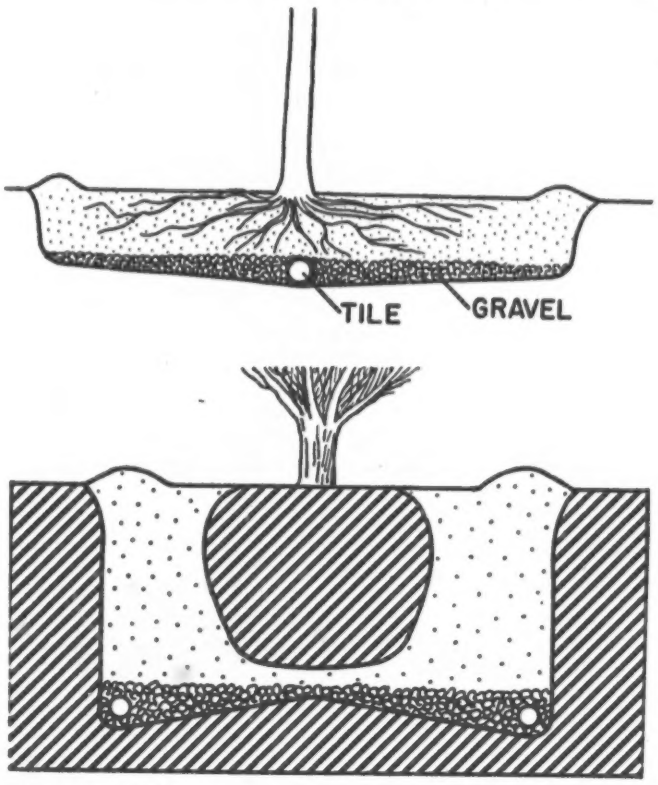

Fig. 10. Poorly drained soils may require additional drainage. Be sure to allow sufficient depth for the drain tile, gravel fill, and 2 to 3 inches of soil over the gravel before the tree is placed in the hole. The bottom of the hole should slant toward the tile.

holes and for evergreens, which in general require better drainage than deciduous trees, two lines of tile are recommended. The tile should lead to a suitable free outlet or, if such an outlet is not available, a dry well may be installed. A dry well (Fig. 11) is a large hole filled with gravel into which the water can flow. In some locations the drain tiles empty into a storm sewer. Never connect a drain to a sanitary sewer. Do not use crushed limestone in the bottom of the hole;

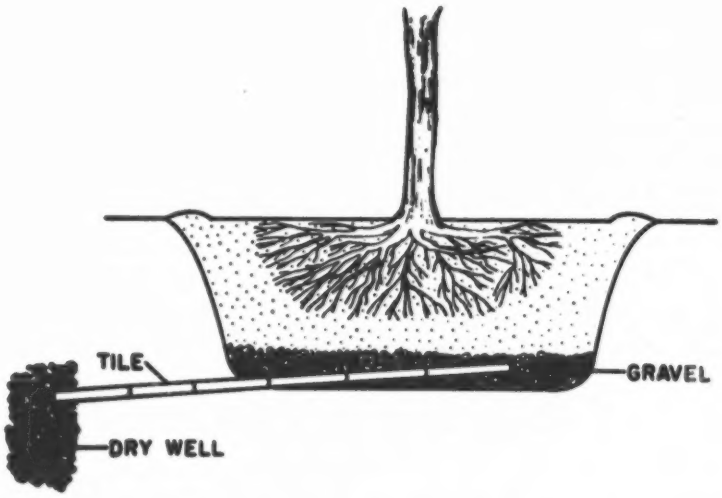

Fig. 11. A dry well or other suitable tile outlet may provide effective drainage in holes not over 6 feet in diameter. Use a single tile drain across the bottom and place enough gravel in the hole to cover the tile.

it tends to create an alkaline condition and cause a tree to develop chlorosis.

Improving soil fertility and texture. Heavy clay soil, low in nutrients, does not allow for adequate aeration and retains too much water for good root growth. Light, sandy soil is low in nutrients, allows for excessive aeration, and does not retain enough moisture for good root growth.

Poor quality soil can be improved in texture by adding peat moss, granulated sphagnum, well-rotted manure, or other suitable materials. Well-rotted manure supplies some nutrients. Usually it is not necessary to add commercial fertilizer until new root growth has developed. However, if the soil is low in nutrients you can improve it by adding superphosphate or commercial fertilizer high in superphosphate such as a 4-12-4 formulation. Five pounds of 20 percent superphosphate is recommended for each cubic yard of soil (3 3/4 ounces per bushel). The amount of commercial fertilizer to use varies from 3 pounds per cubic yard of soil (2 1/4 ounces per bushel) for small trees with bare roots to 10 pounds per cubic yard of soil (7 1/2 ounces per bushel) for large trees with balls of soil.

Breaking the ball. Delay in planting after a tree is dug may result in the formation of a

hard crust an inch or more deep at the surface of the ball of soil, especially if the soil is heavy clay. To assure a better moisture and air supply for good root growth, you can fork off or fracture the hard crust, or punch holes through it, before the backfill is added. A light surface application of a nonionized detergent (not over 1 ounce in 1 gallon of water) may help in initiating water penetration of the ball of soil that has a hard crust.

Placing the plant. Before placing the tree in the hole, put 2 or 3 inches of good loam soil in the bottom, or over any drainage material provided, including tile and gravel. To avoid air pockets under the soil ball, arrange the soil at the bottom of the hole so it is slightly higher in the center. If the tree was marked for proper orientation before it was dug, set it so that each side will have the same exposure or position that it had in its previous location. This is especially important in preventing sunscald or winter injury of bark on smooth- or thin-barked trees. If a tree cannot be properly oriented, you can protect its trunk and large branches by wrapping them with paper or burlap, or coating them with wax or latex.

Filling the hole. After placing the tree in the proper position, fill the hole with good loam soil. Bare-root trees need special attention. Work the soil in firmly around the roots as the hole is gradually filled. Gently raise and lower the tree slightly as the soil is added, to help eliminate air pockets around the roots. Add the soil in layers of about 6 inches, and tamp each layer to make it firm and to hold the tree perpendicular. Water may be used to settle the soil and to eliminate air pockets around the roots. If the soil is wet it should be tamped very little and the tree may not need "watering in." Spread a top layer of 1 to 2 inches of loose soil over the tamped soil to serve as a mulch. Leave a ridge or collar of soil at the margin of the hole (Fig. 12) to form a basin for holding water.

When planting a tree with a ball of soil, remove the burlap before filling the trench around the ball. Heavy burlap left around the ball of soil will reduce the amount of moisture reaching the roots. Also, the burlap may decay slowly and act as a barrier to normal

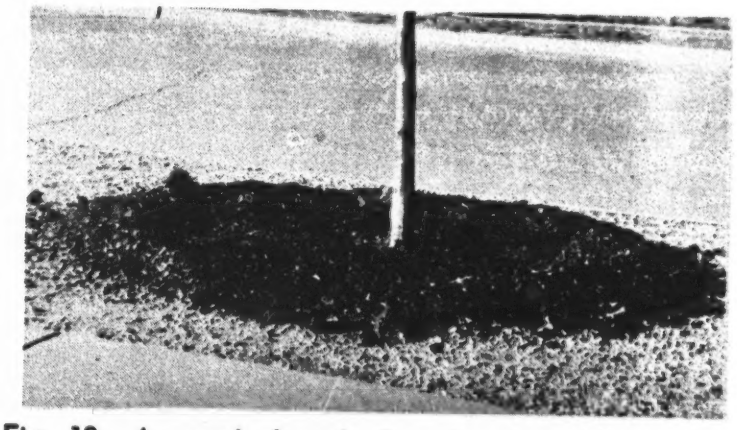

Fig. 12. A mound of earth, 3 to 4 inches high around a newly planted tree serves as the dike of a reservoir. This will hold sufficient water to soak the soil of the backfill and the soil contained in the ball about the plant roots.

root growth. However, if the soil in the ball is likely to crumble, the burlap can be slit along the sides with a sharp knife, rolled back from the top, and left on the ball.

Pruning. Newly planted trees should be pruned because many of the fibrous roots through which water is obtained are lost when the trees are dug. In general, removing 15-35 percent of the leaf-bearing wood to compensate for this root loss is recommended to help prevent injury or death of newly planted trees. Remove injured, weak, interfering, and poorly located branches. Entire branches should be removed, leaving the tree with a thinned out crown, one good leader, and an adequate number of well-spaced lateral branches with uncut tips (Fig. 13). Do not remove small twigs along the leader or main branches.

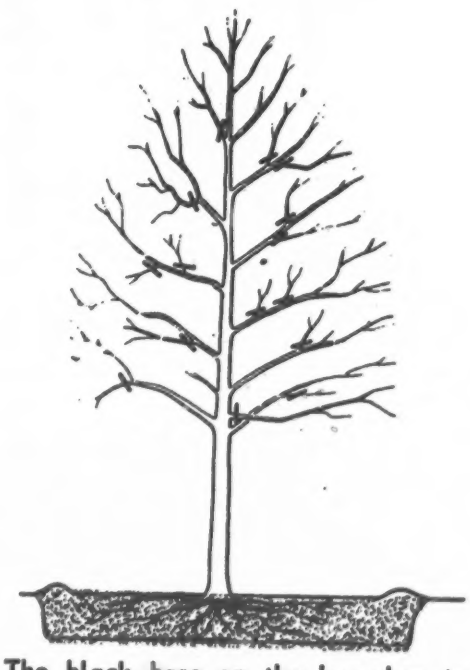

Fig. 13. The black bars on the branches indicate top growth that should be removed on newly planted trees.

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(Address) 434 Mumford Hall, Urbana, Illinois 61801

DATE: June 6, 1967

RE: (Author, Title, Publisher, Date) Transplanting Shade Trees, VAS 5002. Urbana, Illinois: Vocational Agriculture Service, University of Illinois. 12p. 1967.

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TRANSPLANTING SHADE TREES

1. How Should I Prepare a Tree for Moving?
2. How Should I Plant a Tree?
3. How Should I Protect the Tree?

1. HOW SHOULD I PREPARE A TREE FOR MOVING?

Careful attention to recommended practices—including predigging preparations, methods of digging, and protection of roots—is good insurance for your success in getting a tree off to a good start after it is moved.

Tying-in branches, marking orientation

Tying-in the branches of low-branched or bushy plants will help avoid injury and facilitate digging. Heavy twine is usually used for tying-in branches, but burlap strips or 1/4-inch rope may also be used. To tie-in the branches, attach the twine or other suitable material to a branch at the base of the tree and then wind it spirally around the plant to the top and tie it in a loop (Fig. 1).

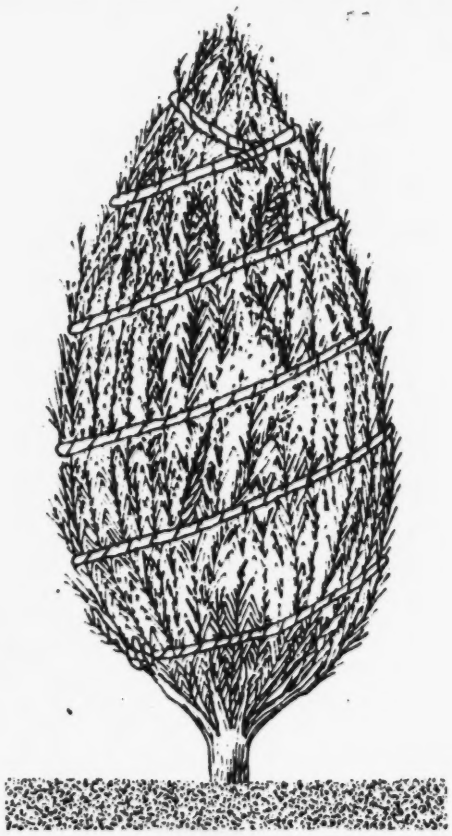

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Fig. 1. To prevent unnecessary injury, tie-in with rope or strips of burlap.

Before digging the tree, mark a branch that faces north (or any other direction) so the tree can be properly reoriented when planted.

Digging the tree

After the branches are tied-in, the tree is ready for digging. Deciduous trees under 2 1/2 to 3 inches in trunk diameter, measured 1 foot above the ground, are usually moved with bare roots. "Bare root" means that most or all of the soil is removed from the roots when the tree is dug. Thus, a tree can be dug with a larger root system than if it is taken with a ball of soil.

The digging operation consists of trenching around the tree and removing the soil from around the roots. Dig the trench far enough from the tree to preserve a large proportion of the fibrous roots. This distance is usually 6 inches for each inch of diameter of the trunk. Thus, for a tree with a 3-inch trunk, the trench would be 18 inches from the trunk. Make the trench deep enough to extend below the level of the lateral roots; the depth may vary from 12 to 18 inches (Fig. 2).

After digging the trench, remove the soil from around the roots. It may be shaken off if the tree is small or it can be loosened and combed out of the fibrous roots with a spading fork. Special care is required to keep root injury to a minimum. This is accomplished by working inward from the trench with the spading fork. Greater root protection is obtained if the tree is moved with "semibare" roots—some soil is left clinging to the fibrous roots. This added protection will help the tree recover more rapidly.

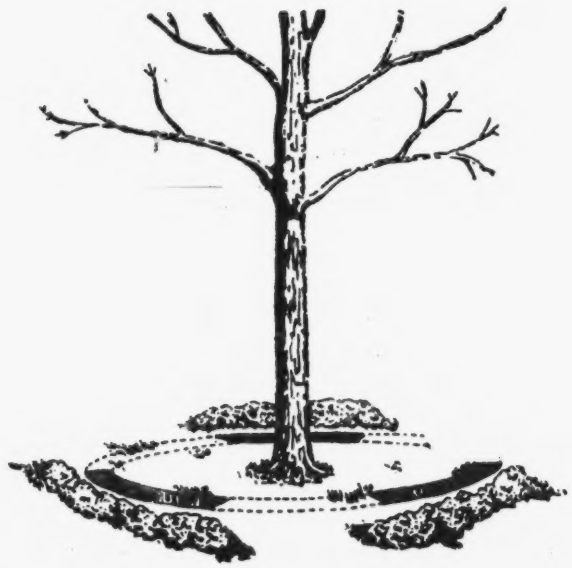


Fig. 2. Dig the trench deep enough to extend below the main lateral roots and far enough from the tree to preserve a large proportion of the fibrous roots (courtesy National Park Service).

After the lateral roots are free of soil, tip the tree to remove the soil from under the plant. Tip the tree very gradually to avoid straining or breaking the roots and loosening the bark near the base of the trunk. Cut any anchor roots or tap roots that still hold at a depth of 14 to 18 inches. To lift the tree out of the hole, grasp it at the junction of the roots and trunk. Pack the exposed roots in some moisture-holding material, such as straw, sphagnum, peat moss, sawdust, shingle tow, or wood chips, and wrap in burlap to protect against drying and mechanical injury (Fig. 3).

"Balled and burlapped" means that the soil is not removed from the roots when the tree is dug. This is referred to as a B&B tree by the nursery trade. Deciduous trees 2 1/2 to 3 inches and larger in trunk diameter, measured 1 foot above the ground, and evergreens are usually moved and planted with balls of soil covering their roots. The size of the ball will depend on the size and species of the tree and the type of soil in which the tree is growing. Trees that are difficult to move, such as beech, hickory, hornbeam, sassafras, sweet gum, tupelo, walnut, and white oak, need larger balls than trees that are easy to move. Trees growing in loose, well-drained soil, such as a sandy soil, will have more extensive or spreading root systems than trees growing in a hard, poorly drained soil like a tight clay.

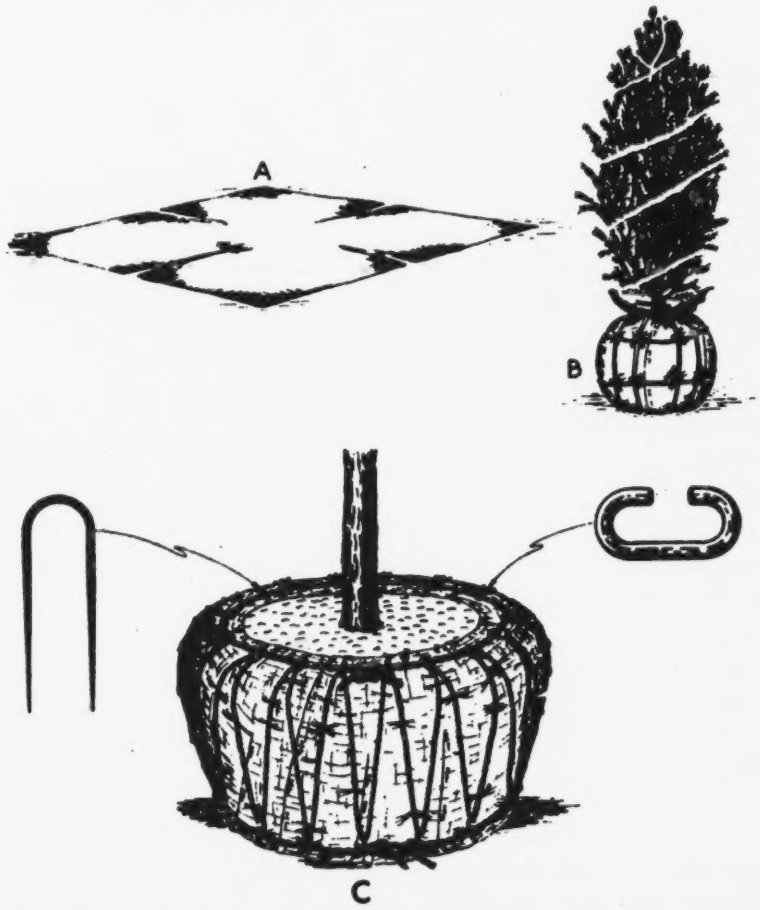


Fig. 3. Trees can be "balled and burlapped" for transplanting. (A) Burlap cut for wrapping small tree, (B) Small evergreen properly wrapped, and (C) Strips of burlap are used on larger trees (courtesy National Park Service).

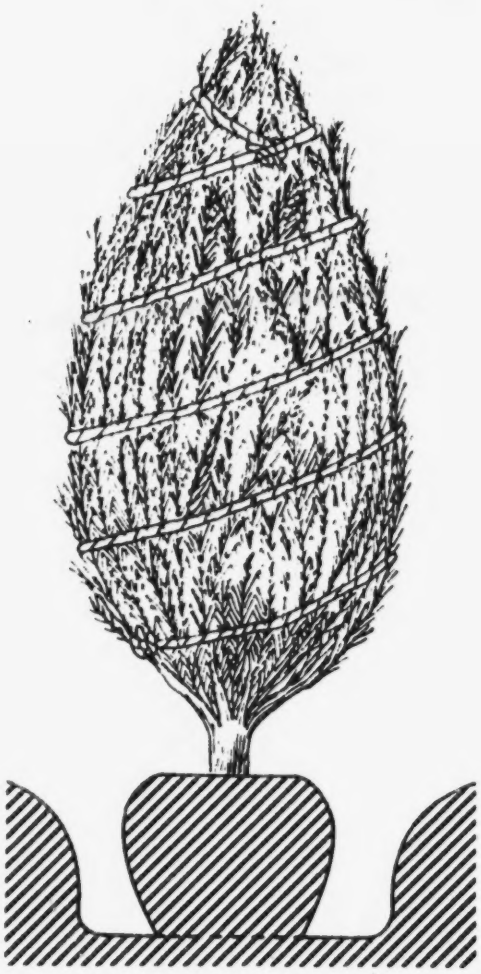
In general a ball for deciduous trees is approximately 10 inches in diameter for each inch of trunk diameter 1 foot above ground. Therefore, a tree with a trunk 3 inches in diameter needs a ball 30 inches in diameter. If a ball is too large, the roots will be inadequate to hold the soil together and the ball may break apart when the tree is moved.

The ball of soil for evergreens is determined by the height of the plant rather than by the diameter of the trunk. Evergreens 1 1/2 to 2 feet high need a ball 12 inches in diameter. For each additional foot in height, up to 10 feet, the ball diameter is increased 2 inches. For each additional foot in height above 10 feet the diameter is increased 1 1/2 inches.

Before digging is started, remove any loose soil above the roots. Then make a circle around the plant approximately 6 inches beyond the anticipated diameter of the finished ball. Cut the roots to a depth of approximately

12 inches by inserting a spade at the marked circle with the back side of the spade toward the tree. Using a sharp spade will result in clean cuts which heal rapidly. Next, dig a trench outside and adjacent to the marked circle and about three-fourths the desired depth of the ball, which is usually 10 to 16 inches.

Trim the ball to proper size and shape with the spade, keeping the back side of the spade toward the tree. Round off the trimmed ball at the top edge and taper it inward toward the base (Fig. 4). Avoid loosening the soil



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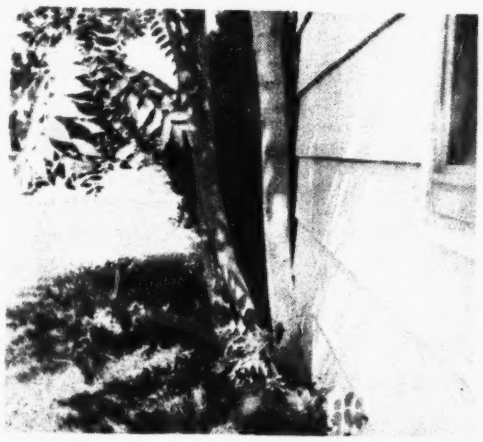

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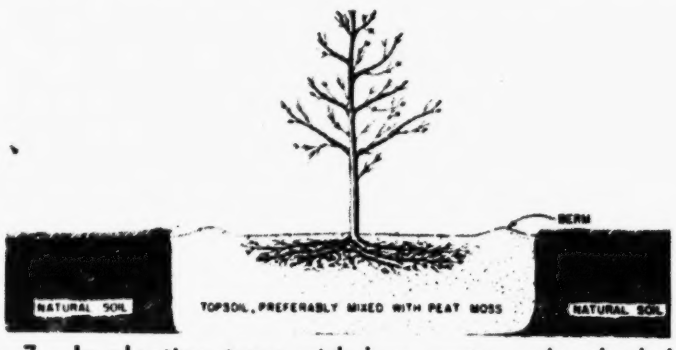

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wall of the hole or all in one direction. Fig. 8 shows the result of improper root arrangement, where the roots were twisted and pointed in one direction when the tree was planted.

Fig. 8. This twisted and lopsided root system resulted from improper planting. Such root systems frequently do not supply adequate nutrients and water for normal tree growth.

Improperly arranged roots may result in retarded growth or even death of entire trees after a few years. Balled trees need a hole 2 to 3 feet wider than the soil ball (Fig. 9). This allows for a trench 1 to 1 1/2 feet wide around the ball to be filled with good soil. The hole should be deep enough so the tree can be planted at the same depth as it was before it was dug. Some arborists prefer to set a tree slightly higher than it was in its original position. This allows for settling of the tree.

Fig. 9. Balled trees need a hole 2 to 3 feet wider than the soil ball.

Providing drainage. Adequate drainage is essential for the survival of newly planted trees, and any hole in soil that will not drain readily should have drainage provided. If clay or hardpan at the bottom of a hole is underlaid by gravel, you can provide adequate drainage with holes made by a soil auger or through fissures made by compressed air or dynamite. Fill holes made by a soil auger with gravel.

It is advisable to tile-drain holes for large trees. In clay soil, a single 3- or 4-inch standard agricultural tile drain across the bottom of the hole is adequate if the hole is not over 6 feet in diameter (Fig. 10). For larger

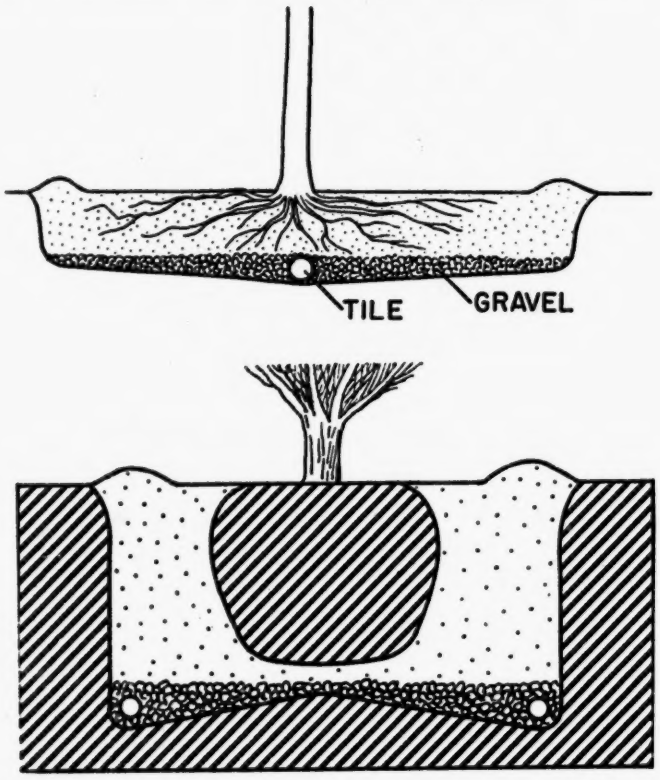

Fig. 10. Poorly drained soils may require additional drainage. Be sure to allow sufficient depth for the drain tile, gravel fill, and 2 to 3 inches of soil over the gravel before the tree is placed in the hole. The bottom of the hole should slant toward the tile.

holes and for evergreens, which in general require better drainage than deciduous trees, two lines of tile are recommended. The tile should lead to a suitable free outlet or, if such an outlet is not available, a dry well may be installed. A dry well (Fig. 11) is a large hole filled with gravel into which the water can flow. In some locations the drain tiles empty into a storm sewer. Never connect a drain to a sanitary sewer. Do not use crushed limestone in the bottom of the hole;

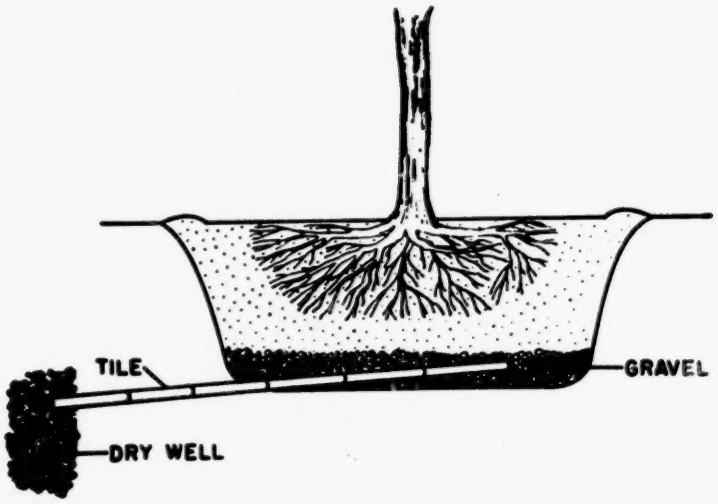

Fig. 11. A dry well or other suitable tile outlet may provide effective drainage in holes not over 6 feet in diameter. Use a single tile drain across the bottom and place enough gravel in the hole to cover the tile.

it tends to create an alkaline condition and cause a tree to develop chlorosis.

Improving soil fertility and texture. Heavy clay soil, low in nutrients, does not allow for adequate aeration and retains too much water for good root growth. Light, sandy soil is low in nutrients, allows for excessive aeration, and does not retain enough moisture for good root growth.

Poor quality soil can be improved in texture by adding peat moss, granulated sphagnum, well-rotted manure, or other suitable materials. Well-rotted manure supplies some nutrients. Usually it is not necessary to add commercial fertilizer until new root growth has developed. However, if the soil is low in nutrients you can improve it by adding superphosphate or commercial fertilizer high in superphosphate such as a 4-12-4 formulation. Five pounds of 20 percent superphosphate is recommended for each cubic yard of soil (3 3/4 ounces per bushel). The amount of commercial fertilizer to use varies from 3 pounds per cubic yard of soil (2 1/4 ounces per bushel) for small trees with bare roots to 10 pounds per cubic yard of soil (7 1/2 ounces per bushel) for large trees with balls of soil.

Breaking the ball. Delay in planting after a tree is dug may result in the formation of a

hard crust an inch or more deep at the surface of the ball of soil, especially if the soil is heavy clay. To assure a better moisture and air supply for good root growth, you can fork off or fracture the hard crust, or punch holes through it, before the backfill is added. A light surface application of a nonionized detergent (not over 1 ounce in 1 gallon of water) may help in initiating water penetration of the ball of soil that has a hard crust.

Placing the plant. Before placing the tree in the hole, put 2 or 3 inches of good loam soil in the bottom, or over any drainage material provided, including tile and gravel. To avoid air pockets under the soil ball, arrange the soil at the bottom of the hole so it is slightly higher in the center. If the tree was marked for proper orientation before it was dug, set it so that each side will have the same exposure or position that it had in its previous location. This is especially important in preventing sunscald or winter injury of bark on smooth- or thin-barked trees. If a tree cannot be properly oriented, you can protect its trunk and large branches by wrapping them with paper or burlap, or coating them with wax or latex.

Filling the hole. After placing the tree in the proper position, fill the hole with good loam soil. Bare-root trees need special attention. Work the soil in firmly around the roots as the hole is gradually filled. Gently raise and lower the tree slightly as the soil is added, to help eliminate air pockets around the roots. Add the soil in layers of about 6 inches, and tamp each layer to make it firm and to hold the tree perpendicular. Water may be used to settle the soil and to eliminate air pockets around the roots. If the soil is wet it should be tamped very little and the tree may not need "watering in." Spread a top layer of 1 to 2 inches of loose soil over the tamped soil to serve as a mulch. Leave a ridge or collar of soil at the margin of the hole (Fig. 12) to form a basin for holding water.

When planting a tree with a ball of soil, remove the burlap before filling the trench around the ball. Heavy burlap left around the ball of soil will reduce the amount of moisture reaching the roots. Also, the burlap may decay slowly and act as a barrier to normal

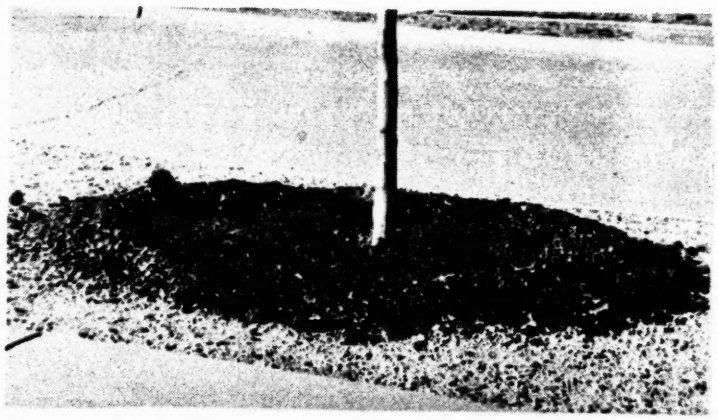

Fig. 12. A mound of earth, 3 to 4 inches high around a newly planted tree serves as the dike of a reservoir. This will hold sufficient water to soak the soil of the backfill and the soil contained in the ball about the plant roots.

root growth. However, if the soil in the ball is likely to crumble, the burlap can be slit along the sides with a sharp knife, rolled back from the top, and left on the ball.

Pruning. Newly planted trees should be pruned because many of the fibrous roots through which water is obtained are lost when the trees are dug. In general, removing 15-35 percent of the leaf-bearing wood to compensate for this root loss is recommended to help prevent injury or death of newly planted trees. Remove injured, weak, interfering, and poorly located branches. Entire branches should be removed, leaving the tree with a thinned out crown, one good leader, and an adequate number of well-spaced lateral branches with uncut tips (Fig. 13). Do not remove small twigs along the leader or main branches.

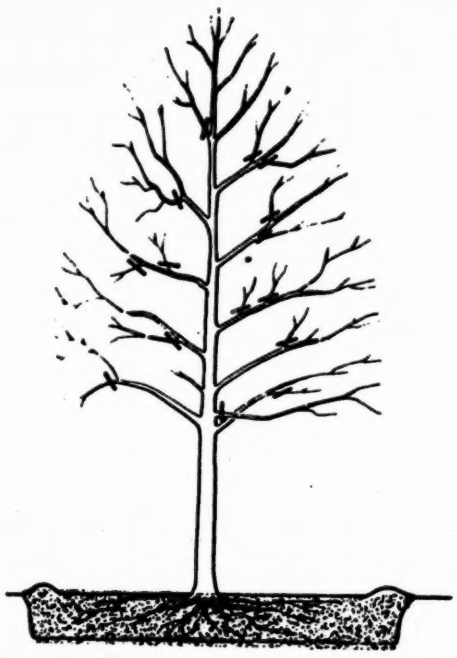

Fig. 13. The black bars on the branches indicate top growth that should be removed on newly planted trees.

3. HOW SHOULD I PROTECT THE TREE?

After planting a tree, take several precautions to protect it against wind, insect, drought, and other dangers. The following suggestions cover the most commonly required practices—bracing, wrapping, and watering.

Bracing

Most trees over 1 inch in trunk diameter must be braced with stakes or guys to hold them in an upright position and prevent loosening of the soil around the base of the trunk and drying out of the roots. Such bracing is usually required during the first year. One or two stakes are adequate for bracing trees less than 3 inches in trunk diameter. Trees can be braced with 2 x 2 or similar wood stakes, with light metal posts or with guys (Fig. 14). Either two stakes placed on opposite sides of a tree, or one stake or metal post placed on the side of the prevailing winds (1 foot or so away from the tree and driven into the ground 2 or 3 feet), may be used. To avoid injuring the tree roots, set the stakes before the roots are covered with soil.

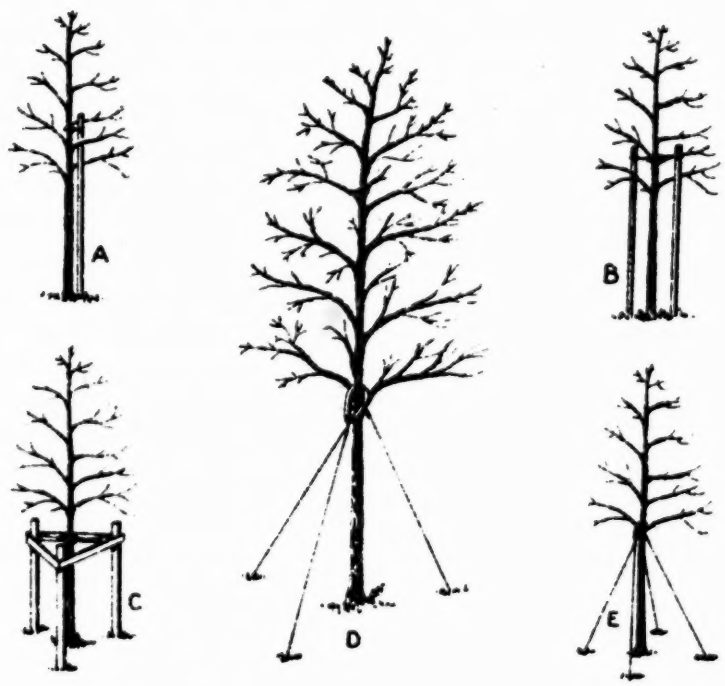

Fig. 14. Methods of staking and guying young trees. (A). Single stake, (B). Double stakes, (C). Triple stakes, (D). Three-way guys, and (E). Four-way guys (courtesy National Park Service).

Attach the tree to a stake with a soft rope or wire run through a piece of hose (Fig. 15 and 16) or other suitable material to avoid injury to the trunk. If the wire encircles the trunk without such protection, it will girdle

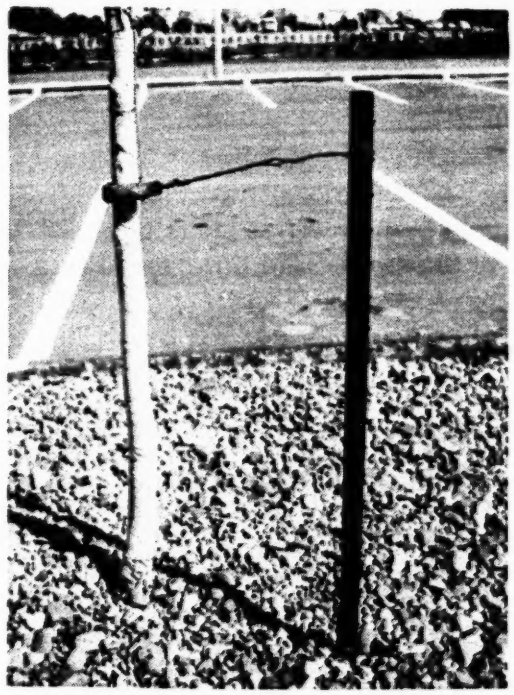

Fig. 15. Metal posts are strong and durable, and may be used repeatedly for bracing newly planted trees.

Fig. 16. A single guy or wire is sometimes used for bracing small trees. Attach the guy to the tree through a piece of hose that encircles the trunk at a crotch and fasten the other end to a stake placed several feet from the tree.

the trunk and is likely to kill the tree (Fig. 17). Cross or "figure eight" the rope, or twist the wire between the stake and the tree, to prevent chafing of the bark.

Fig. 17. Bare guys or wires that encircle the trunk and that are too tight or left on too long will girdle the trunk. Such girdling frequently prevents enlarging of the trunk below the girdle as shown here.

Trees more than 3 inches in trunk diameter need three stakes or three or four guys for adequate bracing. To brace with three stakes, place the stakes at equal intervals around the tree and 1 foot from the trunk. Brace the stakes with cleats, attached 4 to 6 inches below the tops of the stakes, to form a triangular structure connecting the three stakes. Attach the tree to the stakes with soft rope or wire as described previously. Trees planted with large balls of soil may not need bracing.

Guys for large trees consist of 3/16- to 1/4-inch, 7-strand cable, or two strands of No. 9, or four strands of No. 10 or No. 12 galvanized steel wire, twisted. Attach the guys to the tree through pieces of hose that encircle the trunk at a crotch or through lag hooks equally spaced around the trunk. Place the lag hooks 8 or 10 inches apart to avoid weakening of the trunk, and in line with the deadmen (anchor pieces) to which they will be attached. Locate the deadmen, which may be 4- by 6-inch pieces of timber 4 feet long buried to a depth of 4 feet, or other suitable anchor materials, at a distance from the tree so that the guys will be at a 45-degree angle when twisted taut. In clay and nonrocky soils, wing anchors 30 inches long or longer can be used in place of deadmen. Examine the guys at regular intervals to see that they are taut and that they are not injuring the trunk.

Wrapping

Protect the trunks of newly planted trees that have smooth bark from sunscald, drying, and borer attacks by wrapping them with special tree-wrapping crepe paper, Kraft wrapping paper of at least 40-pound weight, burlap, or other suitable material (Fig. 18). The trunks of trees with coarse or rough bark should be treated with DDT instead of being wrapped.

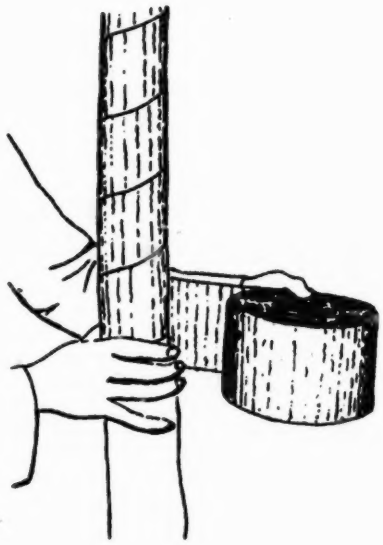

Fig. 18. Wrapping the trunks of newly planted trees protects the bark from excessive drying, sunscald, and borer injury (courtesy National Park Service).

Crepe paper reinforced with asphalt is effective in preventing borer injury. In addition to acting as a barrier, the wrapping reduces loss of water and thus prevents excessive drying of the bark. Dry bark is especially attractive to borers. As a general recommendation, keep the trees wrapped for two growing seasons or until they are growing vigorously. Remove the wrappings each spring and fall to examine the bark for insect injury. If borers are present, treatment is recommended.

Rolls of paper or burlap 3 to 8 inches wide are commonly used for spiral wrappings. Suitable widths are 3 or 4 inches for small trees, 5 or 6 inches for medium trees, and 7 or 8 inches for large trees. Burlap 4 inches wide and sewn on one edge makes a neater wrapping than unsewn or torn strips. Apply the wrapping material neatly. To wrap the trunk, start at the base of the branches and wrap spirally to the ground. Cover any bark exposed below the wrapping with soil. Secure the wrapping with raffia, string, or stout twine. The twine may be tied around the base of the wrapping with a slip knot and then wrapped, using spaced loops, as shown in Fig. 19, or it may be wrapped spirally around the trunk in the opposite direction to the spiral of the wrapping paper. The twine is tied securely at the top of the wrapping. Examine the twine periodically and loosen it if this becomes necessary to avoid girdling the trunk.

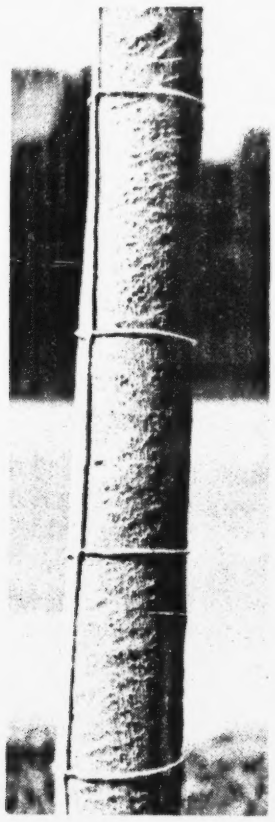

Fig. 19. Tie twine securely on top of the wrapping paper to hold it in place.

Watering

Newly planted trees with limited root systems need an abundance of water during the growing season. Supply enough water to soak the soil around the roots at each watering, but do not water too often; allow the soil to dry sufficiently between waterings to provide adequate aeration for good root growth. A common practice is to soak the soil thoroughly every 7 to 10 days during prolonged dry periods in the growing season. Sandy soils require more water to maintain good tree growth than do loam or clay soils. You can get a rough idea of the amount of moisture present by squeezing a handful of the soil. Adequate moisture is available if the soil remains in a firm ball after it has been squeezed.

Water distribution will be more even throughout the root area if dikes, collars, or levees are made around the tree, as indicated in Fig. 12, beyond the edges of the original hole or beneath the tips of the branches, and holes are drilled to various levels in the soil within the dikes. Recently planted trees, and especially evergreens, also need an abundance of water before the ground freezes in the fall, to carry them through the winter months.

Adapted from Illinois Trees: Selection, Planting, and Care, by J. C. Carter, Illinois Natural History Survey.

MEMORANDUM

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(Address) 434 Mumford Hall, Urbana, Illinois 61801

DATE: June 6, 1967

RE: (Author, Title, Publisher, Date) Setting Up Farm Records to Provide for Analysis, VAS 2037. Urbana, Illinois: Vocational Agriculture Service, University of Illinois. 8p. 1963.

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SETTING UP FARM RECORDS TO PROVIDE FOR ANALYSIS

May-65

1. What Do Records Tell About a Farm?
2. What Kinds of Analysis Measures are Needed?
3. Inventories and Depreciation Schedules
4. Records of Financial Transactions
5. Feed Records
6. Records of Production and Miscellaneous Items

Since farming is now a specialized business with large capital investments, analyzing records is more important than ever before. In this subject matter unit we will attempt to show the value of adequate records and how to set them up to provide for analysis measures.

Most of the illustrations can be used along with the Illinois Farm Record Book, made available from the College of Agriculture, University of Illinois. A problem for use with the book is available from Vocational Agriculture Service and includes analysis measures, as well as material needed for making income and social security tax reports. The present unit will be concerned with analysis measures, rather than items needed only for tax reporting.

1. WHAT DO RECORDS TELL ABOUT A FARM?

This section will illustrate briefly what records can tell about a farm business. Fig. 1 shows 7 measures obtained from a 240-acre hog farm in a recent year. The measures were made possible by accurate and thorough record keeping.

Fig. 1 shows which items have a high rating on this farm and which have a medium or low rating. Production and income items were plotted upward from the center line of the chart if their values were higher than average. Expense items were plotted downward from center if the costs were higher than average so that a high cost item will have a low rating and a low cost item a high rating.

This farm rates considerably above average in returns to operator's labor, capital, and management and in value of farm production per man. Corn yields are somewhat above average. Returns per $100 feed fed are average for hogs but below average for cattle. Labor and machinery costs per tillable acre are low; thus these items have a high rating.

These results give examples of strong and weak points of a farm's operations. With adequate records many other measures can be obtained; you need not consider all of them at this time.

Finding the strong and weak points is a major step toward bringing about improvement of any business. Knowing where the farm stands in relation to other farms does not give the details of exactly what to do to bring about improvement. However, a person thoroughly familiar with the farm's operation will usually have a good idea of the changes likely needed for improvement if he can tell just where the weak points exist.

The results in Fig. 1 indicate that this farmer should carefully study his cattle feeding operations and try to improve them. If he cannot bring about improvement in the next few years, he should probably put his feed and labor in another enterprise; at least he should consider alternatives to find whether they will increase his returns.

Several items may be responsible for the low rating for the cattle feeding operation.

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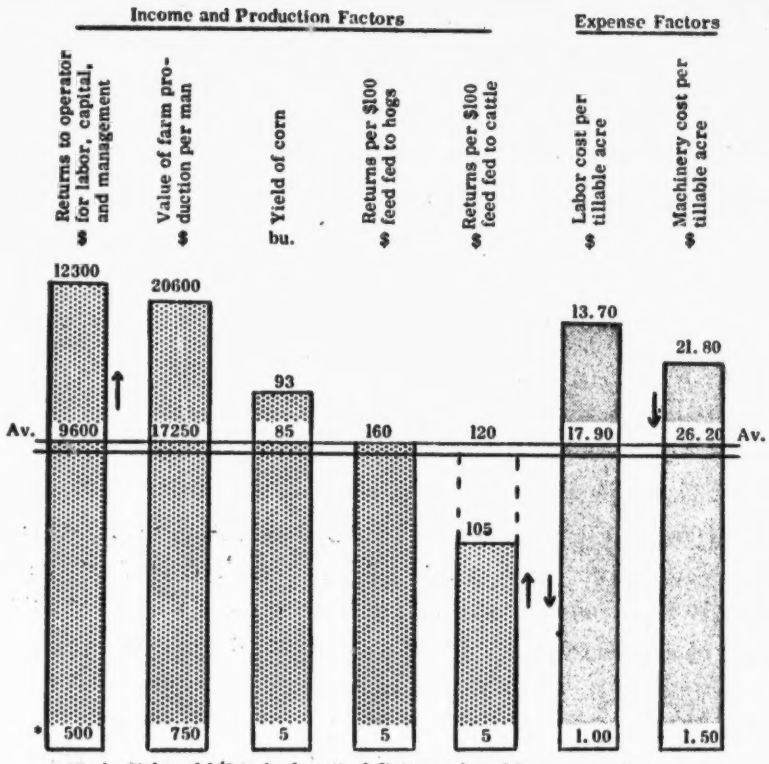

*Scale: Value of 1/8 inch of vertical distance plotted from center line.

Fig. 1. Comparison of results on a 240-acre hog farm with those on similar farms.

With only the preceding information at hand, each of the following may be responsible: low feeding efficiency, high death losses, or purchase and sales prices out of line.

This farmer should also consider what he can do to bring returns per $100 feed fed to hogs to a higher level. Perhaps he can increase his corn yield still more, even though that measure is above average at the present time. He has done a good job of keeping labor and machinery costs low. He will want to preserve his high rating for these items; however, additional expenses may be justified if they increase his income more than the added cost and if such an investment represents the best use of his available funds.

Record analysis thus makes it possible for a farmer to improve his business. Further study and budgeting will be necessary in order to get the full benefits. The analysis is made possible by keeping records carefully throughout the year after first setting up the record system properly. The next section will be concerned with classifying measures into major groups and the rest of the unit with setting up the record system to get such measures.

2. WHAT KINDS OF ANALYSIS MEASURES ARE NEEDED?

Section 1 showed some measures of comparison that can be obtained from complete and well-kept records. The record system must be set up properly if it is to provide the information that makes it possible to secure such measures. This section will classify the analysis measures into groups, give examples for each group, and tell why certain records need to be kept in order to obtain the measures. The kinds of measures discussed are: efficiency of crop and livestock production, costs per tillable acre, volume of business, and farm earnings.

Efficiency of crop production

The most commonly used measure of efficiency of crop production is yield per acre. This is a simple measure and does not require complicated records. However, you do need to know the total production and total number of acres of each crop. Production records are very important in this regard. Sometimes an inventory at the end of the year will help substantiate your estimate of production.

Efficiency of livestock production

Returns per $100 feed fed is a very valuable measure of efficiency with livestock. To get this measure, you need to know two things: returns from each livestock enterprise and the value of feed fed to each kind of livestock. To find the livestock returns, you need to know the values of the beginning and ending inventories, as well as purchases, sales, and products consumed in the household. In order to find the value of feed fed to each kind of livestock, you will need to have some method of recording feed fed to hogs separately from feed fed to cattle, and so on.

Another measure is feed fed per 100 pounds of gain. To get this measure, you will need to know approximately the pounds of each feed fed to each kind of livestock and the total weight or other amount of livestock and livestock products produced during the year. To find the production for the year, you will need the approximate weights of animals in the beginning and ending inventories, of animals purchased and sold (and died), and the amounts of products used in the household.

Costs per tillable acre

An example of a cost item that can readily be calculated if adequate records are kept is machinery cost per tillable acre. Total machinery cost, as reflected in this measure, consists of: annual depreciation, repairs, gas and oil, machine hire, farm share of auto depreciation and operating expenses, and the farm share of electricity and telephone. A farmer also needs to know these amounts to make the proper deductions when he reports his income tax.

Labor cost per tillable acre is a measure which includes some costs that are not tax deductible. Besides including hired labor, a tax-deductible item, this measure also reflects the value of the operator's labor and unpaid family labor used in the farm business.

Volume of business

For a large livestock operation, you should know the hundred weight of pork or beef produced. To do so, you must keep careful account of the weight of livestock bought or sold. An accurate estimate of weights of animals in beginning and ending inventories is also needed. Whenever possible, enter the amounts of physical quantities, such as weight of livestock or bushels of grain, in your record book along with the dollar values.

Value of farm production per man can be found if you know total cash receipts and expenses, purchased livestock and feed, changes in inventories, value of products consumed, and the total months of labor.

Sometimes it is helpful to know the total value of land, labor, and capital going into the business annually. Besides cash operating expenses and depreciation, you also need the values of capital items, inventory items, and unpaid labor in making this calculation.

Farm earnings

You can get an idea of farm earnings from the net farm income figure of your completed income tax report. However, such a figure is not always the best measure of earnings to use when comparing your farm with averages for other farms.

When income tax is reported by the use of the cash method, net farm income may be higher during one year merely because a higher proportion of the corn and soybean crops has been sold and ending inventories are lower than usual. Net farm income may not be a good indication of how well the total farm business is managed because of such differences as ownership, rental rates, and interest payments on borrowed money.

A farmer usually earns money from three sources: his labor, his management, and his capital investment. The returns from his capital investment include returns from land if the farmer owns a part of his land.

In analyzing records we get such measures as management returns, labor and management earnings, and capital and management earnings. If we divide the latter item by the total farm investment, we can also find the rate earned on investment. In order to get these measures, we need to place a value on inventory and capital items and unpaid labor.

3. INVENTORIES AND DEPRECIATION SCHEDULES

In Section 1 we mentioned that inventories and depreciation schedules are necessary to find measures of livestock efficiency, costs per tillable acre, volume of business, and farm earnings.

Using inventories in analysis

A complete inventory account includes 4 parts: beginning inventory, purchases, sales, and ending inventory. Table 1 shows an arrangement of these parts that will be a help later when the records are analyzed; keeping this arrangement in mind while entering records will simplify the job at the end of the year. The Illinois Farm Record Book does not provide for recording items in such an arrangement. Beginning and ending inventories are recorded in Part II of the book; purchases and sales are recorded in Part I. By reading carefully the column headings in the record book, you can find where to record these items.

When the records are summarized and analyzed, livestock product sales and the value of products used in the household should be added to the sales of livestock. Wool is recorded along with the sale of sheep; sales

Table 1. Inventory Accounts

Item	Beginning inventory	Purchases	Sales	Ending inventory
Feed, grain, & seeds				
Beef cattle				
Dairy cattle				
Hogs				
Poultry				
Sheep				

of eggs and dairy products are recorded on separate pages. Sales of livestock products are usually considered to be in cash accounts but need to be combined with sales of inventory items for analysis purposes. The value of home-raised products used in the household is recorded on a separate page near the end of Part I.

The actual taking of inventories at the beginning and end of the year is included in VAS 2008a, Record Keeping on the Farm. The beginning inventories should be taken promptly at the start of the year before any financial transactions are recorded. The beginning-of-year values will, of course, be the same as the end-of-year values for the preceding year.

Using depreciation schedules in analysis

Depreciation schedules are kept in connection with capital accounts. A complete capital account includes parts which in general correspond to those of the inventory accounts: remaining cost at beginning of year, depreciation, remaining cost at end of year, purchases, and sales. Depreciation is a bookkeeping method of spreading the cost of a capital item over its useful life. For items on hand at the beginning and end of the year, it corresponds to the differences between the remaining cost at the beginning and end of year. Table 2 shows the various parts of the capital accounts, including depreciation.

Filling in depreciation schedules is discussed in VAS 2008a, Record Keeping on the Farm. As was true for inventories, the beginning-of-year values should be entered before any of the financial transactions. Here again, the beginning-of-year values are the same as the end-of-year values for the preceding year.

For capital accounts, the beginning and end-of-year remaining costs and the annual depreciation are recorded in Part II of the Illinois Farm Record Book; purchases and sales are recorded in Part I.

Table 2. Capital Accounts, Including Depreciation

Item	Remaining cost beginning of year	Depreciation	Remaining cost end of year	Purchases	Sales
Machinery and equipment					
Auto (farm share)					
Soil improvements					
Farm improvements					

4. RECORDS OF FINANCIAL TRANSACTIONS

A major portion of record keeping consists of recording the financial transactions as they occur throughout the year. The main job to be done at the time of setting up the records is to study the record book so you will know where to make the entries.

Points to remember

Physical quantities, as well as the dollar values, should be entered whenever possible. Always enter number, bushels, pounds, or tons whenever these items are known.

For the purpose of record analysis, all sales made during the year should be included for that year even though payment is not received until a later date. All farm expenses incurred should be included, regardless of whether or not payment has been made by the end of the year. Of course, if you report income tax on the cash basis, you will need to indicate in your record book the expense items not paid by the end of the year and the receipt items for which payment has not been received.

Always enter as sales the value of farm products traded for merchandise. Enter in the record book the full price of capital items purchased on time.

Receipts and expenses

Most receipt items are entered in the separate section for receipts in Part I of the Illinois Farm Record Book. Check the book carefully to find which columns to use.

Notice the instructions given for entering sales of purchased feeder livestock. The column you use will probably depend on whether you use the cash or accrual method of reporting income tax. Sales of breeding or dairy stock are entered in a special column under either method. Differences in entries for the sale of livestock are due chiefly to tax considerations; if the record were used only for analysis purposes, all sales of beef could be entered in a "beef sales" column, all sales of hogs in a "hog sales" column, and so on.

Most cash expenses are entered in the expense section in Part I. However, cash wages paid to hired labor, social security tax withheld from wages, products furnished to workers, and insurance on workers are recorded in a "hired labor" section. Each of these items is a part of the total cost of hired labor.

Most receipt and expense items are entered in two columns; one is a column for entering totals and the other is a classifying column. It is important to make entries in each of these two spaces as an aid in cross-checking totals at the end of the year.

5. FEED RECORDS

Some measures of feed efficiency were discussed in Section 1. These measures depend on a reasonably accurate record of feed fed to each kind of livestock. If you take inventories and estimate grain production accurately, the job of getting suitable feed records will be simplified. If you have more than one kind of livestock, you should work out a system that provides records of feed fed to each kind.

Getting accurate feed records

An accurate estimate of the bushels of corn and oats produced and amounts in beginning and ending inventories is very helpful as a check on the amount of feed fed. A simple method of determining the bushels of small grains or shelled corn on hand is to find the number of cubic feet and divide by 1 1/4 cubic feet per bushel. To find the bushels of ear corn, divide the cubic feet by 2 1/2.

The tons of roughage on hand can also be estimated by first determining the volume. For baled hay, find the number of cubic feet and divide by 150 or 200 cubic feet per ton, depending on the tightness of baling and stacking. For example, hay tightly baled and stacked covers an area 16 feet long and 10 feet wide. The bales are stacked 5 feet high. The total volume is 800 cubic feet (16 x 10 x 5). The number of tons is 5.3 (800 ÷ 150).

The tons of tractor-packed silage in a trench or bunker silo can be estimated by dividing the volume in cubic feet by 57 cubic feet per ton for corn silage, or 50 for grass silage. Since the width at the top may be greater than at the bottom, you will want to use the average width in finding the number of cubic feet.

Various tables give the capacities of round silos. A portion of such a table that assumes average contents of moisture and grain and a settling period of a month or more is shown in the following:

Depth of silage in feet	Inside diameter in feet 14 (tons)	16 (tons)	18 (tons)	20 (tons)
10	27	35	44	55
14	39	51	64	80
18	51	67	85	105
22	64	84	106	130
26	77	100	127	157
30	90	118	149	184

Silage at the bottom of a silo is more densely packed than at the top. You can estimate the tons removed by subtracting the tonnage corresponding to the depth at the end of the year from that before any silage was fed. Example: An upright silo 16 feet in diameter held silage to a depth of 30 feet before feeding began. At the end of the year the silage was 14 feet deep. How much remained in inventory and how much was fed? The estimated weight of silage 30 feet deep is 118 tons; that of silage 14 feet deep in a silo that is 16 feet in diameter is 51 tons: The amount in the ending inventory (or beginning inventory for the next year) is therefore 51 tons; the amount fed was 67 tons.

Purchased feed should be accurately entered in the record book at the time of purchase. Be sure to include the volume in pounds, bushels, or tons along with the price. Also list the kind of livestock that will consume the feed if known, particularly for protein supplement.

You can get a rough estimate, or at least make a check, of each feed fed during the year by the following method: First add the amounts for ending inventory, the year's production, and sales. Then subtract the amounts for beginning inventory and purchases. The resulting figure should be the amount fed, adjusted for any shrinkage or overrun. That estimate of feed fed can be checked against periodic records you keep of amounts fed. Your accuracy in keeping records of beginning and ending inventories and production will therefore be very important in determining the usefulness of your records toward providing figures from which you can get measures of feeding efficiency.

Feed allocation records

If only one kind of livestock is fed, the job of keeping feed records is fairly simple. When more than one kind of livestock is fed, you will need to know the amounts of feed fed to each kind.

Table 3 can be a help for periodically recording the feed fed to the various classes of livestock. You will need one form similar to Table 3 for each kind of livestock fed.

You will need to record periodically the feed fed to each kind of livestock. It is suggested that the recording be done each month; however, variations are permissible as long as all the feed is accurately recorded.

Where facilities permit weighing the feed, that practice will, of course, provide for greatest accuracy. In the absence of such facilities, the estimate should be made by the use of the best alternative. Alternative methods might be feeding from separate bins or estimating the amount for cattle on the basis of pounds fed per head per day. Checks should be made against inventories, production, and purchases as suggested in the first portion of this section.

The amounts of commercial feeds purchased can be obtained directly from the financial entry in the expense section of the record book. The same may also be true for other feeds purchased. Use the actual price paid for commercial feed; an average price for grains (both raised and purchased) will provide simplification.

The number of pasture days can be estimated by several methods. One method is to multiply the carrying capacity per acre of pasture (example: 175 pasture days per acre of alfalfa) times the number of acres consumed by the livestock. This method is commonly used for estimating the pasture days for hogs. Another method is to multiply the number of animal units by the calendar days on pasture. An animal unit equals 1 cow or mature bull, 1 1/2 yearling cattle, 1000 pounds of feeder cattle, 2 weaned calves, 15 pigs, 5 mature sheep, or 10 weaned lambs.

Pasture value can also be figured on the basis of cash rental value or value as hay minus harvesting cost; however, the number of pasture days is not provided directly by the latter methods.

Table 3. Feed Record for _____ (Kind of Livestock); Year _____

Month	Corn (bu.)	Oats (bu.)	_____	Hay (tons)	Silage (tons)	Pasture days	Commercial feed (lb.)
January							
February							
March							
April							
May							
June							
July							
August							
September							
October							
November							
December							
Total							
Price per unit							
Total value							

6. RECORDS OF PRODUCTION AND MISCELLANEOUS ITEMS

Production records are very useful in record analysis. They are important from the standpoint of studying the efficiency of the entire farm business, as well as efficiency of crop and livestock production.

Crop production

The Illinois Farm Record Book provides a page for recording acreage, yield, and total production of each crop. Familiarize yourself with this portion of the book so you will know where to record these items as they become known during the year.

After each crop is planted, you will want to record the acreage planted. A farm map can be helpful in this respect. If the acreage harvested differs from the acreage planted, be sure to record these differences. As soon as bushels or tons harvested are known, record these items in the record book.

The tenant's share of crop acres, expressed as a percentage of total crop acres, may roughly reflect his share of the total value of production. Fig. 4 shows a situation where a tenant receives 50 percent of the corn crop and 60 percent of the soybean and wheat crops. In terms of acres, his share of production is 54.3 percent.

The value of production for the tenant's share as shown in his records, for example, is $12,000. Dividing the value of production by 54.3 percent gives a figure of $22,100. The latter figure is a rough estimate of the value of production for the entire farm.

Determining your share of crop acres when the records are set up, or when the crops are planted, will simplify the job of finding the total value of production for the farm at the end of the year.

Livestock production

Only a limited amount of space is provided in the Illinois Farm Record Book for production records for livestock.

Some farmers keep special detailed records of production as members of livestock improvement associations, such as for dairy

Table 4. Crop Acreage and Summary of Operator's Share

Crop	Acres owned	Acres cash rented	Acres share rented				Total	Operator's share
			50-50		Other			
			Total	Share	Total	Share		
Corn	--	--	160	80			160	80
Soybeans	--	--			80	48	80	48
Wheat	--	--			40	24	40	24
Total tillable acres	--	--	160	80	120	72	280	152
Tenant's share (%)								54.3%

or swine enterprises. These records generally include such items as total production on an individual animal basis, weights at various ages, rate of gain, breeding records, and loss records. These records can be very valuable for longtime improvement of the breeding herd. Farmers who do not belong to livestock improvement associations also need records of some of these items as an aid in analysis at the end of the year.

Various methods of keeping production and loss records have been devised. Usually the very minimum consists of breeding records and number of animals born, weaned, and died. Table 5 provides a method of keeping simple production records and Table 6 serves as a means for recording losses of livestock. Records of the amounts of eggs and milk sold should be kept in addition to the dollar value of such sales. When livestock products used in the household are added to amounts sold, the total production of livestock products can be estimated.

Table 5. Breeding, Birth, and Weaning Record

Sire	Dam	Date		Birth Record		Weaned		REMARKS Identification marks, sex of animals, etc.
		Bred	Due	Date	No.	Date	No.	
TOTALS		xxxx	xxxx	xxxx		xxxx		

Table 6. Death Loss Record 1/

Date	No.	Weight	Cause of Death	Date	No.	Weight	Cause of Death
				TOTALS			

1/ Do not include pig losses before weaning.

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THE PLANTER — SELECTION, ADJUSTMENT, MAINTENANCE, AND USE

ED013339

1. What Should I Consider When Selecting a Planter?
2. How Can I Understand the Operation of a Planter?
3. What Is the Proper Way to Adjust a Planter?
4. How Should I Use a Planter?
5. How Should I Maintain a Planter?
6. What Are Some Practical Applications?

May-67

Compared to the plow, the planter is a recent invention. Recorded history indicates that man used simple plows thousands of years before Christ's birth, but the first planter patent in the United States was issued in 1839. The Indians dug a hole for a dead fish and then planted some kernels of corn. They were practicing minimum tillage with starter fertilizer according to the terms that we use today. Planters have had many design improvements since that time.

If we ask a modern farmer what he expects a planter to do for him, he will promptly list some of the following functions: plant the seed accurately at high speed, at uniform depth, and at different row spacings; apply starter fertilizer, herbicides, and insecticides; and plant more than one crop.

The farmer, in turn, must understand how the planter works if it is to perform all of the functions he expects from it. He must know how to adjust and use it properly and safely and how to maintain it if it is to serve him for a long period of time.

The purpose of this unit is to give some general information on the selection, operation, adjustment, use, and maintenance of modern planters. More complete information on each type of planter is provided in the operator's manual for that implement. Study it carefully for your planter. A "Corn Planter Information Sheet" is included at the end of this unit to provide a systematic approach to the understanding of the operation and adjustment of each type of planter. Suggested laboratory exercises are also included to provide additional information in the form of practical experience.

1. WHAT SHOULD I CONSIDER WHEN SELECTING A PLANTER?

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A planter is designed primarily to plant accurately so you can get a plant population to match the fertility level and potential moisture level of the soil. There are also additional attachments available for the planter just as additional accessories are available for the modern tractor or automobile. When purchasing a planter, there are several questions that should be answered if the planter is to fit your needs.

What types of planters are available?

Planters today can be roughly divided into two kinds - drill planters and hill-drop planters.

Drill planters consist of a seed hopper, a metering mechanism, a seed tube to guide the seed to the soil, a furrow opener, and some device for covering the seed (Fig. 1). The design of the hopper and boot of this planter permits the seed to fall directly from the cell of the seed plate to the ground. The spacing of individual seeds is determined by the relation of the seed plate speed to the ground speed. Drill planters are simpler, less expensive, and easier to operate than hill-drop planters.

Hill-drop planters consist of a seed hopper,

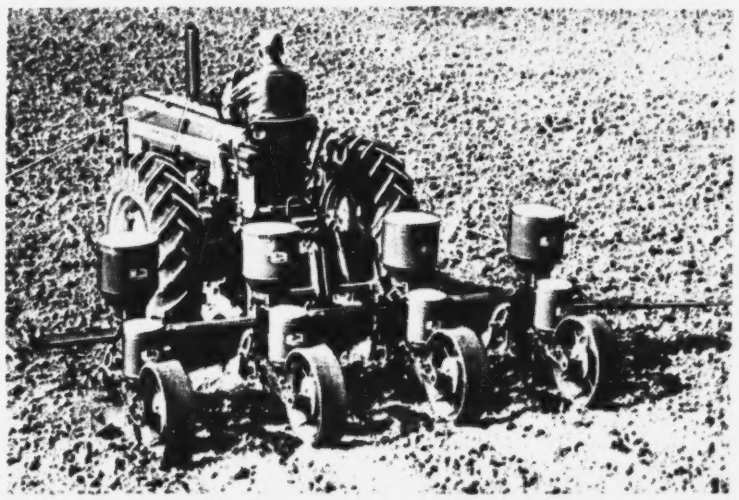

Fig. 1. These drill-planter units are mounted on a tool bar. Hill drop planting cannot be done with this planter since the units do not have valves. Drill planting makes a more uniform load on the harvesting equipment.

a metering mechanism, and a valve system to collect the metered kernels and plant them closely grouped in a hill (Fig. 2). They also have a furrow opener and some device for covering the seed. Most hill-drop planters can be made to drill but drill planters cannot be made to hill-drop. Some hill-drop planters can also be used to check corn if a check-row attachment is available.

Check-row planters require valves in the seed tubes and use a wire with evenly spaced knots or buttons to trip the valves to place the seed in uniformly spaced hills in the row (Fig. 3). However, only a very small percentage of

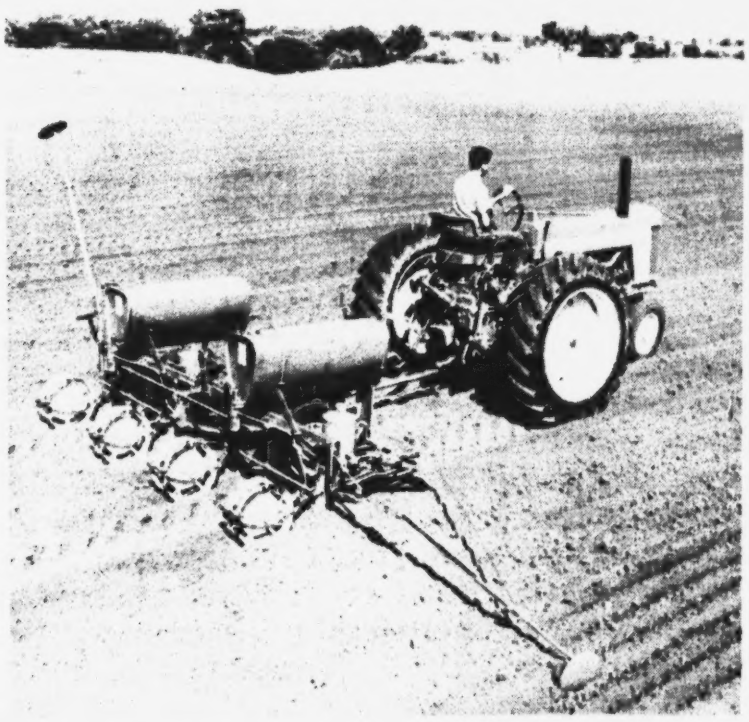

Fig. 2. This planter can hill-drop several kernels in a hill by using a valve mechanism. It can also be changed to drill planting. Some farmers feel that hill-dropped corn will emerge better under crusting conditions and will be less susceptible to wind damage.

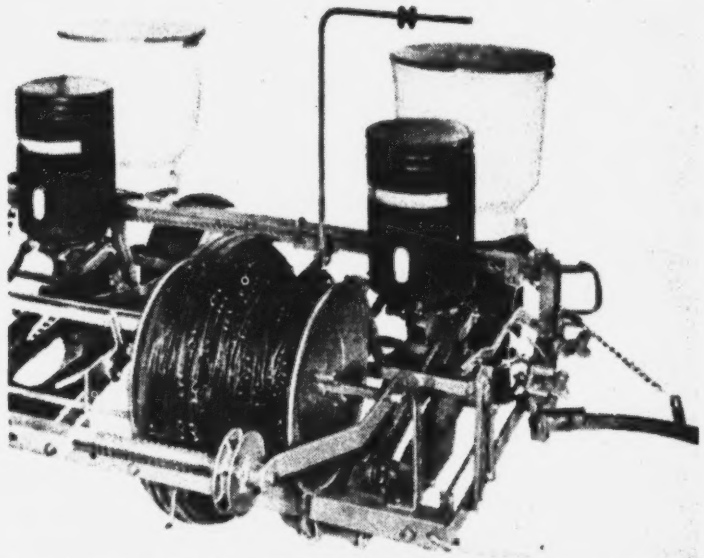

Fig. 3. This planter, equipped with a check-row wire and check attachment, can be used to drill, hill-drop, and check corn.

the corn is checked today. The chief advantage of check planting corn was to permit cross cultivation. Since these planters have such a limited application, the choice for most farmers lies between a drill planter and a hill-drop planter without the check-row attachment.

What type of mountings are available?

There are several choices of mounting for the planter units:

Trailing planters are independent implements that are towed behind the tractor or behind tillage equipment. They may or may not carry fertilizer attachments or herbicide and insecticide applicators. They can be readily detached from the tractor and easily moved from one field to another or changed from one tractor to another. If field conditions permit, these planters can be ganged together with a squadron hitch for eight- or twelve-row planting at one time (Fig. 4).

Mounted planters may be either rear

Fig. 4. For large operations, a squadron hitch permits one operator to plant with two four-row planters at one time.

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mounted or front mounted. This depends on the type of tool bar used and whether or not the equipment is available from the manufacturer. Mounted planters have several advantages over trailing planters. One is the ease with which the row-spacing can be changed. Another is economy - the individual planter units, purchased separately, usually cost less than a trailing planter. The tool bar may thus be used for tillage, planting, and cultivation. The fertilizer units can be used to apply starter fertilizer at planting time and side-dressed fertilizer at cultivating time. The advantage of this economy must be weighed against some inconvenience and lost time in a busy season. Farmers who plant corn and soybeans may need to cultivate the corn before all of the soybeans are planted. The planter units must be removed and the cultivators installed, then the process reversed again in order to plant, cultivate, and then plant.

Front mounted planters permit good observation of the planting units making it easy to check their operation. Front mounted planters can be used on cultivator bars for four- and six-row planting. The addition of caster wheels on the outer ends of the bars will also permit eight-row planting and cultivating, but these wide sweeping units present problems with flexibility. Many of the bars need reinforcing and there are some problems with folding markers. However, the biggest objection to front-mounted planters is that the tractor is essentially tied up with equipment and it can not be easily detached in order to use the tractor for a day or two for plowing, disking, or harrowing.

Rear mounted planters may also be mounted on a tool bar or a cultivator bar just as front-mounted planters. However, visibility is more difficult with rear mounted units and the additional weight on the back of the tractor may make it necessary to counter balance the planter with fertilizer tanks or weights on the front of the tractor. Most rear-mounted planters can be attached by the three-point hitch or fast-hitch mountings (Fig. 5).

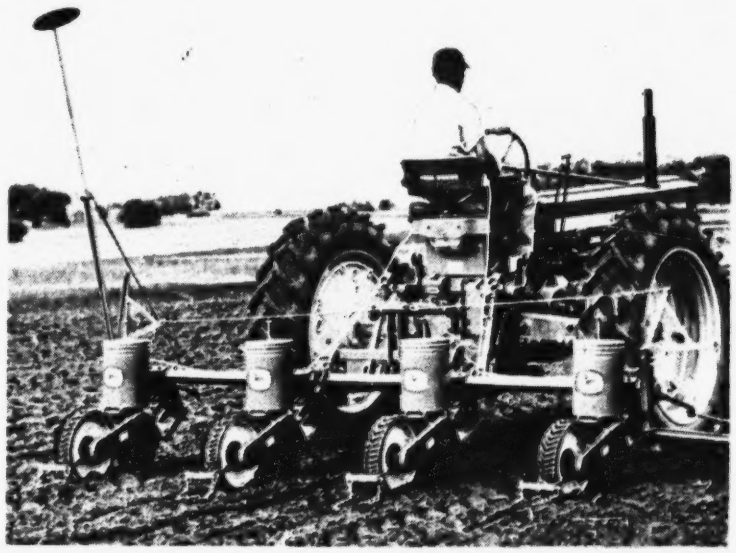


Fig. 5. This planter, consisting of unit planters mounted on a tool bar, can be quickly detached from the three-point hitch of the tractor.

Size of planter

The size of planter will vary with each farmer's own situation. The spring planting season is usually a hurried one and with large acreages to plant, there is always an urgent need to plant as many acres as possible in a short time. Experimental results indicate an optimum time to plant corn from a yield standpoint. Yields of corn planted on these dates were 15 bushels higher than corn planted two weeks earlier and 31 bushels higher than corn planted two weeks later. The anxiety caused by a late season makes a 6-row or 8-row planter more appealing. However, comparisons of the planting capacity of four- and six-row planters, traveling at the same speed, will show about 30% to 35% increase rather than a 50% increase that might be expected for a 6-row planter over a 4-row. Increased coverage can be secured by using a 2-planter hitch with two 4-row planters. At the present time the choice of trailing planters is between standard two-, four-, and six-row planters, and narrow-row four-, six-, and eight-row planters.

The standard 40-inch row spacing that has survived since the days of farming with horses may soon disappear. Recent experimental results with various row spacings for corn and soybeans indicate definite yield increases for soybeans planted in narrow rows but less consistent increases for corn planted in narrow rows.

Changing equipment, however, to plant, cultivate, and harvest narrow-row crops is a complicated and expensive process (Fig. 6). If corn and soybeans are not planted at the same row widths, there will be considerable time spent changing cultivators and planters to fit the different row widths. Chemical weed control may partially solve this problem. If

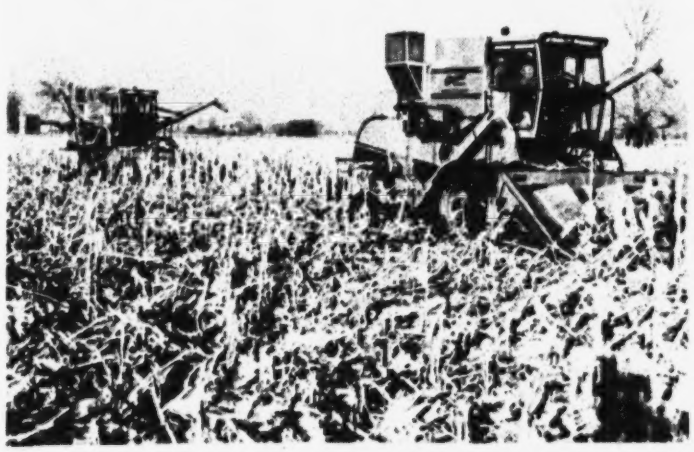


Fig. 6. Changing to narrow rows may require the purchasing of a picker that can accommodate narrow rows or hiring the corn picked by custom pickers as shown here.

Fig. 7. The tractor wheels are spaced to serve as packer wheels for the first and third rows. Special packer wheels serve to compress the seed zone for the second and fourth rows.

corn is planted in narrow rows, then the conventional pickers or picker attachments for combines will no longer fit and these may also have to be replaced.

Should minimum tillage planting equipment be considered?

There are several benefits associated with minimum tillage planting. (1) There are fewer operations to compact the soil. (2) There is less water runoff and reduced soil erosion because rough loose soil absorbs moisture quickly. This is less important on level fields than on hilly or rolling land. (3) Weed control problems are reduced because the corn can get a head start on the weeds since no seedbed is prepared except in the rows. (4) The number of field operations is reduced so labor and fuel costs are reduced. If you are interested in planting with minimum tillage, there are a number of systems available with planters to fit each system.

Wheel-track planters. Several manufacturers offer wheel-track planters that enable you to plant directly in a plowed field with no other tillage operation. This may be in soil that has been firmed by the tractor wheels or the packer wheels of the hitch (Fig. 7). The soil in the seed row has been firmed and freed of clods and air spaces while the inter-row is left open to catch water and rough enough to reduce weed competition. Some wheel-track planters may be used for conventional planting as well. The tractor wheel widths must usually be modified to match the double-row spacings. Since this system is usually practiced on spring plowing, it tends to concentrate the plowing workload to a short period of time. Fig. 8 shows a wheel-track planter hitch that actually carries the weight of the planter on the packer wheels of the hitch.

Strip tillage can be used with fall or early spring plowing (Fig. 9). A modified cultivator is used as a tillage machine and soil in the row

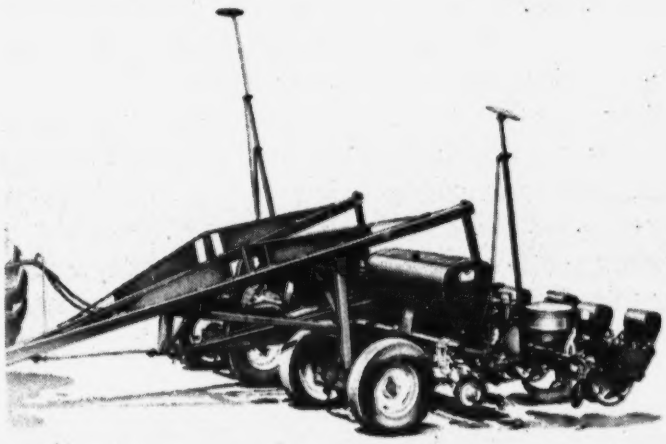


Fig. 8. The planter wheels are removed and the planter is suspended from the wheel-track planter hitch.

Fig. 9. This farmer has combined a row-crop cultivator with a corn planter to save tillage operations in a spring-plowed field.

is leveled by the rotary-hoe tines (Fig. 10). These units utilize a conventional pull-type 4-row planter towed behind a tractor equipped with tillage units on the cultivator tool bars. Unit planters mounted on a tool bar may be used instead of the trailing planter. Present cultivating equipment can be utilized with this system.

Mulch tillage consists of planting directly on soybean stubble or corn ground. The planter is pulled behind a field cultivator, chisel plow, or a mounted tool-bar cultivator (Fig. 11). The planters are usually equipped with spring teeth to push aside clods and mulch a 10-inch wide seedbed in front of each planting unit. Disk coverers will assure positive covering of the seed in rough conditions.

What type of seeding mechanisms are available?

Accurate planting of seed has more to do with producing maximum yields than any other single mechanical factor connected with growing the crop. If more seed is planted than the soil-fertility level will support, many weak plants and barren stalks will develop. If the seed population is too low, tillage, planting, cultivating, and harvesting time is wasted and the opportunity to get maximum returns from the investment in land and labor is reduced.

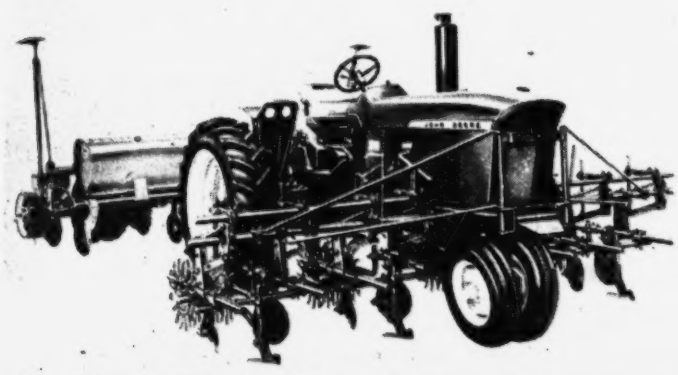


Fig. 10. These tillage units use a sweep, disk hillers, and rotary-hoe wheels to prepare a strip for planting with a conventional planter.

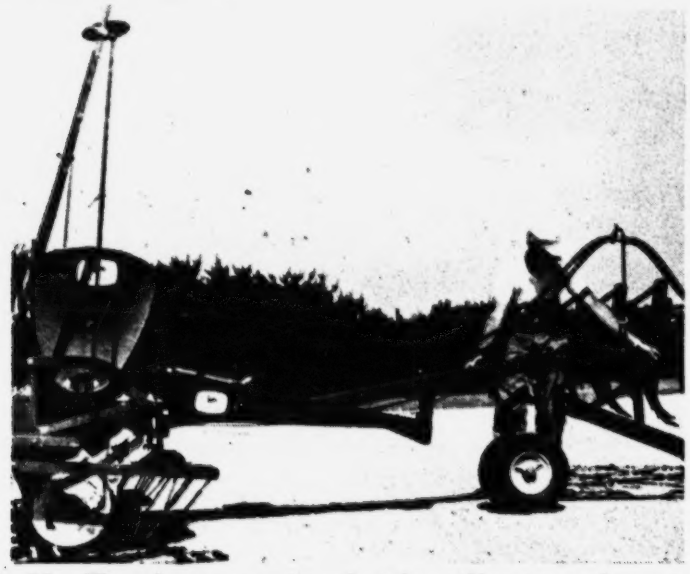


Fig. 11. The planter, equipped with a tillage attachment to mulch a 10-inch seed bed, is shown behind a field cultivator.

A few years ago, we relied on gravity to drop the seed from the level of the seed plate to the soil. As planting speed increased, changes were necessary in valve mechanisms to trap the kernels into clusters for hill-drop planting. At the present time, four types of seeding mechanisms are available.

Double-valve system. The valves have deep, "V"-shaped pockets to eliminate seed bounce and scattering of the hills. An upper valve collects the seed as it drops from the seed plate and a lower valve catches the seed dropped from the upper valve (Fig. 12). On the next opening of the valves, the lower valve ejects the seed rearward to compensate for the forward movement of the planter and the seed in the upper valve drops to the lower valve. These planters should not be operated over six miles per hour. The travel speed depends on the hill spacing desired and seed population desired.

Chain flight and valve. One planter uses the flights of a chain to carry the kernels to the lower valve (Fig. 13). This gives positive control of the seeds and virtually eliminates problems of seed bounce.

Drill planters have an open tube that allows the seeds to fall by gravity to the furrow.

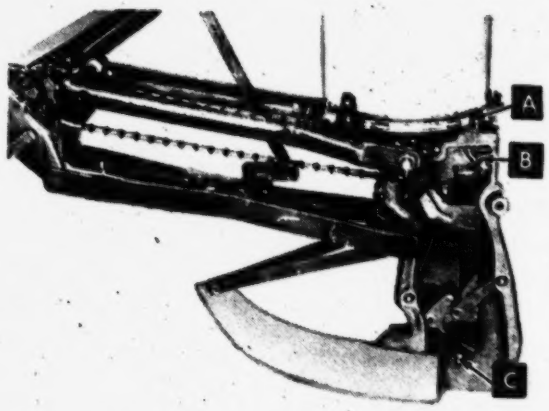


Fig. 12. The seeds drop from seed plate A and are collected in upper valve B. When the valves open, the seeds collected in B are dropped to lower valve C. On the next opening of the valves, the seeds in the lower valve are dropped in the row while the seeds dropped by the upper valve are caught in the lower valve.

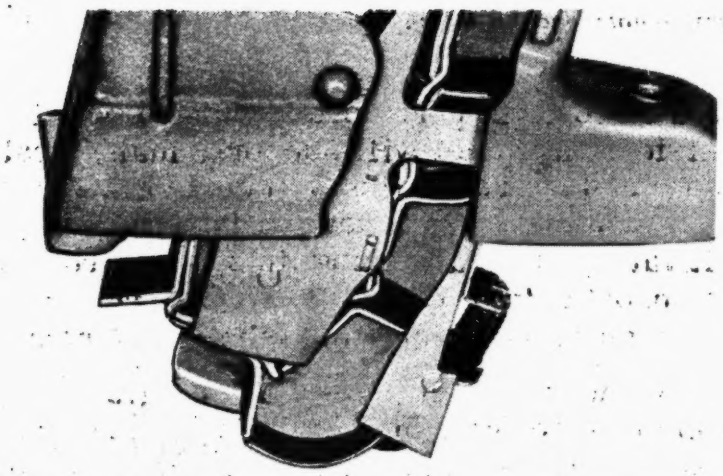


Fig. 13. The flights on the chain carry the kernels from the seed plate to the bottom of the boot where they are deposited in the soil. Each flight of the chain carries the entire hill of seed.

Rotary valves provide a continuous controlled flow of individual kernels or groups of kernels from the hopper to the soil. The cam action of the impeller wheel opens the valve and ejects the kernel or groups of kernels into the furrow to give evenly spaced hills and closely grouped kernels in the hill (Fig. 14).

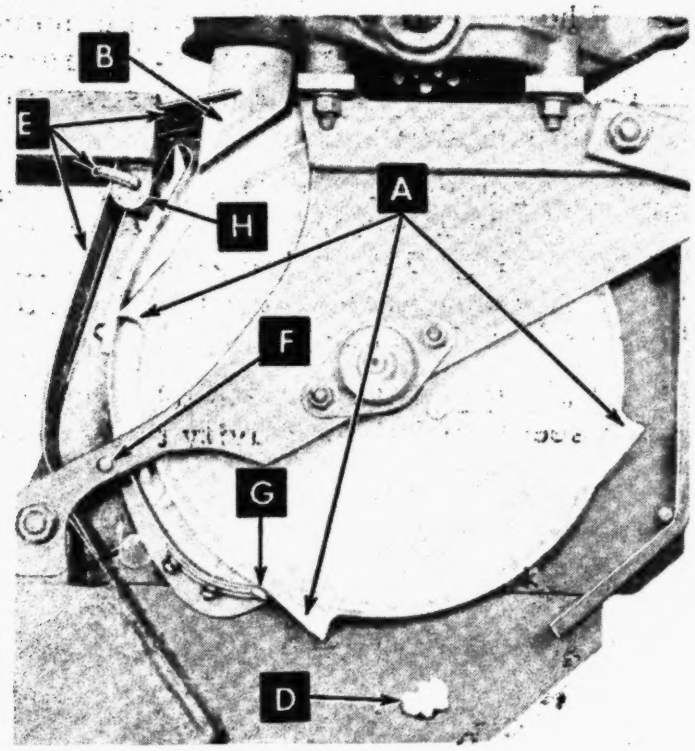


Fig. 14. The ejector lugs A, mounted on the rim of the rotor, catch the kernels discharged through spout B and carry them down where they are closely grouped at G. Kernels that reach point G ahead of the ejector lug are held there to prevent dribbling between the hills. The grouped kernels D are ejected directly into the trench made by the runner opener. The valve can be easily cleaned by removing pin F and cover plate E. Pin H must be in position against the spring to hold the valve in contact with the rotor.

VAS 3021

Which fertilizer applicator should be purchased?

The type of fertilizer applicators to purchase should be based on several factors. The kind of service available to the farmer by the fertilizer dealer is perhaps the most important one. Liquid fertilizer is often easier to handle than the dry types because the planter tanks can be pumped full or filled by gravity flow from a supply tank. This advantage must be weighed against a slightly higher cost per pound of plant nutrients in the liquid form. In some areas there is a more limited range of analysis available in liquid fertilizers than in dry. There is no appreciable difference between liquid and dry fertilizer as far as performance, leaching, or danger in handling is concerned.

Liquid fertilizer is metered by gravity flow under a constant head through an orifice in a given period of time so the planter must always travel at the same selected speed. If it travels faster, the application will be lighter than expected. If planting speed is slowed down, the rate of application will be heavier than calibrated.

Dry fertilizer is metered to the distance traveled and variations in speed will have little effect on the rate of application.

Type of seed hoppers

Most manufacturers offer a choice of seed hoppers to the buyer. Large capacity hoppers, holding up to 70 pounds of seed, reduce stops and cut down refill time. Transparent hoppers (Fig. 15) or those equipped with float-type seed gauges give a quick visual

Fig. 15. This planter is equipped with transparent hoppers. Either a transparent hopper or a floating seed gauge gives some indication of the rate at which each unit is planting.

check on the amount of seed in each hopper. This is also an indication that all units are planting seed at the same rate.

Types of seed plates

The selection of the correct seed plates is one of the most important decisions that must be made in the selection of planting equipment. The plates need to be checked every planting season for the grades and varieties used that year to be certain they are properly matched. It is often necessary to select different plates for the same variety of seed from year to year. Single cross seed is becoming more and more popular. This seed has greater irregularities in size and shape than conventional double-cross seed. For single-cross seed proper plate match is doubly important. As planting speed increases so do the chances for inaccurate planting because the plate cells have less time to fill and discharge the seed. Check the instruction book for the correct travel speed for a given plant population.

There are at least three ways to select seed plates. The best method is to select seed plates based on their performance in a test in the barnyard or driveway with the planter operating at the speed at which planting is to be done. Another method is to take a sample of the seed corn and plates to the dealer and check the seed against the plate in a seed-plate selector stand. Be sure the seed-plate tester is operated at a speed that corresponds to the actual seed plate speed when planting. The third and probably least reliable method is to follow the recommendations on the tag of the sack of seed.

Seed plates should be purchased as a full set (four plates for a four-row planter) rather than just replacing a worn or broken one. A set is more likely to give uniform planting rates among the rows. In the past, there has been some justifiable criticism of plastic seed plates but they do have some advantages. They are less expensive and quality control or uniformity among plates is better than with cast-iron plates; plastic plates are less likely to warp; and they are more accurate at high speeds because there is less reduction in cell fill due to increased speed.

Once you are in the field, spot check the planting rate as you change varieties and the corresponding plates. Many fields of corn have been underplanted or overplanted because the operator used the wrong size plates for the grade of corn.

The faster the planter is operated, the faster the seed plate revolves. At faster planting speeds, it may be necessary to use seed plates with slightly longer cell length to obtain proper cell fill for the planting rate desired. With a 24-cell seed plate, there is better cell fill at the same planting speed because the plate revolves slower for the same seed rate. In general it is better to use a 24-cell seed plate for hill-drop or drill planting. The 24-cell plate is the same diameter as the 16-cell plate but has eight more seed cells available for filling at any one time. With this plate, you can normally expect 30% to 40% faster travel speed for a given planting rate.

The addition of a tablespoonful of powdered graphite to each hopper full of seed corn will help improve cell fill.

Many companies provide edge drop (Fig. 16), flat drop (Fig. 17), and hill-drop plates (Fig. 18). Over one-hundred different plates

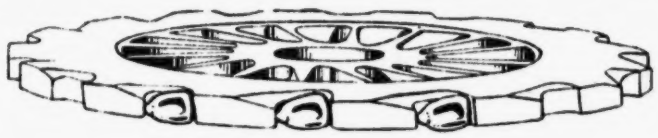


Fig. 16. An edge-drop plate is used to plant graded seed. With this type plate, one seed stands on edge in each cell. Edge-drop plates take maximum advantage of accurate seed selection.

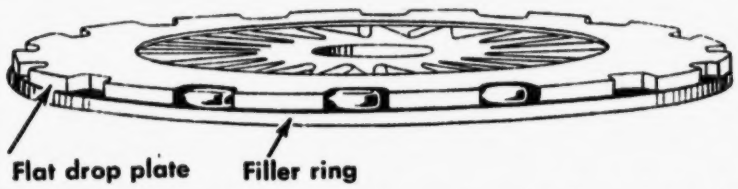


Fig. 17. A filler ring is required with a flat drop plate. It is best suited for flat kernels.

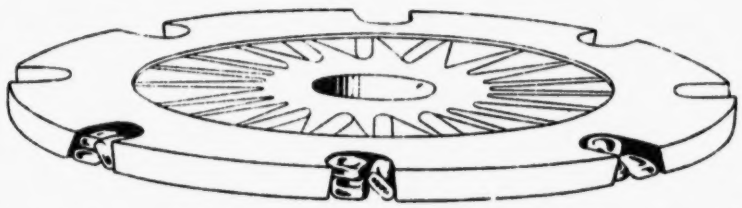


Fig. 18. A hill-drop plate has larger cells, so several seeds are gathered in each to plant an entire hill. These plates are adapted for hill dropping of poorly graded corn, irregularly shaped seed, and hybrid butt and tip kernels.

are available for some planters including plates for round kernels of corn, soybeans, and a variety of other crops.

What other special equipment is available?

In addition to the basic planter, there are accessories that make the planter function more effectively under certain conditions.

Gauge shoes are mounted on the planter runners to give a more uniform planting depth in extremely loose soil. They add flotation to the planter runners. They are adjustable up and down on the runner for deeper or shallower planting (Fig. 19).

Trash kickers are installed on planters that will be operated in fields with small stones or trash. They run directly in front of the planter runners and push aside small stones and trash (Fig. 20).

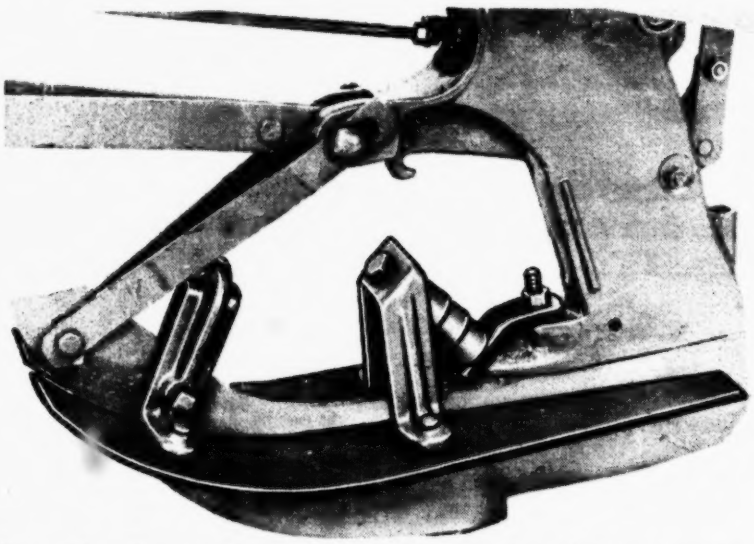


Fig. 19. Gauge shoes are mounted on the planter runners and can be adjusted for different depths.

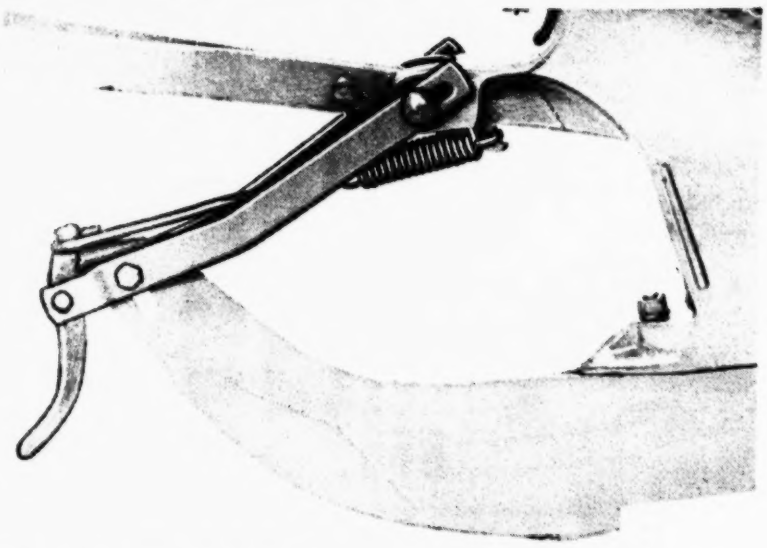


Fig. 20. Trash kickers are mounted on the front of the planter runner.

Multi-luber system or built-in lubricating system consists of a reservoir, pump, and outlets for greasing the planter (Fig. 21).

Press wheel scrapers keep the wheels clean if soil has a tendency to stick to the wheels (Fig. 22). These scrapers are not intended for use with the zero pressure press wheel tires.

Press wheel bands give a more compact seedbed when they are installed between the

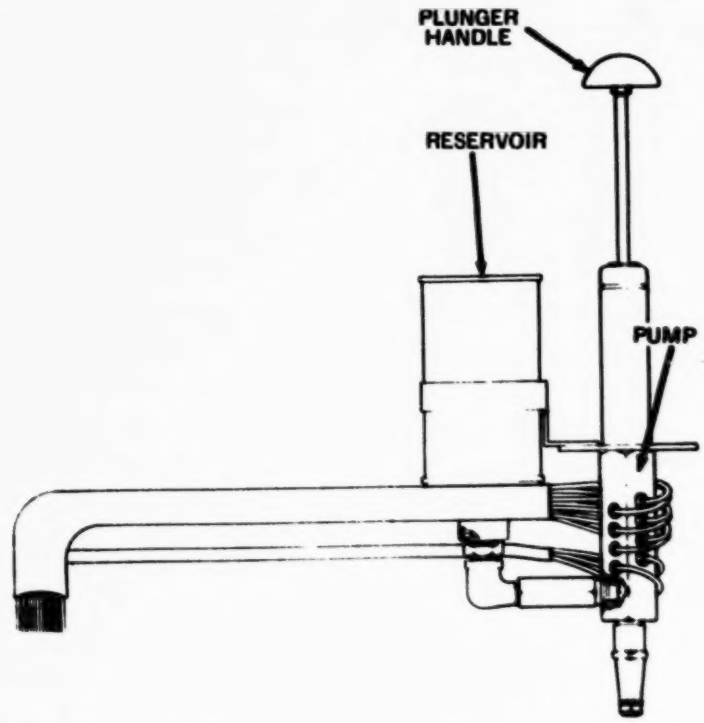


Fig. 21. Multi-luber systems make lubrication of the planter a quick and easy process.

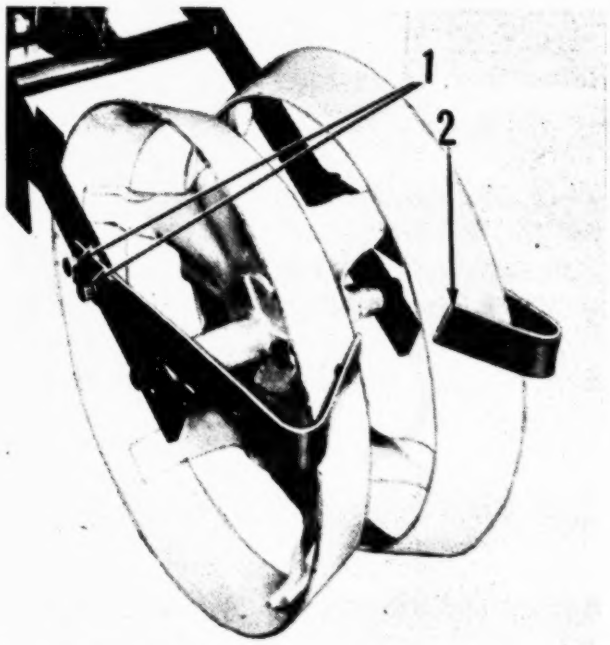


Fig. 22. Press-wheel scrapers clean the press wheels and prevent sticking soil from accumulating. They should be adjusted by the bolts (1) to bear lightly against the wheel (2).

rims of the open centered press wheels (Fig. 23). The overlap joints must be fitted so they prevent the press wheel scrapers from catching in them.

Press wheel tires. Zero pressure tires are designed to fit over the steel press wheels (Fig. 24). The flexing action of the semi-pneumatic rubber tires sheds the soil and keeps the wheels cleaner. No scrapers are used with tires.

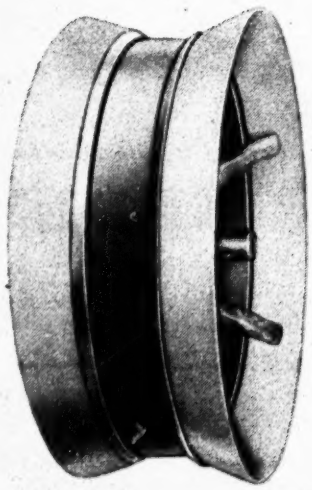


Fig. 23. Press-wheel bands are used to convert open-center press wheels to solid-center wheels.

Fig. 24. Press-wheel tires can be smooth or cleated as shown.

Disc furrowing attachments (Fig. 25) permit uniform planting depth in rough seedbeds. The seed is placed deeper in moist firm soil. The distance from the bottom of the disk blades to the bottom of the runner heel is the depth of planting (Fig. 26). They can be adjusted for various depths.

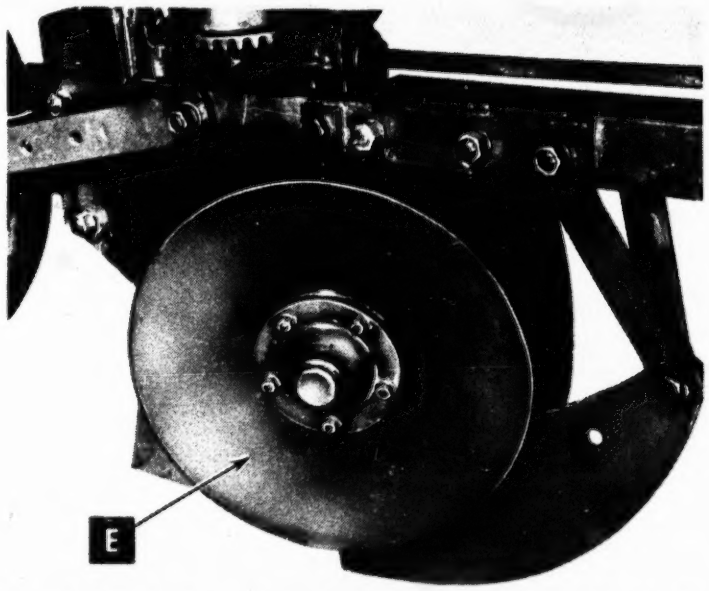


Fig. 25. Disk furrowing attachments E are recommended with minimum tillage planting. They are mounted on both sides of the runners.

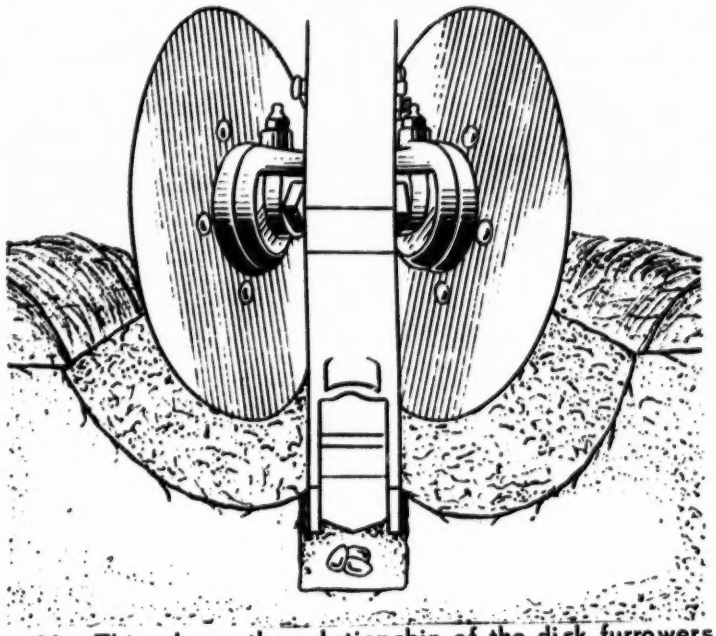
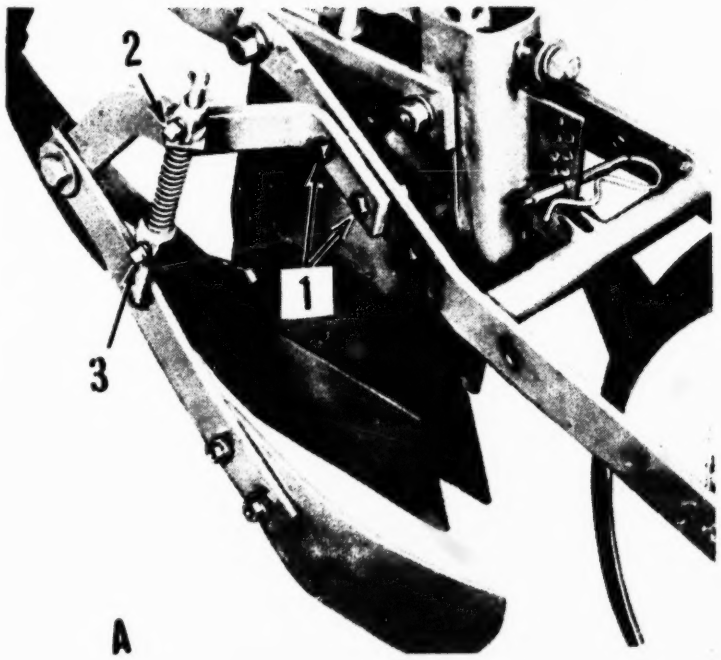


Fig. 26. This shows the relationship of the disk furrowers to the planted seed.

Covering attachments may be of the blade or disk type (Fig. 27). A pair of right and left units may be used with each row unit or one to each row unit if desired.

Seed firming wheels run directly behind the planter runners and press the seed against the moist soil in the bottom of the runner furrows (Fig. 28). If they are operated in moist soil, there may be clogging problems.

Minimum tillage attachment decreases tillage operations prior to planting (Fig. 29). It pushes clods aside, eliminates air pockets, and mulches the soil. It prepares a band of soil approximately 10 inches wide in front of the furrow opener.



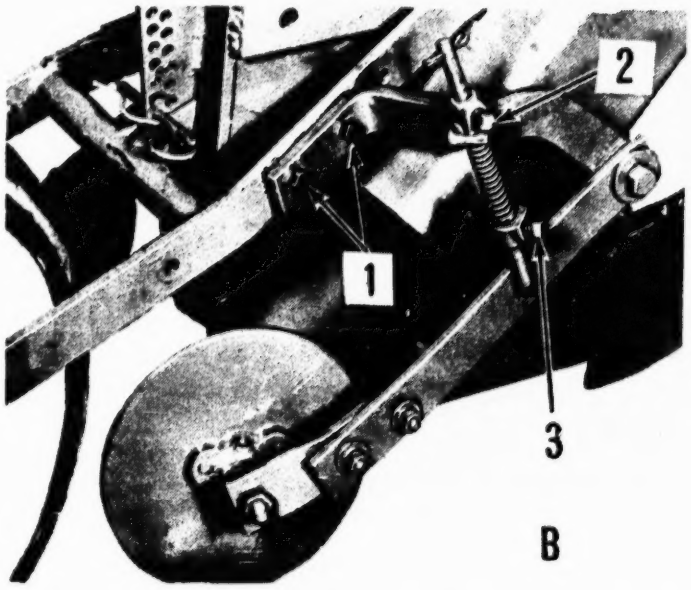


Fig. 27. The blade covering attachment A or the disk covering attachment B is used for more positive covering, especially when planting shallow. 1 shows mounting locations. The depth is adjusted at 2 and the pressure at 3.

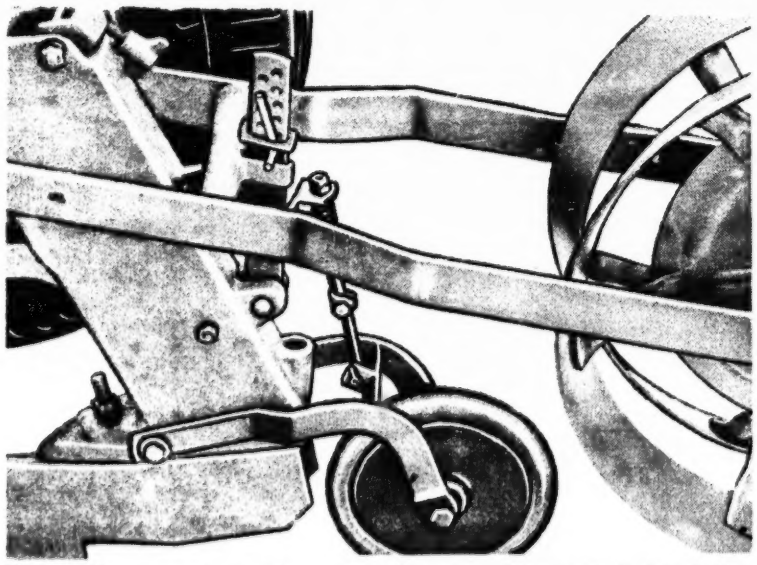


Fig. 28. Seed firming wheels are attached behind the planter runners.

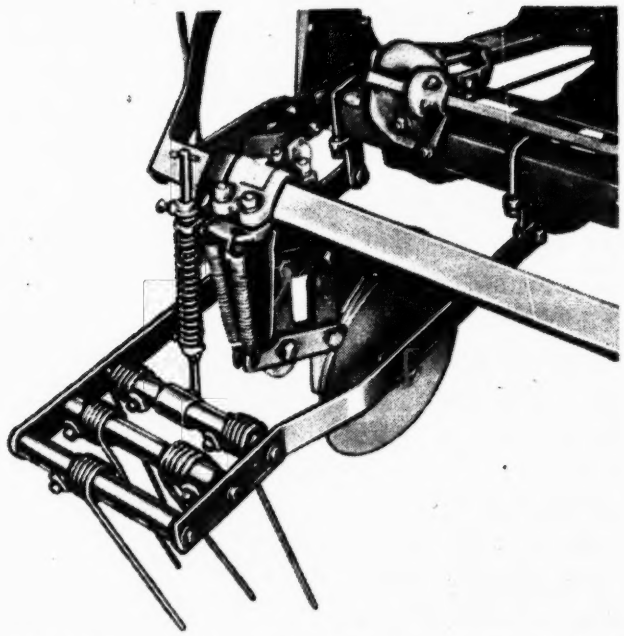


Fig. 29. Minimum tillage attachments are mounted directly in front of the furrow openers.

Disk furrow openers are mounted on the front of the runners (Fig. 30).

Disk markers. For rough or trashy fields, disk markers are sometimes preferred instead of regular markers (Fig. 31).

Soil incorporation equipment. An additional accessory that seems to pay dividends under certain conditions is some device for incorporating herbicides and insecticides into

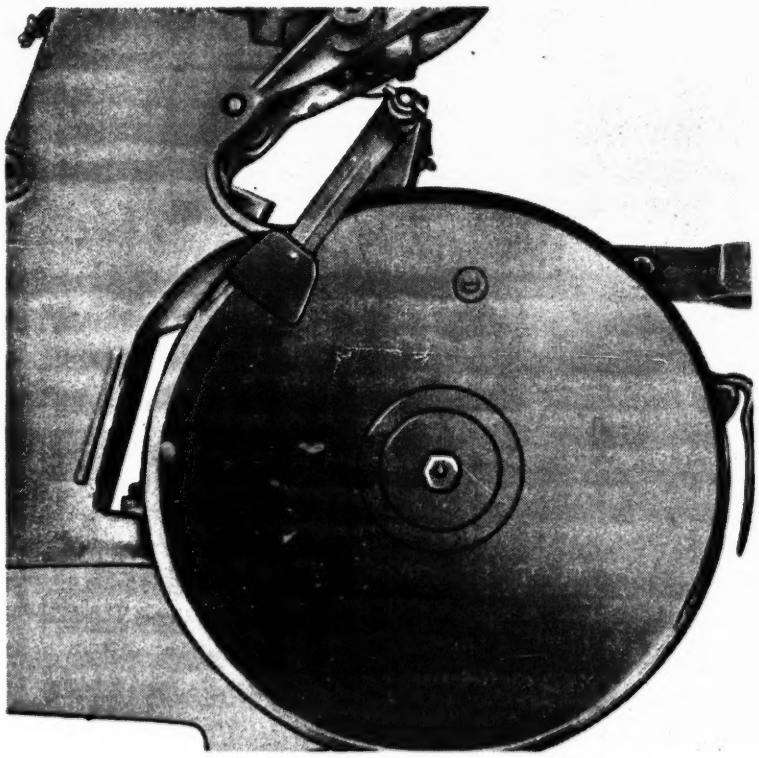


Fig. 30. These openers work well in trashy or stony fields, because the disks cut through or roll over obstructions.

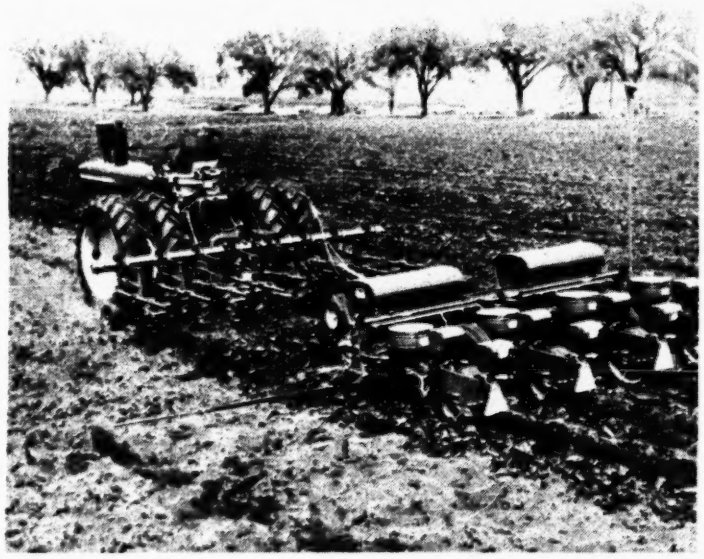


Fig. 31. Disk markers roll over rough soil.

the soil (Fig. 32). Some chemicals are volatile and tend to dissipate when exposed on the surface. Others are susceptible to sunlight and break down if left on the surface. More uniform control is likely if the pesticides are incorporated because chemical activation is accelerated due to placement in moist soil. In dry periods some pesticides never function because they need moisture to become effective. Surface application confines them to dry soil which limits their effectiveness. With soil incorporation equipment the erosion losses are likely to be lower.

There are a number of incorporating devices on the market at the present time. The ground-driven devices are more effective on well prepared soils. They are not likely to be very effective in cloddy or trashy conditions found with minimum tillage planting.

Fig. 32. The perforated roller mixes the herbicide with the soil.

2. HOW CAN I UNDERSTAND THE OPERATION OF A PLANTER?

Most farmers want the following operating features in a corn planter: 1) Be as simple to operate as possible and still meet the requirements of a modern planter. 2) Plant accurately at a uniform depth and be easily adjusted to different planting rates and planting depths. 3) Be able to operate for a sustained period at speeds up to 6 or 7 miles per hour. 4) Be easy to change from one crop to another and from drill to hill-drop planting. 5) Have the capacity to plant seed for high plant populations with starter fertilizer without frequent stops for refilling. 6) Have the strength to carry the seed, fertilizer, and pesticides without bending the frame or damaging the planter in other ways.

You must understand how the planter operates if you are to adjust, use, and maintain it properly. The best way to gain this understanding is to carefully study the planter and the operator's manual. It may help to block up the planter and turn the wheels by hand.

WHAT ARE THE MAJOR PARTS OF A PLANTER?

Hitch

The hitch on a trailing planter is usually equipped with some clevis adjustment so the seed plates in the planter can operate level (Fig. 33). If the planter is hitched high, it tends to drag the planting units down and places undue strain on them. Also, the depth of planting may be affected by the height of the planter hitch.

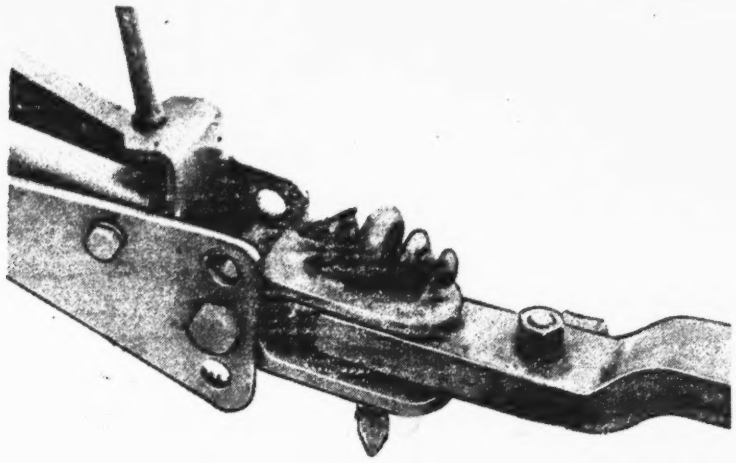


Fig. 33. The adjusting holes for the hitch are shown here.

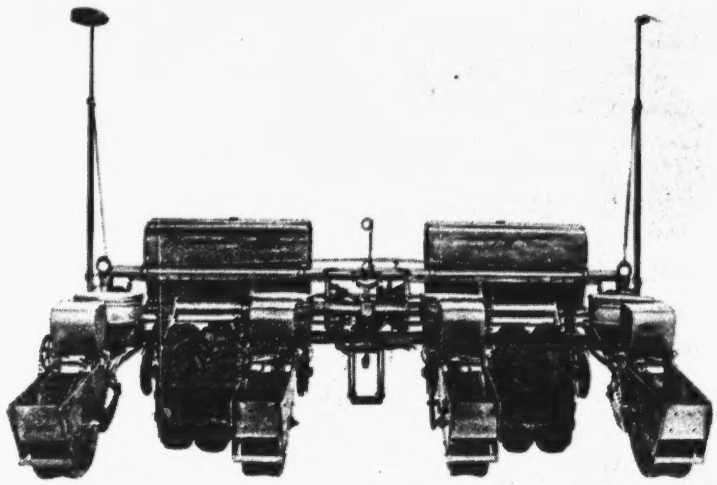


Fig. 35. The dual wheels provide better stability in soil where floatation is a problem.

Power lift

The power lift on a planter may be a ground drive power lift or a hydraulic lift (Fig. 34).

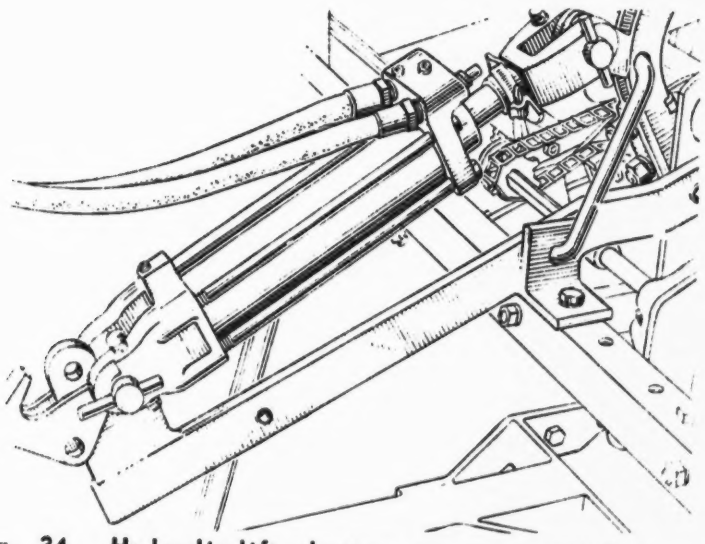


Fig. 34. Hydraulic-lift planters are most prevalent, although ground driven power-lift planters can be purchased.

Frame

The frame of the planter must be strong enough to carry the load of seed and fertilizer. Some planters have transport wheels welded in place. Others are movable so the planting units may be adjusted to various row spacings from 28 to 40-inch rows. Some planter frames can be equipped with dual wheels for better flotation in soft soil (Fig. 35).

Planter units

The planter units consist of a frame, boot or valve case, seed hopper, hopper bottom, seed plate, runner, and press wheel (Fig. 36).

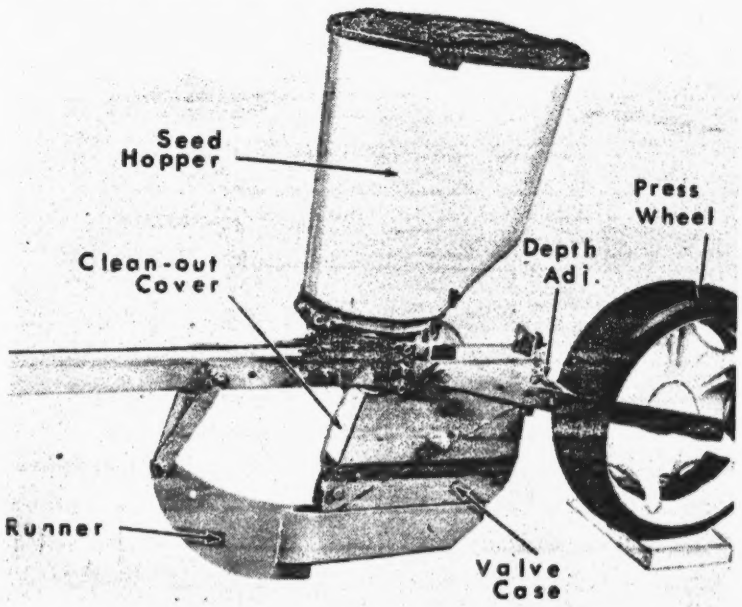


Fig. 36. This illustration shows a row planting unit for a planter.

WHAT IS THE CORRECT IDENTIFICATION OF ALL PLANTER PARTS?

Study the planter and the operator's manual and learn to identify the parts. Be able to identify such parts as these:

Hitch
Power lift
Transport link
Transport wheels
Main frame
Clutch
Marker
Drive chain
Runner
Pressure rods
Press wheel
Fertilizer hoppers (tanks)

Rotary valve
Ejector lugs
Accumulator plate

Boot
Upper valve
Lower valve
Gear case
Shift lever
Drive sprockets
Drill shaft
Striker

Fertilizer opener
Disk opener
Disk furrower
Insecticide attachment
Herbicide attachment
Seed hopper
Cut-off pawls
Seed plate
Knock-out pawl
Chain flight valve

HOW DOES THE PLANTING MECHANISM OPERATE?

Seed metering

The function of the seed metering assembly is to deliver an accurate number of seeds to the boot at the correct rate or at correctly spaced intervals.

Hopper bottom

The hopper bottom is cone shaped to feed the seed to the cells on the outer edge of the seed plate (Fig. 37). Lowering the planter engages the seed plate drive by the planter wheels. Seeds drop into the cells in the seed plate before the cells pass under a cut-off pawl that prevents more than one seed from entering the planting chamber at a time (Fig. 38). These cut-off pawls should be aggressive enough to prevent more than one seed from entering each cell. The cut-off pawls should not be aggressive enough to crack seeds. Inspect them to see that they operate freely.

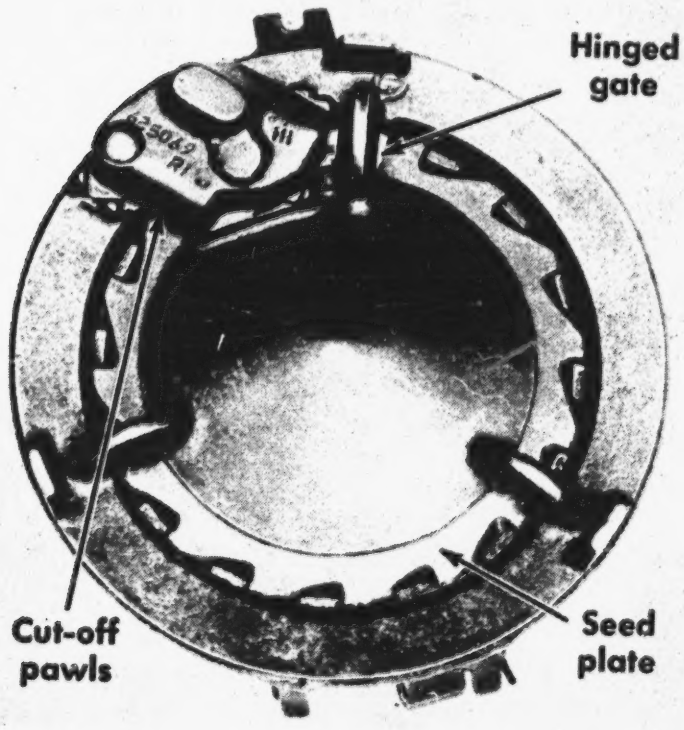


Fig. 37. The conical hopper bottom forces the seed against the seed plate.

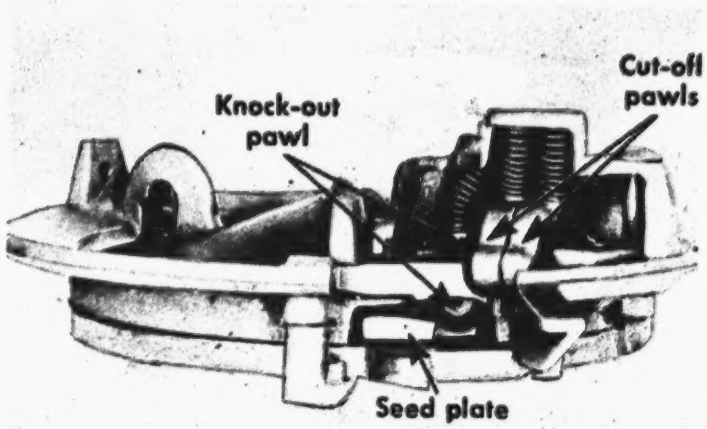


Fig. 38. As the seed plates rotate, the seeds drop into the cells. The cut-off pawls dislodge any seeds caught sideways in the cells. The knock-out pawl helps push the seed out of the cell.

As the cell in the seed plate turns over the hole in the hopper bottom, the seed drops from the cell through the passage. The knock-out pawl assists the seed out of the cell (Fig. 39). The empty cell passes out of the seed chamber under the gate on the rear side of the pawl cap. The gate is free to move up and down which allows loose seed or trash to move out of the chamber back into the seed can. The design of the gate prevents any seeds from entering the seed chamber from the back side.

Hill-drop planting

Two-stage valve. Some models of planters have an upper valve and a lower valve in the seed tube. The seeds are first held in the upper valve where they are retained in the "V" or upper pocket (Fig. 40). When a hill of two or three or four seeds, according

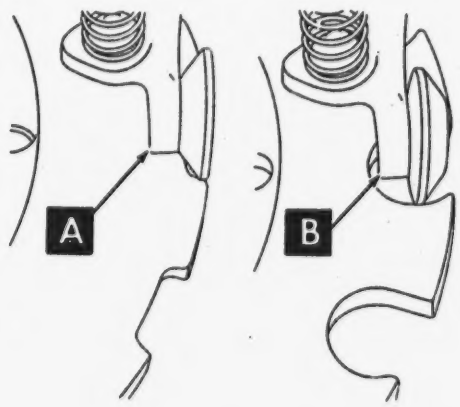


Fig. 39. The roller knock-out pawl may be assembled with the roller rim either toward the edge as in A, or toward the center as in B. Set the roller as in B for deep-cell plates.

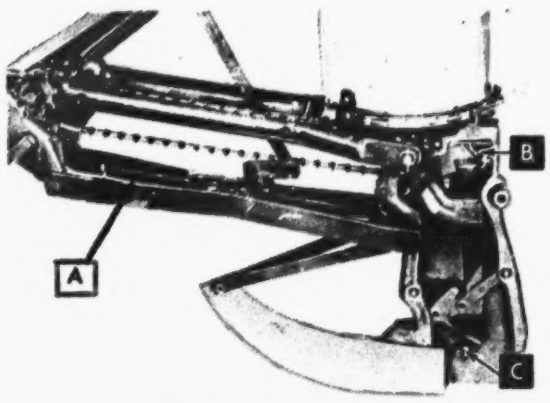


Fig. 40. The seeds that have dropped from the planting chamber through the hole in the hopper bottom plate are retained in upper valve B. The valves are tripped simultaneously by pull rod A. The lower valve C catches the seeds released by upper valve B.

to the position of the selector lever, is collected in the upper valve, the valves are tripped and the seeds drop down the tube to the lower valve. Both valves open and close simultaneously during the cycle of operation. The lower valve closes and catches the seeds released by the upper valve. The rotating seed plate replaces the seeds in the upper valve. When the pull rod opens the valves again, the seeds held by the lower valve are deposited into the furrow prepared by the runner and opener.

Rotary valve. On one rotary-valve planter, the kernels drop from the seed plate to an accumulator plate (Fig. 41). This plate groups the kernels by twos or threes depending whether a 16- or 24-cell seed plate is used. The grouped kernels are dropped together when the opening in the accumulator plate passes over the opening in the hopper bottom plate. The ejector lugs on the rim of the rotary valve catch the seeds and carry them down through the valve and deposit them directly in the furrow made by the runner opener.

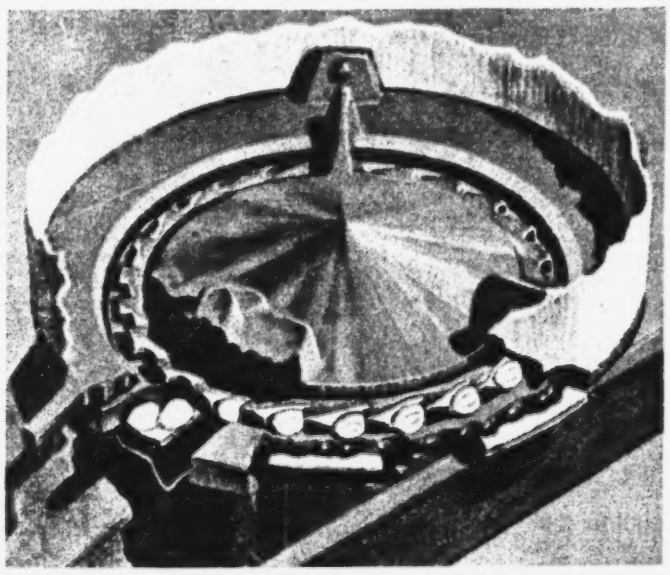


Fig. 41. This accumulator plate has eight large notches cut in the circumference. Two kernels from the seed plate have dropped on the accumulator plate and the third kernel from the seed plate will drop just about the time the notch in the accumulator plate passes over the opening in the seed tube. Thus, the three kernels are dropped in the rotary valve as a group.

Chain-flight valve. On the chain-flight valve planter, the chain runs constantly when the planter is lowered and the drive wheels turn forward. The number of cells in the seed plate and the number of teeth on the valve sprocket regulates the number of kernels per hill. Each flight on the chain contains the entire hill of seed. The lower gate valve must work freely or the kernels will not be spaced evenly. The flights need to be timed to the cells in the plate and to the valve at the bottom of the boot.

Drilling

Two-stage valve. On the two-stage valve planters, the valves are locked open and the seed falls from the seed plate in the planting chamber through the seed tube to the soil.

Rotary valve. To change some rotary-valve planter models, simply reverse the hoppers and let the seed pass down the seed tube. On other models, you remove the rotary valve, chute, and sprockets and insert a drill tube. For power drilling, one model rotary valve operates as though it were hill-dropping one kernel at a time after the accumulator plate has been removed and two extra lugs bolted on the rotor. Drill planting can be done by removing the accumulator plate, disengaging the rotor valve, and removing the valve-case assembly and replacing it with a drill case (Fig. 42). The rotor must be pinned in place so the lug doesn't interfere with the drill case.

Chain-flight valve. The chain-flight valve planter can be set to plant one kernel per hill by using a 16-cell seed plate which is power drilling. The addition of powdered graphite to the seed corn will lubricate the chain flights. To drill soybeans, maise, or sorghum, the spring holding the arm on the cam should be released. Some operators prefer to remove the entire chain flight unit to plant soybeans.

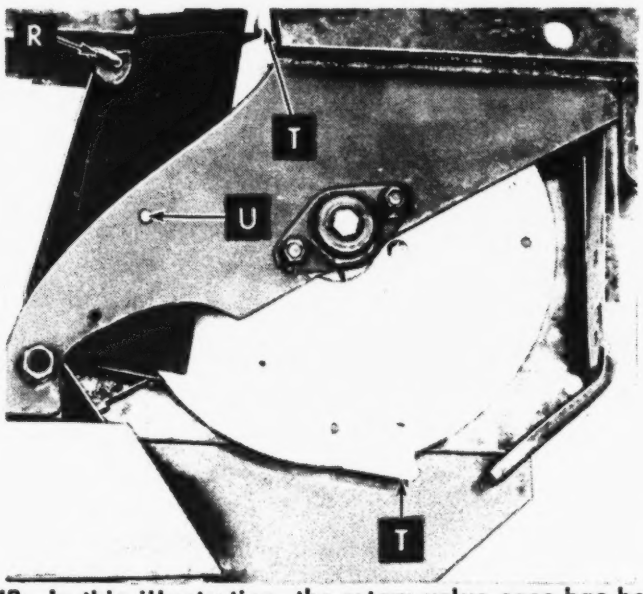


Fig. 42. In this illustration, the rotary-valve case has been removed and replaced with a drill case, secured by pin R. The rotor is turned so the lugs T are in the position shown and a pin is inserted at U to lock the rotor.

HOW DOES YOUR PLANTER OPERATE?

Study the planter and the operator's manual and see if the planter can be set to drill corn. Can it be set to hill-drop one kernel per hill? How is it set to drop two kernels per hill? Can it be set to hill-drop three kernels per hill? Will it drop four kernels per hill?

Trace the power train from the seed plates to the drive wheels. What effect will it have on the number of seeds per hill if the drive chain is placed on a larger sprocket? What effect does increased ground speed have on seed plate speed? How is the planter changed to plant soybeans instead of corn?

Trace the power train to the fertilizer unit, herbicide, and insecticide attachments.

What effect does the runner have on seed placement? How is depth of planting increased? Why are furrow openers used? When are covering attachments used? How is the planter timed? Do the planting units operate separately?

HOW DOES THE MARKER WORK?

Automatic markers

The automatic markers raise and lower with the planter frame. They will operate efficiently and automatically if they are set correctly. The proper timing sequence can be set by manually changing the marker control lever or the ratchet timing dial when the planter is raised. Once the proper timing sequence is established, the markers will continue to operate with alternate markers dropping and raising as the planter is lowered and raised.

Grass waterway attachment

When planting fields with grass waterways, the marker will raise as the planter is raised to cross the waterway. Upon leaving the waterway, the opposite marker would normally drop because of the alternating feature of the automatic mechanism. With a grass waterway attachment, the desired marker will fall when the correct rope is pulled.

Dual marker control

A dual marker control is desirable when planting in irregularly-shaped fields so both markers may be lowered when starting in the center of a field or on a terrace.

3. WHAT IS THE PROPER WAY TO ADJUST THE PLANTER?

With other farm operations like plowing, cultivating, or harvesting, you have an easy check on the operation and efficiency of the machine. Just a glance from the tractor seat will tell you what kind of job is being done when you are plowing. A more thorough inspection can be quickly made by checking depth, etc., as you walk around the plow. With the corn planter, however, a glance at the field behind the planter will only tell you if you are planting in straight rows and with some of the newer attachments even the wheel tracks may be covered over. You can not really tell what kind of job you've done with the planter until at least ten days after planting. As the corn plants emerge, you have a check on the effectiveness of the insecticide. As the plants continue to grow rapidly, you have a check on the starter fertilizer application and as the plants grow in a row almost free of weeds you have a check on the herbicide application. Now, it is relatively too late to

make any correction for this year's crop. Any checks must be made prior to the planting season by careful calibration of the planter before the rush of the planting season begins.

There are many variations in planting conditions! Soil types vary from one field to another; one planting season is damp and cold; another is hot and dry; and one field is more fertile than another. Soybeans may be profitably planted in narrower rows than corn. A particular hybrid that was planted last year is no longer available. A new variety of corn shows great promise.

Farmers want planters that can be adjusted for different row widths, planting rates, hill spacings in the row, drilling distances, planting depths, fertilizer rates and locations, kinds of crops, herbicide rates, and insecticide rates. In order to adjust a planter to meet these and other variations in planting conditions, you must be familiar with planter adjustment.

Study your planter and the operator's manual (Fig. 43). Can row width be varied? What row widths are possible? How can row widths be changed? Must the fertilizer discharge be changed? Will it be necessary to change the marker if row widths are changed?

Fig. 43. Study the operator's manual carefully. Keep it handy, in a safe place for future reference.

Row width

Changing row widths is currently receiving a great deal of attention. There is always interest among good farmers in ways to increase corn yields. One method that has attracted considerable interest is to change to narrow-row corn. The Agronomy Department of the University of Illinois has found that at high yield levels, corn yields benefit about five percent from narrowing rows from 40 inches to 30 inches. In no case did they find corn planted in 30-inch rows yielding less than corn planted in 40-inch rows. Soybean yields have been found to increase from 10 to 15% due to narrow rows.

Lodging and stalk breakage in corn seem to increase with narrow rows. Shorter, earlier hybrids yield better than tall late varieties. Narrow-row corn makes more efficient use of light and moisture and there is less competition from weeds. Changing to narrow rows is primarily an economic decision and many factors must be considered before making the change.

Planting rate

The importance of correct planting rate has been mentioned earlier. Select the proper population for the fertility and moisture level of your field.

The plant population at harvest time is usually less than the number of kernels planted or assumed to have been planted. This reduction in number can be caused by all or any one of the causes discussed here. Wheel slippage at planting time, losses from cultivation, damage by insects, competition from weeds, and failure to germinate usually reduces the population 15 to 20%.

Buying poorly graded seed can cause inaccurate planting. A seed plate actually grades seed corn. Larger kernels tend to be retained in the hopper while smaller ones are planted. For this reason, it is a good idea to dump all hoppers occasionally because the larger kernels accumulate and may actually prevent good cell fill. Failure to do this has caused some farmers to have a diminishing plant population from the desired planting rate they started with.

Planting too fast will result in a lower planting rate than expected. If the seed plates turn too fast, there will be an incomplete cell fill. When planting at faster speeds (4-5 miles per hour) the seeds should fit in the cells with sufficient clearance to allow them to enter and leave the cells freely. If the seed fits the cell too snugly, it won't have time to settle in the cell before reaching the cutoff and will be crowded back into the hopper. The addition of powdered graphite to the seed corn will improve the cell fill at higher speeds. Empty cells mean a lower planting rate than expected. The tables shown in the operator's manuals for different hill spacings also suggest a recommended planter speed.

The operator's manual also suggests a specified tire size and tire pressure. If tires are the wrong size or are not inflated to the correct pressures, then the planting rate will vary from the expected rate. If the planter wheels slip, the planting rate will be decreased.

If you calibrate your planter at one speed and plant at a different speed, you will not plant at the rate you expected.

The cut-off pawls are often a cause for inaccurate planting, even in a new planter. If the cut-off pawls stick open or are worn, then more kernels will be planted and you will overplant the field. If they stick closed or are too long, they may reduce the number of kernels planted. If the knockout pawls are worn or have weak springs, the planting rate will be reduced. If chain drives are placed on the wrong sprockets, the planting rate cannot be correct.

The corn planter can also be calibrated by pulling it at field travel speed in the barnyard. Lower the runners until they are just above the surface of the soil. On most planters the seed plates can be driven without lowering the runners but lowering the runners will keep the kernels closer together. Use the instruction book to find how to move the proper lever to put the planter in gear so the plates will turn. On some planters, it may be necessary to wire the seed plate drive in this position to keep it engaged. On others, it may be necessary to block the valves open. Count the kernels for 66 feet for 40-inch rows, 72 feet for 36-inch rows and 87 feet for 30-inch rows. Then by multiplying the number of kernels in each row by 200, you will get the kernels per acre.

To insure planting at the correct rate:

(1) Buy well graded seed.

(2) Select seedplates carefully and check them on the dealer's seedplate test stand.

(3) Check to see that all parts of the hopper bottoms are working properly, such as, cut-off pawls, knock-out pawls, and springs. See that the parts are free of excessive accumulations of dust, chaff, and rust.

(4) Check the general condition of the planter sprockets, gears, tires, etc.

(5) Check to see that chains are on the correct sprockets and the selector lever set correctly.

(6) Calibrate the planter at the speed at which planting will be done.

Hill spacings

These are determined by the choice of sprockets (drive and driven) and the accumulator plate or the striker and selector lever position for planters so equipped.

Table 1 taken from an operator's manual shows the hilling distance variations that are possible by changing the striker, shift lever, and gear case chain drive.

Table 2 taken from an operator's manual shows the hill spacing variations that are possible by changing the lugs on the rotor, using the accumulator plate, and changing the drive chain to different sprockets.

Table 1. Approximate Hilling Distances and Maximum Recommended Speed For Planter Equipped with 6.70x15 Tires Inflated to 24 Pounds Air Pressure

For a hilling distance of	Maximum recommended speed	Kernels per hill		Use striker	Set shift lever on	Set gear case drive chain on	
		16-cell plates	24-cell plates			Drive sprocket	Driven sprocket
11.6"	2. mph	2	3	Double	4	18-Tooth	7-Tooth
13.2"	2.5 mph	2	3	Double	4	18-Tooth	8-Tooth
15.6"	3. mph	2	3	Double	3	18-Tooth	7-Tooth
17.6"	3.5 mph	2	3	Double	3	18-Tooth	8-Tooth
19. "	3.75 mph	2	3	Double	4	11-Tooth	7-Tooth
21.8"	4. mph	2	3	Double	4	11-Tooth	8-Tooth
23.2"	2.75 mph	4*	-	Single	4	18-Tooth	7-Tooth
23.2"	4.25 mph	2	3	Double	2	18-Tooth	7-Tooth
25.4"	4.75 mph	2	3	Double	3	11-Tooth	7-Tooth
26.4"	3.25 mph	4	-	Single	4	18-Tooth	8-Tooth
26.4"	5. mph	2	3	Double	2	18-Tooth	8-Tooth
29. "	5.25 mph	2	3	Double	3	11-Tooth	8-Tooth
31.2"	3.75 mph	4	-	Single	3	18-Tooth	7-Tooth
35.2"	4.25 mph	4	-	Single	3	18-Tooth	8-Tooth
38. "	4.50 mph	4	-	Single	4	11-Tooth	7-Tooth
38. "	4.75 mph	2	3	Double	2	11-Tooth	7-Tooth
43.6"	5.25 mph	4	-	Single	4	11-Tooth	8-Tooth
43.6"	6. mph	2	3	Double	2	11-Tooth	8-Tooth
46.4"	5.75 mph	4	-	Single	2	18-Tooth	7-Tooth
50.8"	6. mph	4	-	Single	3	11-Tooth	7-Tooth
53.2"	6. mph	4	-	Single	2	18-Tooth	8-Tooth
58. "	6. mph	4	-	Single	3	11-Tooth	8-Tooth
76. "	6. mph	4	-	Single	2	11-Tooth	7-Tooth
87.2"	6. mph	4	-	Single	2	11-Tooth	8-Tooth

Drilling distances

Drilling distances are determined by the choice of seed plate, choice of sprockets (drive and driven), and the choice of selector lever position. Table 3 shows the drilling distances in inches for different seed plates. Table 4 shows the drilling distances for another planter.

Notice that increasing the number of cells in the seed plate reduces the drilling distances. This is logical, because with the seed plate turning at the same rate the increased number of openings will permit seeds to drop closer together.

One model planter power drills one seed at a time by bolting two extra ejector lugs to the rotor. If straight drilling is desired, the accumulator plate is removed. By removing the valve, the planter can be made to operate like a drill planter.

Planting depth

On trailing planters the planting depth is gauged by the press wheel and not the hydraulic cylinder. The depth of each unit is adjusted by setting a depth adjusting pin. Moving the pin up one hole adds approximately 1/2 inch to the planting depth (Fig. 44). The pressure on the pressure springs helps insure uniform planting depth (Fig. 45).

Table 2. Approximate Hill Spacings and Plant Populations (Based on 6.70 x 15 planter tires)

Drive Chain Sprocket (teeth on sprockets)		Planter Speed Recommended (m.p.h.)	16-Cell Seed Plates			
			Plant Population per acre (40" rows)	Hill Spacings (inches apart) Seeds per Hill		
Sprocket on Countershaft	Sprocket on Drill Shaft			One (See Note A)	Two	Three (See Note B)
18	8	3.5	26,100	6.0	12.0	18.0
16	8	4	23,100	6.8	13.5	20.3
18	10	4.5	20,800	7.5	15.1	22.6
13	8	5	18,800	8.3	16.7	25.0
16	10	5	18,500	8.5	16.9	25.4
18	12	5.5	17,350	9.0	18.0	27.0
18	13	6	16,000	9.8	19.5	29.3
16	12	6	15,400	10.1	20.3	30.4
13	10	6	15,000	10.4	20.9	31.2
16	13	6.5	14,230	11.0	22.0	33.0
18	16	7	13,000	12.0	24.1	36.2
13	12	7	12,520	12.5	25.0	37.5
18	17	7	12,400	12.6	25.2	37.9
13	13	7	11,580	13.5	27.0	40.5
16	16	7	11,580	13.5	27.0	40.5
16	17	7	10,900	14.4	28.7	43.1
13	16	7	9,350	16.7	33.5	50.2
13	17	7	8,830	17.7	35.5	53.2

Drive Chain Sprocket (teeth on sprockets)		Planter Speed Recommended (m.p.h.)	24-Cell Seed Plates			
			Plant Population per acre (40" rows)	Hill Spacings (inches apart) Seeds per Hill		
Sprocket on Countershaft	Sprocket on Drill Shaft			One (See Notes A and C)	Two (See Note C)	Three
18	8	3.5	39,200	4.0	8.0	12.0
16	8	4	34,700	4.5	9.0	13.5
18	10	4.5	31,200	5.0	10.0	15.0
13	8	5	28,200	5.6	11.1	16.7
16	10	5	27,800	5.6	11.2	16.9
18	12	5.5	26,000	6.0	12.0	18.0
18	13	6	24,000	6.5	13.0	19.5
16	12	6	23,100	6.7	13.5	20.3
13	10	6	22,500	7.0	13.9	20.9
16	13	6.5	21,400	7.3	14.7	22.0
18	16	7	19,500	8.0	16.0	24.1
13	12	7	18,800	8.3	16.6	25.0
18	17	7	18,600	8.4	16.8	25.2
13	13	7	17,400	9.0	18.0	27.0
16	16	7	17,400	9.0	18.0	27.0
16	17	7	16,400	9.6	19.2	28.7
13	16	7	14,000	11.1	22.3	33.5
13	17	7	13,220	11.8	23.6	35.4

Note A - Use four lugs on rotor. Remove accumulator plate.
Note B - Replace the 12-tooth sprocket on the rotor shaft with the special 18-tooth sprocket. Remove accumulator plate.
Note C - Replace the 12-tooth sprocket on the hopper shaft with the special 18-tooth sprocket Remove accumulator plate.

Table 3. Approximate Drilling Distances in Inches

Drilling Distance — Cells in Seed Plate				Set Shift Lever on	Set Drive Sprocket on	Set Driven Sprocket on
12	16	20	24			
8. "	6.1"	4.8"	4. "	4	18-Tooth	7-Tooth
9.3"	6.9"	5.5"	4.6"	4	18-Tooth	8-Tooth
10.9"	8.2"	6.5"	5.4"	3	18-Tooth	7-Tooth
12.3"	9.2"	7.3"	6.1"	3	18-Tooth	8-Tooth
13.2"	10. "	7.9"	6.6"	4	11-Tooth	7-Tooth
15.2"	11.4"	9.1"	7.5"	4	11-Tooth	8-Tooth
16.2"	12.1"	9.7"	8. "	2	18-Tooth	7-Tooth
17.7"	13.3"	10.7"	8.8"	3	11-Tooth	7-Tooth
18.4"	13.9"	11.1"	9.2"	2	18-Tooth	8-Tooth
20.2"	15.2"	12.1"	10. "	3	11-Tooth	8-Tooth
26.4"	19.9"	15.9"	13.2"	2	11-Tooth	7-Tooth
30.3"	22.8"	18.2"	15.2"	2	11-Tooth	8-Tooth

Table 4. Drilling Distances

Drive Chain Sprocket (teeth on sprockets)		Cells in Seed Plate (inches apart in row)						
Sprocket on Countershaft	Sprocket on Drill Shaft	16	22	24	29	34	38	40
18	8	6.0	4.4	4.0	3.3	2.8	2.5	2.4
16	8	6.8	4.9	4.5	3.7	3.2	2.8	2.7
18	10	7.5	5.5	5.0	4.1	3.5	3.2	3.0
13	8	8.3	6.0	5.6	4.6	3.9	3.5	3.3
16	10	8.5	6.2	5.6	4.7	4.0	3.6	3.4
18	12	9.0	6.5	6.0	5.0	4.2	3.8	3.6
18	13	9.8	7.1	6.5	5.4	4.6	4.1	3.9
16	12	10.1	7.3	6.7	5.6	4.8	4.3	4.0
13	10	10.4	7.6	7.0	5.8	4.9	4.4	4.2
16	13	11.0	8.1	7.3	6.1	5.2	4.7	4.4
18	16	12.0	9.7	8.0	6.6	5.7	5.1	4.8
13	12	12.5	9.1	8.3	6.9	5.9	5.3	5.0
18	17	12.6	9.2	8.4	7.0	5.9	5.3	5.0
13	13	13.5	9.8	9.0	7.4	6.3	5.7	5.4
16	16	13.5	9.8	9.0	7.4	6.3	5.7	5.4
16	17	14.4	10.4	9.6	7.9	6.7	6.0	5.7
13	16	16.7	12.2	11.1	9.2	7.9	7.0	6.7
13	17	17.7	12.9	11.8	9.8	8.3	7.5	7.1

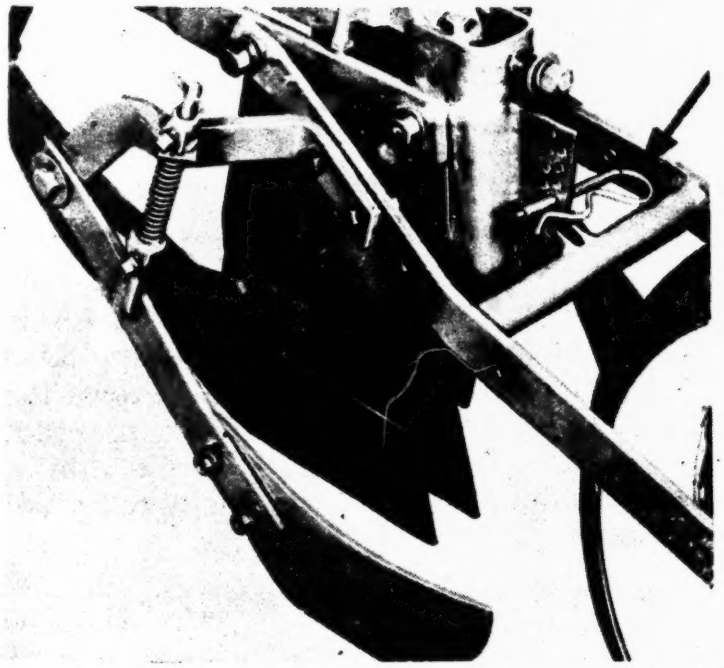


Fig. 44. Moving the cotter pin up to the next hole adds approximately ½-inch to the planting depth.

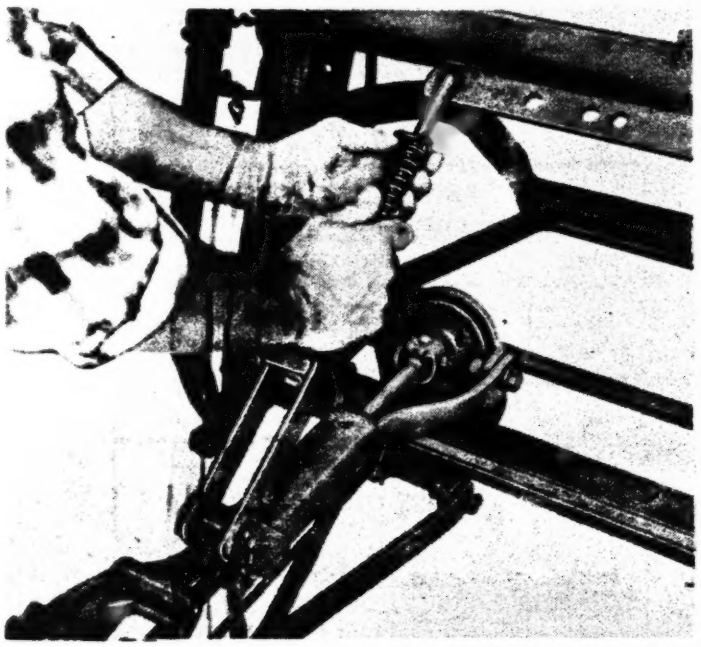


Fig. 45. Compressing the pressure springs increases the down pressure on the runners. Do not attempt to penetrate plow pan or extremely hard soil by increasing the pressure. In hard ground excessive pressure can cause the drive wheels to lift off the ground.

Table 5. Delivery Rates of Dry Fertilizer (Pounds per acre)

*Calculated for 40-Inch Row Spacing and 10-10-10 Fertilizer

Pounds per Acre Type of Auger			Differential Sprocket	Fertilizer Sprocket
Low	Reg.	High		
52	104	156	9-Tooth	18-Tooth
63	125	188	9-Tooth	15-Tooth
79	157	236	12-Tooth	18-Tooth
94	188	282	12-Tooth	15-Tooth
105	209	314	9-Tooth	9-Tooth
118	236	354	9-Tooth	8-Tooth
142	283	425	18-Tooth	15-Tooth
157	313	470	12-Tooth	9-Tooth
177	353	530	12-Tooth	8-Tooth
235	470	705	18-Tooth	9-Tooth
264	528	792	18-Tooth	8-Tooth

Table 6. Delivery Rates of Dry Fertilizer

40" Rows

Sprocket on Main Drive Shaft	Sprocket on Fertilizer Feed Shaft	Pounds Per Acre	
		Low Rate Auger	High Rate Auger
8-Tooth	18-Tooth	50	115
8-Tooth	15-Tooth	60	140
12-Tooth	18-Tooth	75	170
12-Tooth	15-Tooth	90	205
8-Tooth	9-Tooth	100	230
17-Tooth	18-Tooth	105	240
8-Tooth	8-Tooth	110	260
17-Tooth	15-Tooth	130	290
12-Tooth	9-Tooth		340
12-Tooth	8-Tooth		385
17-Tooth	9-Tooth		485
17-Tooth	8-Tooth		540

Fertilizer rates and locations

Dry fertilizer. Rates of dry fertilizer are adjusted by selecting a low or high rate auger and by selecting the correct sprockets (drive and driven). Table 5 shows the dry fertilizer rates in pounds per acre for one planter while Table 6 shows the fertilizer rates for another planter.

The charts serve as a guide but they are not precise. Dry fertilizer is metered by volume and not by weight so the weight metered may vary as much as 100% from the weight calculated in the charts. For accurate metering of the fertilizer, it is important that the augers be properly assembled -- the large tapered ends should be on the outside with the small tapers toward the center. A diagram similar to Fig. 46 and complete information are in the operator's manual.

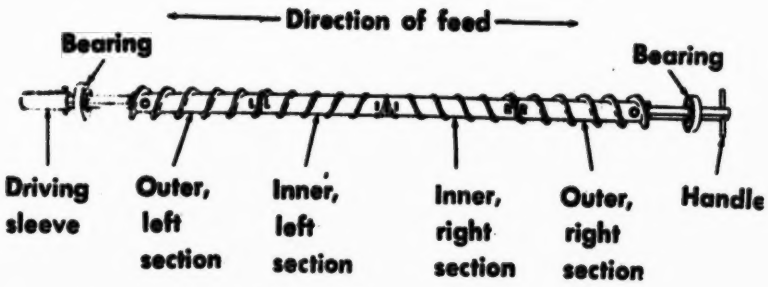


Fig. 46. When the augers are removed for cleaning, it is important that they be re-assembled correctly as shown in the operator's manual.

On some planters the fertilizer can be applied in a short band next to the hill when hill-drop or check-row planting corn (Fig. 47). A striker plate is set to trip the pull rod on the fertilizer valves.

Shop calibration can be done with fertilizer in the hopper, and the planter on supports by placing a container under the discharge opening and turning the wheels ten revolutions. Measure the circumference of the tire and calculate the distance traveled. Multiply the distance by the width of the row. Divide this figure by 43,560. This gives the fraction of an acre covered. Weigh the fertilizer and divide by the fraction of an acre covered. The result will be approximately the amount applied per acre. It takes a great deal of effort to turn the wheels manually at the proper speed. On some planters the differential in the drive mechanism may also affect the calibrated rate of application. Field planting conditions may cause the applied rate to vary greatly from the rate calibrated in the shop.

Field calibration may be done by removing one delivery tube and tying a bag to the spout under the hopper. Engage the fertilizer attachment and drive forward 131 feet at the speed at which planting will be done. Weigh the amount of fertilizer caught and multiply this by 100. The result will be the pounds of fertilizer delivered per acre when planting 40-inch rows.

The fertilizer openers have a drawbar linkage that gives unrestricted flotation (if they are not integral parts of the runner openers). The separate openers can be shifted to place fertilizer on either side of the seed and below if desired. The drawbars should retain vertical flexibility with the pressure springs for protection against breakage as well as penetration.

Liquid fertilizer. Rates of liquid fertilizer are determined by the metering head and the rate of travel. Table 7 shows the approximate delivery rates for a planter. Notice that for any given orifice, the rate of application decreases as the speed of travel increases.

Table 7. Delivery Rates of Liquid Fertilizer (Pounds per acre)

*Calculated for 40" Row Spacing

Speed 3 mph	Speed 4 mph	Speed 5 mph	Orifice Number
LOW RANGE ORIFICE DISK No. 1			
42	31	25	1
67	50	40	2
100	75	60	3
150	112	90	4
183	138	110	5
200	150	120	6
HIGH RANGE ORIFICE DISK No. 2			
242	181	145	1
283	212	170	2
325	244	195	3
392	294	235	4
420	315	252	5
483	362	290	6
EXTRA HIGH RANGE ORIFICE DISK No. 3			
517	388	310	1
575	431	345	2
670	478	382	3
703	528	422	4
775	581	465	5

Fig. 47. This planter is set to deposit fertilizer slightly below the hill of corn.

Different crops

A wide variety of crops can be planted with the conventional planter by changing plates. Soybeans are an important crop in the midwest. To plant soybeans with the planter, it may be desirable to change row spacings to a narrower row. Table 8 shows the distribution table for a planter for 40-inch rows. When row widths to be planted are other than 40-inch, allow for the difference when calculating pounds per acre or plant population per acre as follows:

Row width	Multiply by
38	1.05
36	1.11
34	1.18
32	1.25
30	1.33
28	1.43

Table 9 shows the approximate pounds per acre with two different seed plates for a planter. When planting soybeans with this planter, you may have to remove the chain valve to reduce wear on the valve assembly.

Herbicide applications

The granular applicators are mounted on the planter frame or on fenders over the press wheels, and distribute a band of granular herbicide behind the press wheels (Fig. 48). Most applicators are considered gravity flow de-

Table 8. Distribution Table for Soybeans

Drive Chain Sprocket (teeth on sprockets)		SEED PLATE (pounds per acre - 40" rows)					
Sprocket on Countershaft	Sprocket on Drill Shaft	3127A 22-Cell	3301A 34-Cell	3114A 24-Cell	3231A 38-Cell	1926A 29-Cell	3302A 29-Cell
18	8	137	99	76	65	56	45
16	8	123	87	67	58	50	40
18	10	110	79	60	52	45	36
13	8	99	71	54	47	40	36
16	10	97	70	54	46	40	32
18	12	91	64	50	43	37	30
18	13	84	61	46	40	35	28
16	12	81	59	45	39	33	27
13	10	79	57	44	38	33	26
16	13	75	54	41	36	31	25
18	16	68	49	38	33	28	23
13	12	66	48	36	32	27	22
18	17	66	47	36	21	27	22
13	13	61	44	33	29	25	20
16	16	61	44	33	29	25	20
16	17	57	41	32	27	24	19
13	16	49	36	27	23	20	16
13	17	46	33	26	22	19	15

Table 9. Approximate Pounds of Soybeans per Acre With 20-Cell Plates
Based on a Speed of 5 Miles per Hour

Pounds per Acre			Set Shift Lever on	Set Drive Sprocket on	Set Driven Sprocket on
Row Width					
36"	38"	40"			
27 Lbs.	25 Lbs.	24 Lbs.	2	11-Tooth	8-Tooth
29 Lbs.	27 Lbs.	26 Lbs.	2	11-Tooth	7-Tooth
38 Lbs.	37 Lbs.	34 Lbs.	3	11-Tooth	8-Tooth
43 Lbs.	41 Lbs.	39 Lbs.	3	11-Tooth	7-Tooth
43 Lbs.	41 Lbs.	40 Lbs.	2	18-Tooth	8-Tooth
45 Lbs.	43 Lbs.	41 Lbs.	4	11-Tooth	8-Tooth
50 Lbs.	48 Lbs.	45 Lbs.	2	18-Tooth	7-Tooth
51 Lbs.	49 Lbs.	46 Lbs.	4	11-Tooth	7-Tooth
56 Lbs.	54 Lbs.	51 Lbs.	3	18-Tooth	8-Tooth
71 Lbs.	67 Lbs.	64 Lbs.	3	18-Tooth	7-Tooth
73 Lbs.	69 Lbs.	66 Lbs.	4	18-Tooth	8-Tooth
85 Lbs.	80 Lbs.	76 Lbs.	4	18-Tooth	7-Tooth

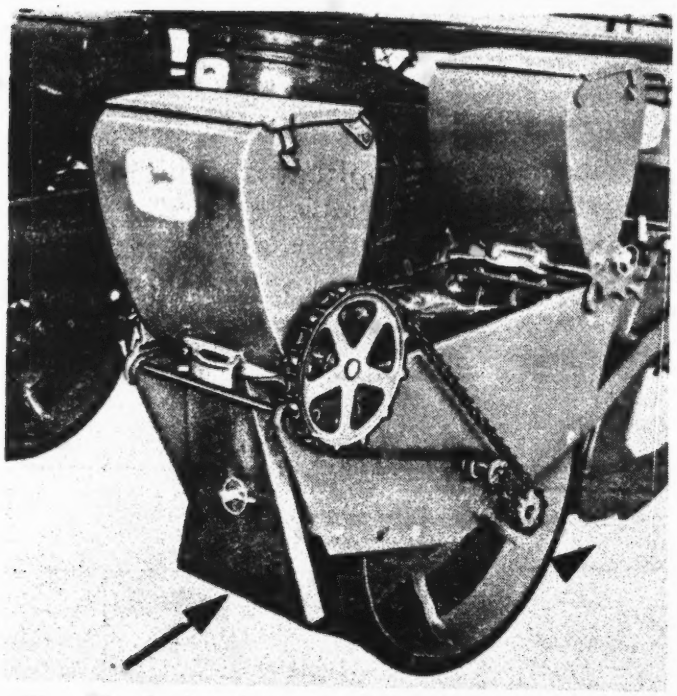


Fig. 48. The herbicide is distributed over the row by a diffuser.

vices, since the rate is varied by changing the size of opening in the hopper bottom. The rotor in the hopper serves primarily to prevent bridging and assure a supply of granules to the opening. The amount of material fed is more a function of time than of distance traveled. Any changes in travel speed or size, shape, or density of the granules requires recalibration.

The liquid herbicide is usually applied under pressure from a supply tank (Fig. 49). The nozzles are mounted behind the press wheels and the height of the nozzles determines the width of pattern.

Fig. 49. A pump driven by the tractor power-take-off delivers liquid herbicide to the nozzles back of the press wheels.

Calibration of granular pesticides (herbicides and insecticides) should be done for the rate (number of pounds per acre) at the normal planting speed. Attach a cloth bag over the diffuser or the discharge tube, lower the planter and drive a complete row (preferably in the field at planting speed). Weigh the herbicide (or insecticide) caught in the cloth bag and calculate the rate per acre.

Make the necessary adjustments and recheck. This calibration should be done for both pesticides for each planting unit.

Calibration of liquid herbicide (and insecticide) applicators can be done by the following method. Drive a measured distance

of 176 feet in the field at the speed at which planting will be done. Record the time it takes to travel to 176 feet. Note the rpm of the engine or mark the throttle quadrant. With the tractor and planter stationary and the spraying pressure at 20 - 40 psi, place a container under a nozzle and advance the throttle to the rpm used in the field. Measure the amount of fluid caught under the nozzle in the recorded time.

Adjust pressure or change nozzles until the proper output is obtained.

Insecticide applications

Granular insecticide is placed in the furrow at the back of the runner (Fig. 50). Granular applicators are mounted on the press-wheel fenders or on the planter frame and the insecticide is delivered to the furrow through a spout connected to the rear of the runner.

Liquid insecticide is sometimes applied with liquid fertilizer. If applied separately, it should be applied in the furrow ahead of the press wheel.

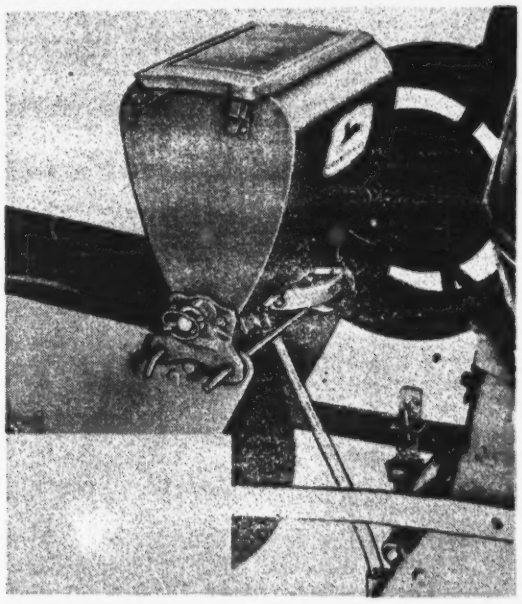


Fig. 50. The insecticide attachment is mounted in front of the press wheels and the insecticide flows through the plastic tube to the furrow.

4. HOW SHOULD I USE A PLANTER?

Safety practices

Permit only one person on the tractor while the tractor and planter are in operation. Never permit others (especially children) to ride on the planter.

Do not drive at excessive speed (Fig. 51).

Do not clean, lubricate, or adjust the planter when it is in motion.

Be especially careful when operating on hillsides because the tractor may tip sideways if it strikes a hole, ditch, or bump.

Lower the planter to the ground when it is not in use (Fig. 52). Whenever possible, perform service work and adjustments with the planter on the ground. If the planter must be in the raised position while working on it, be sure it is securely supported on blocks.

Leave ample clearance when making turns (Fig. 53).

Lock the marker chains in transport position at all times except when actually planting. Markers can be accidentally tripped causing injury to someone or damage to the marker (Fig. 54). Keep the loose end of the marker chain from dangling.

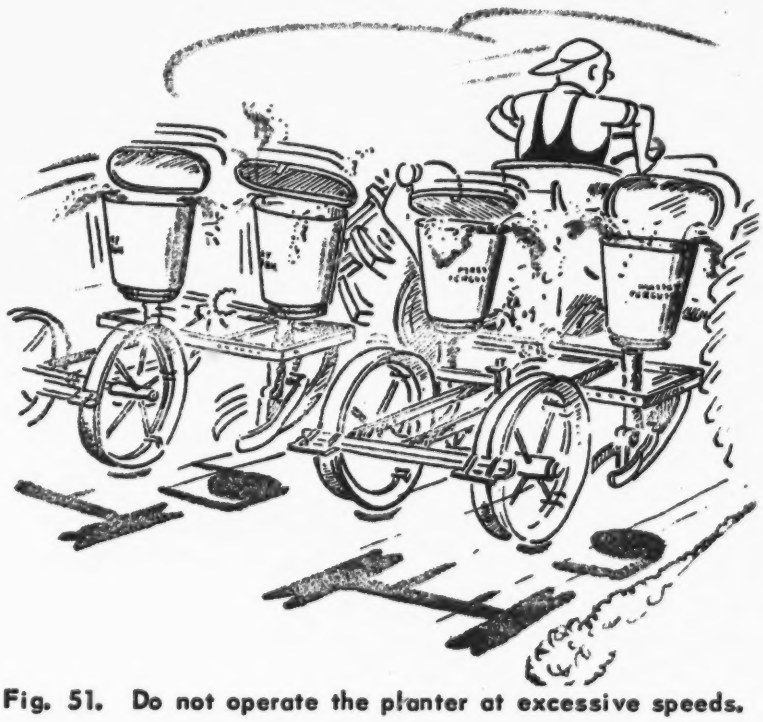


Fig. 51. Do not operate the planter at excessive speeds.

Fig. 52. Never leave the planter in a raised position.

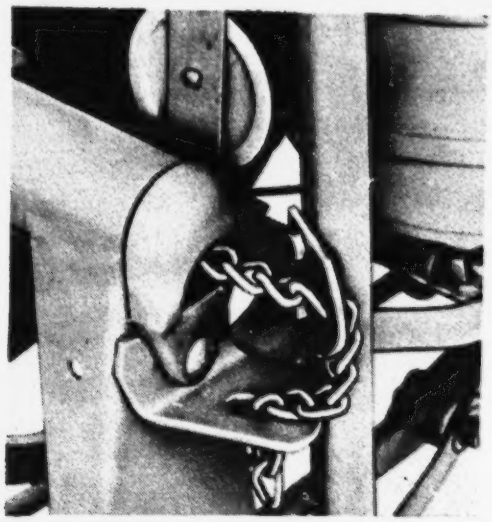


Fig. 54. Lock the marker in transport position at all times, except when actually planting.

Fig. 53. Do not turn too fast and strike the planter on trees, fences, or gate posts.

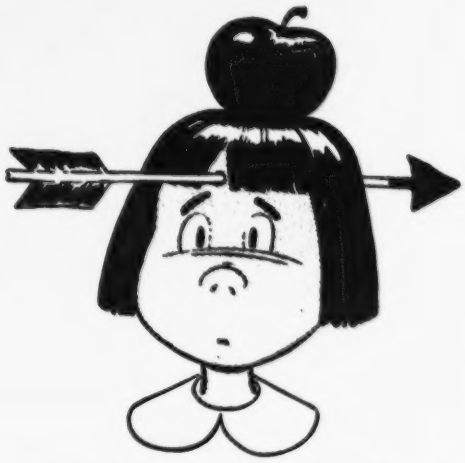


Fig. 55. Haste causes accidents.

Do not hurry when working around implements. Haste causes accidents (Fig. 55).

Always check behind the planter when backing the unit to avoid injuring a person or damaging the planter.

Keep small children away from the planter.

Use warning flags or Slow Moving Vehicle emblems when transporting the planter on the highway in the daytime. Use accessory lights for adequate warning to other vehicle operators at night or dusk.

<u>What preparation should be made to use the planter?</u>

Clean the planter thoroughly. Be sure there are no obstructions in the valves.

Inflate the planter tires to the pressure suggested in the operator's manual.

Stop the tractor engine and let it cool before refueling. Do not smoke during refueling. A tractor fire will cause a greater delay in planting than a few seconds required to start the tractor engine.

Move the planting units to the desired row widths. Set the fertilizer openers as recommended in the operator's manual. Set the markers for the row width chosen.

Inspect the seed hopper bottoms. Be sure the cut-off pawls and knockers are free.

Set the hitch clevis so the planter is level when operating.

Be sure the marker-control latch is lubricated and working freely.

Be sure all set screws and bolts are tight and all cotters spread, to keep them from falling out.

Be sure all hose connections and gaskets are tight on liquid fertilizer attachments. If dry fertilizer parts were oiled when the planter was stored, wipe all parts dry.

Set the planting depth desired.

Check the planter parts for excessive wear.

Match the seed to the seed plate as discussed above. Check seed plates for wear. If the center of the seed plate is worn, there will be so much play between the seed plate and the side of the hopper bottom that there will be an imperfect cell fill.

Calibrate the seeding rate at the correct planting speed.

Calibrate the fertilizer applicator.

Calibrate the pesticide applicator(s).

Lubrication. First of all, consult the lubrication charts in the operator's manual for instructions on lubricating the planter as shown in Fig. 56. Check the oil level in the gear case if the planter is so equipped. Keep the clutch (or clutches) well lubricated for positive and easy action. Marker chains last longer and operate easier if they have a light coating of oil. Chain tighteners that turn freely provide less resistance to the moving chain so it is advisable to keep them well lubricated.

Follow the manufacturer's recommendations on daily lubrication.

What are some other practices that insure more satisfactory use of the planter?

Transporting the planter. The hydraulic cylinder on trailing planters should be extended or retracted as far as it will go. When moving the planter, the transport link should be connected. On some planters it is advisable to detach the chain drive. The planter will not be as noisy and there will be far less wear on the parts.

Wait until the planter is in the field to fill large fertilizer hoppers and granular pesticide applicators. The dry fertilizer tends to pack so it is recommended that a wrench be used to turn the auger shaft after moving the planter with the hoppers loaded. This takes some of the shock load off the fertilizer drive. Transporting hoppers full of fertilizer has been known to pack it so tightly that the augers have been broken. Keep the hopper and agitator clean and free of caked materials to insure uniform application at the calibrated rate.

When contour planting is not necessary, it is suggested that the field be worked crosswise or on a slight diagonal to the direction of planting so the marker lines can be seen more easily (Fig. 57).

Field conditions. A well prepared seedbed aids in obtaining uniform depth of planting from all seed openers and assists the operator in obtaining straight rows.

Field operation. It is best if the planter wheels follow in the wheel tracks of the tractor, giving the planter greater stability. Do not operate the planter with pressure springs on the fertilizer openers or runner openers compressed tightly.

Do not drive nearer than eight rows of the end before raising the planter. Turn carefully and sharply at the ends of the field to bring the planter in proper location without backing up.

Raise the planter units before backing or the runners or boots will become clogged (Fig. 58).

The runners can be forced out of alignment by turning the planter around in hard ground without raising the planter units (Fig. 59).

Dump the seed hoppers occasionally to eliminate the accumulation of larger kernels.

What can be done if the planter fails to function properly?

Most planter troubles are caused by im-

Fig. 56. Lubrication Chart

Location	Number of Fittings or Locations*	Lubricant		Frequency	
		oil	pressure gun grease	twice daily	daily
Cylinder anchor bearing	1		✓	✓	
Drill shaft bearings	6		✓		✓
Row Unit drive shaft bearings (front)	4		✓		✓
(rear)	4		✓		✓
Main drive shaft bearings	3		✓		✓
Wheel frame pivot	4		✓		✓
Throwout bearing	1		✓		✓
Ring gear bearings	4		✓		✓
Press wheel hubs	4		✓		✓
Drive chain idlers	2		✓		✓
Disk marker hubs	2		✓		✓
Marker chain pulleys	5*	✓			✓
Marker trip timing dial	1*	✓			✓
Ratchet pawls	2*	✓			✓
Fertilizer Unit					
Intermediate shaft bearings	2		✓		✓
Driving sleeve	1		✓		✓
Drive sprocket	1		✓		✓
Drive chain idlers	2		✓		✓

Wipe the dirt from fittings before greasing. Apply sufficient lubricant to flush out the old grease and dirt. Wipe off excess grease because this accumulates dirt.

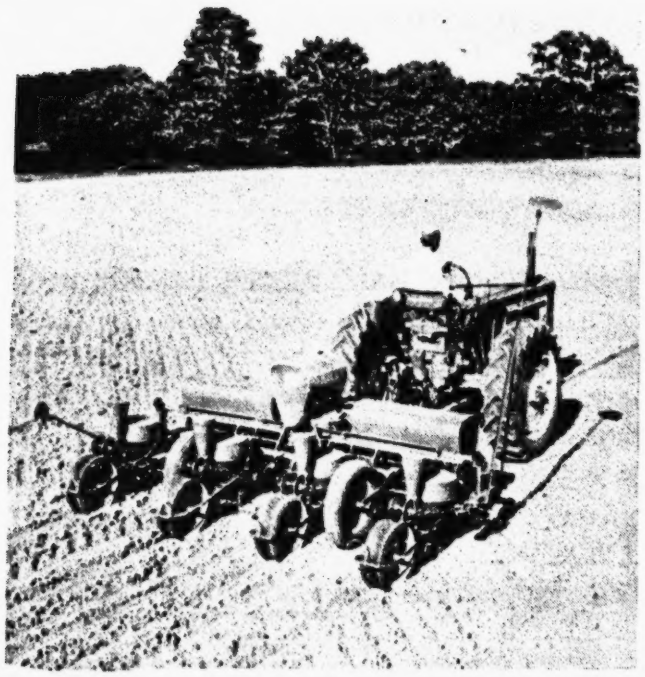


Fig. 57. The marker line shows up more clearly when the final tillage operation was crossways or diagonal to planting.

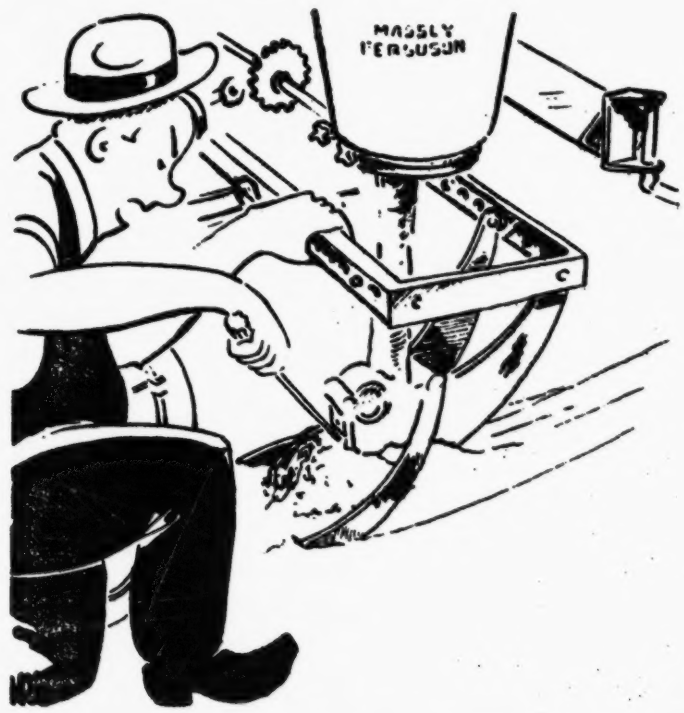


Fig. 58. Never back up with the planter in operating position.

proper adjustment. When you encounter trouble in the field make a systematic check of all planter adjustments. Checking and correcting operating adjustments usually clears up planter troubles.

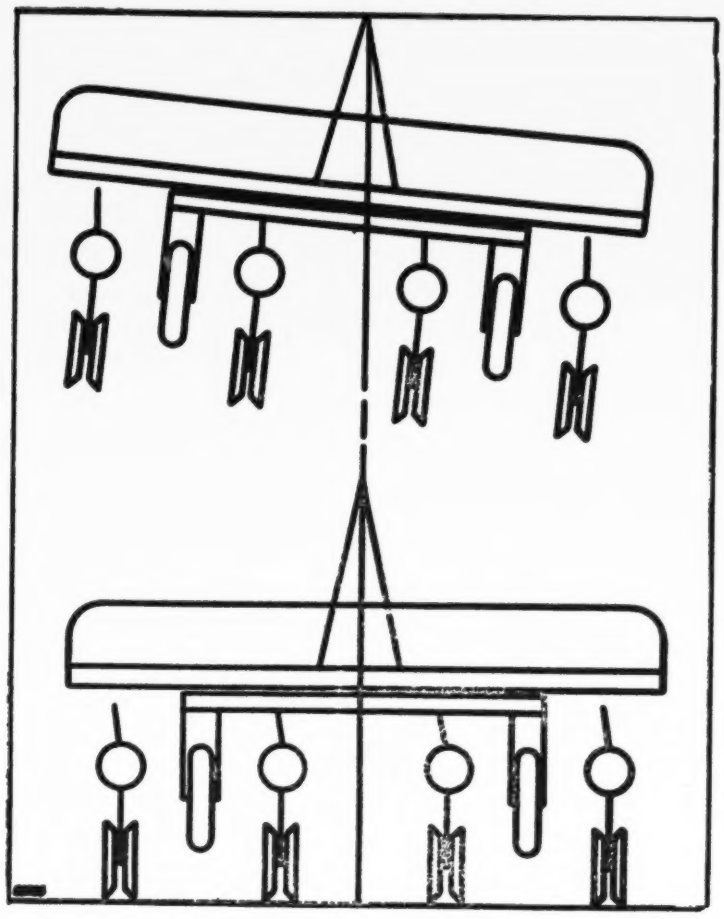


Fig. 59. These illustrations are exaggerated examples of what happens when the runners are out of alignment.

FURROW OPENERS NOT PENETRATING GROUND

Possible Causes	Remedy
1. Hard ground	1. Use pressure spring attachment to increase pressure on runners.
2. Worn out furrow openers	2. Replace worn out runner openers. Weld additional plate to replace worn portion of opener.
3. Fertilizer openers set too deep	3. Readjust fertilizer openers.
4. Planter not level	4. Adjust hitch clevis.

SEED OR FERTILIZER NOT PROPERLY COVERED

Possible Causes	Remedy
1. Soil condition	1. Use covering blades or covering disks.
	2. Adjust covering blades or disks.
	3. Prepare a better seedbed.
	4. Set planter deeper.

SINGLE DISK FERTILIZER OPENER NOT ENTERING GROUND

Possible Causes	Remedy
1. Depth set deeper than plowing depth	1. Prepare deeper seedbed.
	2. Adjust opener for shallower depth.

SOIL LOOSE AROUND SEED

Possible Cause	Remedy
1. Cloddy soil condition	1. Use rubber tires on press wheels. Use seed firming wheels. Prepare seedbed more thoroughly.
2. Insufficient press wheel pressure	2. Increase pressure on press wheels.

MARKERS NOT LATCHING

Possible Causes	Remedy
1. Chain stretched	1. Shorten length of chain.
2. Chain too long	2. Shorten length of chain.

INACCURATE SEED DROP

Possible Causes	Remedy
1. Poorly graded seed corn	1. Use seed that is graded more uniformly.
2. Planter speed too fast	2. Use recommended planter speeds. Check seed against seed plate on dealer's seed plate test stand at recommended speed. Reduce planter speed.
3. Wrong seed plates	3. Use recommended seed plates. Check seed against seed plate on dealer's seed plate test stand. Check planting rate in barn lot.
4. Planter out of time	4. Check timing of planter (see operator's manual for procedure).
5. Floor plate turned wrong side up	5. Check floor plate.
6. Wrong false ring used	6. Use correct false ring.
7. Cut-off pawls or knocker not working	7. Check for worn cut-off pawl. Check cut-off pawl springs. Check operation of knock-out pawls. Seed may get into housing of knock-out pawl and cut-off pawls. Pawls may be too rusty or too tight.
8. Chain on wrong sprocket or too loose	8. Check if chain is on correct sprockets. Tighten chain.
9. Weak rockshaft spring	9. Replace rockshaft spring.
10. Valves out of adjustment	10. Check valve adjustment.
11. Obstruction in shank	11. Check shanks for clear operation.
12. No oil or oil too heavy in gear case	12. Check kind and level of oil in gear case.
13. Check heads and check forks not adjusted properly on check-row planter	13. Check adjustment

SCATTERING OF HILLS IN ROW

Possible Causes	Remedy
1. Planter out of time	1. Retime planter (see operator's manual for correct procedure).
2. Clogged boots or runners	2. Do not back up with furrow openers in ground. Depth of split-row fertilizer boot set too deep.
3. Planting too fast	3. Use recommended planting speeds.
4. Valve rod out of adjustment	4. Readjust valve rod.
5. Check shaft spring out of adjustment	5. Adjust spring to proper tension or replace spring.
6. Check shaft binding	6. Check for interference of misalignment of check shaft.
7. Worn runner openers	7. Replace or repair runner openers.
8. Poorly prepared seedbed	8. Prepare seedbed more thoroughly to eliminate trash, roots, or grassy conditions.

MARKER LINE NOT VISIBLE

Possible Cause	Remedy
1. Marker shoe or disk improperly set	1. Adjust angle of shoe or disk to drag smoothly on ground.
	2. Place more weight on marker.

PLANTER DRIVE JERKING OR CATCHING

Possible Cause	Remedy
1. Drive chain too loose	1. Tighten drive chain

PLANTER MISSES SETS OF HILLS

Possible Causes	Remedy
1. Clutch not engaging properly	1. Adjust clutch or repair.
2. Roller or clutch stop lever loose or worn	2. Tighten clutch stop lever. Replace worn clutch stop lever.
3. Clutch dog spring weak or broken	3. Replace clutch dog spring.

PLANTING MORE CORN IN SOME ROWS THAN IN OTHERS

Possible Causes	Remedy
1. Action of cut-off pawl or knocker	1. Check for seed in cut-off pawl or knocker housing. Check for weak or broken cut-off spring. Check for worn cut-off pawl.
2. Wrong seed plate	2. Check for uniformity of seed plates so they are the same in all planting units. Plates and hoppers are not all the same size which gives larger cell sizes in some hoppers.
3. Wrong false ring	3. Check for uniformity of false rings so they are the same in all planting units.
4. Warped false ring	4. Check condition of false rings.
5. Hopper not clamped down tight	5. Be sure all hoppers are clamped down tight.
6. Not enough corn in the hopper	6. Empty when 2 inches of corn remains in the hopper to remove larger kernels.

5. HOW SHOULD I MAINTAIN THE PLANTER?

Care and maintenance of the corn planter is important for two reasons. (1) The corn planter is used only a few days each year. The performance of the planter during the few hours it is in the field may make the difference between a profit or a loss on the crops it plants. On a farm where the principal crops are row crops, the poor performance of the planter may mean financial ruin. Since its performance is so important, it deserves good care during the rest of the year when it is not in use. (2) Planters are precisely made farm implements and they are expensive. Equipment that represents this large an investment should receive good care. Good care and maintenance will assure efficient and accurate planting at high speeds for many years.

Remember, good care and long service go together. How long your planter will last and continue to do good work depends largely on the maintenance and care given by the operator.

What preparations should be made for off-season storage?

Store the planter on blocks or jacks. Block up the runners so the weight of the planting units doesn't rest on the zero-pressure press-wheel tires. This will prevent deformity or flat spots caused by the tires being depressed for a long period of time. Store the planter in a shed or cover the entire unit with a tarpaulin.

Replacement Parts. The first step in post-season service and repair is to determine in detail the needed replacement parts, adjustments, and service. These jobs should be marked with tags on the planter or written down in a notebook or on a service inspection sheet (Fig. 60).

Parts that are broken or badly worn may need to be replaced. Refer to the owner's manual and order these parts by the correct part number. Some worn parts can be built

Fig. 60. Planter repair jobs that need to be done before next planting season should be listed so they can be completed when the press of farm work is not so heavy.

up in the shop. Parts that are wearing by soil abrasion may be hard surfaced to prolong their life.

Cleaning and lubrication. Clean the planter to remove grease, dirt, chemicals, etc. This can be done with water pressure. The accumulation of grease may be softened with solvent and removed by putty knife or wire brush.

Grease the polished surface of all ground working parts of the planter (fertilizer opener, runners, marker, etc.).

Lubricate chains with heavy oil or grease.

Fertilizer attachments. The worst enemy of dry fertilizer distribution equipment is corrosion. Empty the hoppers as soon as possible after planting is completed. Wash out the hopper, tube, and opener thoroughly and replace them. Remove the augers and clean them thoroughly. Use a wire brush if necessary to remove any accumulation of fertilizer. Some manufacturers recommend repainting scarred surfaces with an aerosol spray can to prevent corrosion. Protect the parts subject to rusting with oil, grease, paint, or any suitable rust preventive.

As double disk openers wear, the disks of the offset type can be exchanged because the leading disk wears faster.

For liquid fertilizer attachments, open the distributor valve and flush the system well. If the tanks are metal, add a pint of light oil to the final flush. Use compressed air to clean and dry the liquid fertilizer system.

6. WHAT ARE SOME PRACTICAL APPLICATIONS?

Fill out this information sheet for your corn planter. Use the operator's manual as a reference.

CORN PLANTER INFORMATION SHEET

Mfg. Name_____ Model_____ Size_____

In the space below each unit list other information about the unit.

THE PLANTER

Identify the major parts of the planter

- Hitch and Frame
- Power Transmission Train
- Planter Unit and Gauge Wheel

What row spacings are possible?

Trace power from wheels to all attachments. (sketch if necessary)

List special precautions for transporting.

Describe marker operation.

Check the accessories noted.

- ___ runner openers
- ___ disk openers
- ___ check-row attachment
- ___ gauge shoes
- ___ trash kickers
- ___ multi-luber
- ___ press wheel scraper
- ___ press wheel bands
- ___ rubber press wheel tires
- ___ covering knives
- ___ covering disks
- ___ seed packer wheels
- ___ minimum tillage attachment
- ___ dual wheels
- ___ herbicide attachment
- ___ insecticide attachment
- ___ soil incorporating equipment
- ___ disk marker
- ___ check-row equipment
- ___ grass waterway attachment
- ___ fertilizer attachment
- ___ other

PLANTING UNIT

Identify all parts in planting unit and describe their function.

What is maximum and minimum distance between hills? Between kernels when drilling?

What maximum and minimum planting rates are possible? (40 in. rows)

How fast can you drive at different planting rates?

How is hill spacing varied?

How are kernels per hill varied?

How is the planter set for drilling?

How is planter set for hill dropping?

How many hill dropping rates are possible?

How is depth of planting controlled?

How is pressure on press wheel adjusted?

What is the capacity of seed hoppers?

How are the seed plates matched to seed?

FERTILIZER ATTACHMENT

Identify all parts of fertilizer attachment and describe their function.

What is the capacity of hoppers? Tanks?

How is the fertilizer attachment engaged?

What are minimum and maximum rates per acre? (40 in. rows)

How is fertilizer applicator calibrated?

How is depth of placement adjusted?

Where can fertilizer be placed in relation to the row?

What daily care is needed?

What maintenance is needed?

INSECTICIDE ATTACHMENT

What care is needed?

What is the range in rate of application per acre?

How is it calibrated?

HERBICIDE ATTACHMENT

What care is needed?

What is the range in rate of application per acre?

How is it calibrated?

LUBRICATION

What are the twice daily lubrication requirements?

What are the daily lubrication requirements?

What are the periodical lubrication requirements?

PRE-SEASON SERVICE CHECK

Is planter lubricated properly?

What tire pressure is recommended?

Are width settings correct? Are markers set to match row widths?

Are seed hoppers and hopper bottoms ready to use?

Does seed fit the seed plates?

Is fertilizer attachment ready for field use?

Are all bolts, nuts, set screws and cotter pins tight?

END - OF - SEASON STORAGE PREPARATIONS

Check for worn, lost, or damaged parts and replace them.

What service should be given fertilizer attachment?

What service should be given insecticide attachment?

What service should be given hoppers and hopper bottoms? Runners?

What protection should be given soil engaging parts?

How can planter parts be folded for close storage?

Be prepared to complete these Laboratory Exercises or Demonstrations:

1. Change press wheel pressure.
   a. How much increase or decrease in planting depth does this cause?
2. Select correct seed plate to match seed.
3. Set planter to hill drop 2 kernels per hill for approximately 18,500 plants per acre population with 40-inch rows.
   a. What seed plate is used?
   b. What is the recommended planter speed?
   c. What is the hill spacing in the row? If this is changed to approximately 21 inches, will it affect the population? How much?
4. Set planter to hill drop 3 kernels per hill for approximately 19,500 plants per acre with 40-inch rows.
   a. What seed plate is used?
   b. How far apart are the kernels in the row?
5. Set planter to hill drop 4 kernels per hill for approximately 23,000 plants per acre.
   a. What sprockets are used on the drill shaft and counter shaft?
   b. What change would be made if the sprocket on the drill shaft were changed to a 12-tooth sprocket?
6. Set planter to drill corn 6 inches apart in the row using the 16-cell seed plate, then the 24-cell seed plate.
   a. What plant population will each setting give?
7. Set planter to plant 45, 46, 47, or 48 pounds of soybeans per acre.
8. Show how to change row spacings.
   a. What different row spacings can be set on this planter?
9. Demonstrate how to clean and service fertilizer attachment.
   a. What daily service is recommended?
   b. What prestorage service is recommended?
10. Calibrate fertilizer attachment.
    a. What are maximum and minimum rates that can be applied?

(Laboratory calibration) With fertilizer in hopper, and planter on supports, place container under the discharge opening and turn wheels 10 revolutions. Measure circumference of tire and calculate distance traveled. Multiply distance by the width of row. Divide this by 43,560. This gives the fraction of an acre covered. Weigh the fertilizer and divide by the fraction of an acre covered. The result will be the amount applied per acre.

(Outdoor calibration) Remove one delivery tube and tie a bag to the spout under the hopper. Engage the fertilizer attachment and drive forward 13 ft. after fertilizer starts flowing. Weigh the amount of fertilizer caught and multiply this by 100. The result will be the pounds of fertilizer delivered per acre when planting 40-inch rows.

11. Demonstrate how moist or lumpy fertilizer causes irregular flow.
12. Demonstrate how restricted fertilizer boot openings affect rate of application.
13. Demonstrate how gravity flow liquid fertilizer application rate is affected by forward speed.
14. Calibrate granular herbicide and insecticide attachments.
    a. This should be done for the rate (number of lbs. per acre) at the normal planting speed. Attach a cloth bag over the diffuser, lower the planter and drive a complete row at planting speed. Weigh the herbicide caught in the cloth bag and calculate the rate per acre. Make necessary adjustments and recheck. This calibration should be done for each unit.
15. Calibrate liquid insecticide or herbicide attachments.
    a. This should be done for the rate (gallons per acre) at the normal speed or rpm at which planting is done.
16. Demonstrate correct planter lubrication.
    a. What parts require lubrication twice daily?
    b. What parts require daily lubrication?
17. Time the planter.
18. Disassemble unit to inspect the valves.
19. Examine the runner.
    a. Identify and explain the function of all parts.
    b. Does runner opener need to be rebuilt.
20. Examine sprockets, chains, and gears.
    a. Are any parts worn so badly they affect timing?
21. Examine planter for lost, worn, or broken parts.
    a. What is correct replacement part number for this model planter? (Use operator's manual to identify missing part)
22. Examine seed hopper, hopper bottom, and seed plates.
    a. Are hopper bottom plates worn?
    b. Are cut-off pawls worn? Is movement free?
    c. Do the knock-out pawls need adjusting?
23. Outline pre-storage service procedure for the end of the season.
24. Outline pre-season checks and service before starting to plant.

The illustrations used in this unit were provided by Allis Chalmers Mfg. Co., Milwaukee, Wisconsin; Deere & Company, Moline, Illinois; Gandy Company, Owatonna, Minn.; International Harvester Co., Chicago, Illinois; and Massey Ferguson Inc., Detroit, Michigan.

Fill out this information sheet for your planter. Use the operator's manual as a reference.

CORN PLANTER INFORMATION SHEET

Mfg. Name_____ Model_____ Size_____

In the space below each unit list other information about the unit.

THE PLANTER

Identify the major parts of the planter

Hitch and Frame
Power Transmission Train
Planter Unit and Gauge Wheel

What row spacings are possible?

Trace power from wheels to all attachments. (sketch if necessary)

List special precautions for transporting.

Describe marker operation.

Check the accessories noted.

___ runner openers
___ disk openers
___ check-row attachment
___ gauge shoes
___ trash kickers
___ multi-luber
___ press wheel scraper
___ press wheel bands
___ rubber press wheel tires
___ covering knives
___ covering disks
___ seed packer wheels
___ minimum tillage attachment
___ dual wheels
___ herbicide attachment
___ insecticide attachment
___ soil incorporating equipment
___ disk marker
___ check-row equipment
___ grass waterway attachment
___ fertilizer attachment
___ other

cut along this line for class use

PLANTING UNIT

Identify all parts in planting unit and describe their function.

What is maximum and minimum distance between hills? Between kernels when drilling?

What maximum and minimum planting rates are possible? (40 in. rows)

How fast can you drive at different planting rates?

How is hill spacing varied?

How are kernels per hill varied?

How is the planter set for drilling?

How is planter set for hill dropping?

How many hill dropping rates are possible?

How is depth of planting controlled?

How is pressure on press wheel adjusted?

What is the capacity of seed hoppers?

How are the seed plates matched to seed?

FERTILIZER ATTACHMENT

Identify all parts of fertilizer attachment and describe their function.

What is the capacity of hoppers? Tanks?

How is the fertilizer attachment engaged?

What are minimum and maximum rates per acre? (40 in. rows)

How is fertilizer applicator calibrated?

How is depth of placement adjusted?

Where can fertilizer be placed in relation to the row?

What daily care is needed?

What maintenance is needed?

INSECTICIDE ATTACHMENT

What care is needed?

What is the range in rate of application per acre?

How is it calibrated?

HERBICIDE ATTACHMENT

What care is needed?

What is the range in rate of application per acre?

How is it calibrated?

LUBRICATION

What are the twice daily lubrication requirements?

What are the daily lubrication requirements?

What are the periodical lubrication requirements?

PRE-SEASON SERVICE CHECK

Is planter lubricated properly?

What tire pressure is recommended?

Are width settings correct? Are markers set to match row widths?

Are seed hoppers and hopper bottoms ready to use?

Does seed fit the seed plates?

Is fertilizer attachment ready for field use?

Are all bolts, nuts, set screws and cotter pins tight?

END - OF - SEASON STORAGE PREPARATIONS

Check for worn, lost, or damaged parts and replace them.

What service should be given fertilizer attachment?

What service should be given insecticide attachment?

What service should be given hoppers and hopper bottoms? Runners?

What protection should be given soil engaging parts?

cut along this line for class use

MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) J. W. Matthews (Agency) Vocational Agriculture Service

(Address) 434 Mumford Hall, Urbana, Illinois 61801

DATE: June 6, 1967

RE: (Author, Title, Publisher, Date) Selecting, Feeding, and Caring for Light Horses, VAS 1040. Urbana, Illinois: Vocational Agriculture Service, University of Illinois. 16p. 1967.

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SELECTING, FEEDING, AND CARING FOR LIGHT HORSES

1. Breeds of Light Horses and Their Characteristics
2. What Should I Look For When Selecting Light Horses?
3. How Should I Feed Light Horses?
4. What Care Should I Give Light Horses?
5. What Buildings and Equipment Are Necessary?

May-67

Horses may be classified as light horses, ponies, or draft horses, according to their size, build, and use.

Light horses stand 14-2 to 17 hands high,* weigh 900 to 1,400 pounds, and are used primarily for riding, driving, or racing, or for utility purposes on the farm. Light horses are usually more rangy and capable of more action and greater speed than draft horses.

Ponies stand under 14-2 hands high and weigh 300 to 900 pounds.

Draft horses stand 14-2 to 17-2 hands high, weigh 1,400 pounds or more, and are used primarily for pulling loads and other heavy work.

1. BREEDS OF LIGHT HORSES AND THEIR CHARACTERISTICS

Some of the light-horse breeds, common to Illinois, are included here. Characteristics of the lesser common breeds may be found in some of the horse publications or from the respective breed associations.

American Saddle Horse (Fig. 1)

Animals of this breed furnish an easy ride with great style and animation. They may be either three or five gaited. Three-gaited horses, by custom, are shown with their manes roached, or clipped short, and the upper part of their tails clipped or sheared close. Five-gaited horses, by custom, are shown with flowing manes and full-length tails. Most of them are 15 to 16 hands high and weigh 1,000 to 1,200 pounds. This breed is noted for a beautiful head carried on a long, graceful neck; short, rounded back; level croup; high-set tail; and proud action.

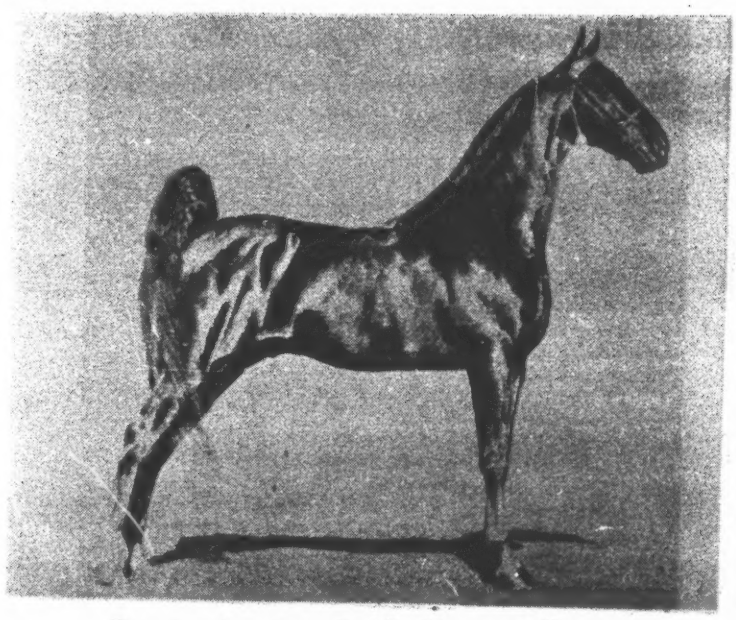

Fig. 1. American Saddle Horse stallion

Arabian (Fig. 2)

Distinctive characteristics of the Arabian breed are medium to small size, beautiful head, short coupling, docility, great endurance, and a gay way of going. The usual height is 14 to 15-1 hands and the weight, 850 to 1,100 pounds. The breed is used primarily for saddle, show, and stock purposes.

*A "hand" is 4 inches. The measurement is taken from the highest point of the withers to the ground when the animal is standing squarely on a level area. A horse measuring 62 inches is said to be 15-2 hands high (15 hands and 2 inches).

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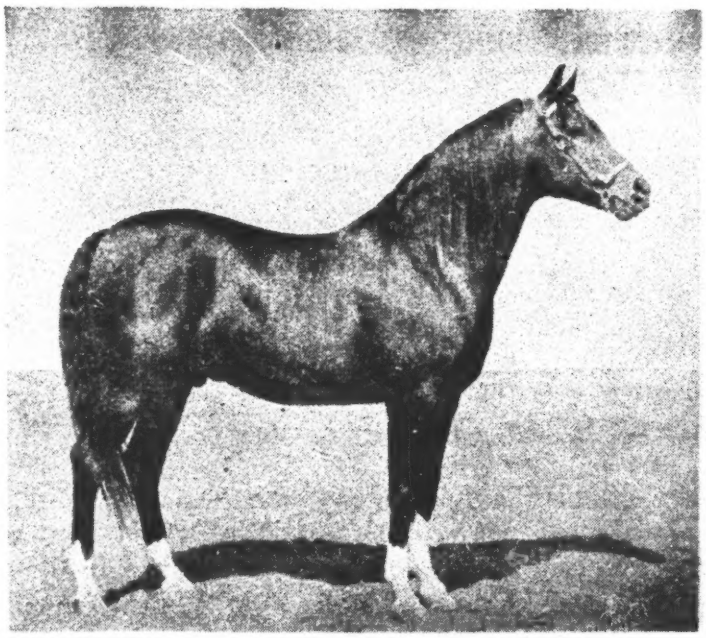

Fig. 2. Arabian stallion

Hackney (Fig. 3)

High natural action is a distinguishing feature of this breed. The Hackney varies more in size than any other breed, ranging from 12 to 16 hands high; the Hackney pony should not exceed 14-2 hands. The Hackney was bred to be a heavy harness horse—a large light horse used for pulling carriages. It has become essentially a show animal. In the show ring, it is customary that heavy harness horses be docked and have their manes pulled.

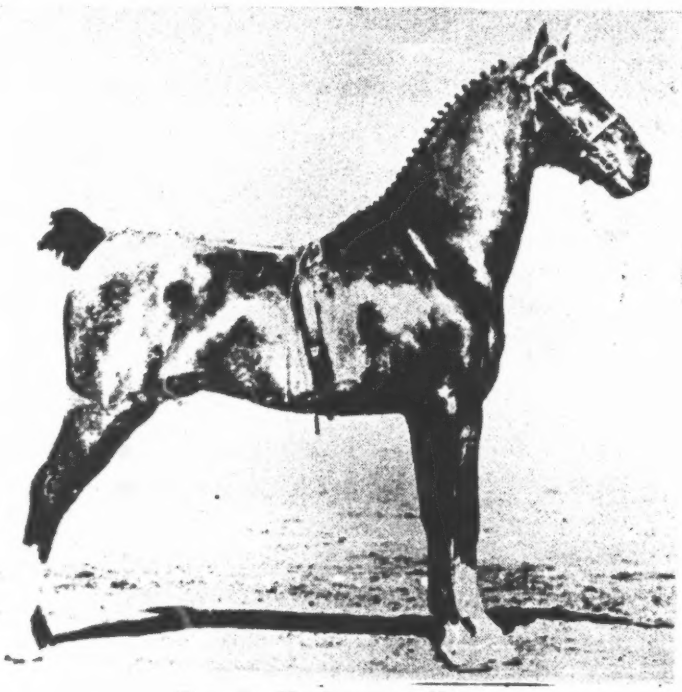

Fig. 3. Hackney stallion

Morgan (Fig. 4)

The Morgan is an American breed that was developed in New England from the stallion

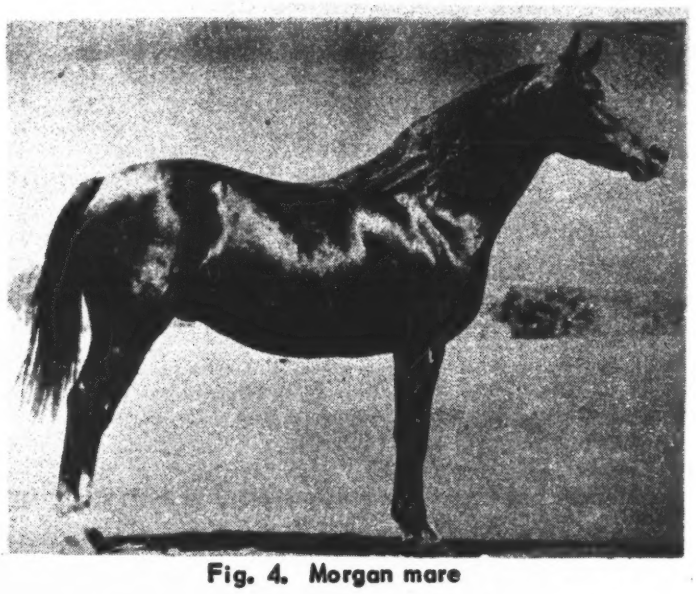

Fig. 4. Morgan mare

Justin Morgan. Very little, unfortunately, is known of his ancestry.

This breed always has been noted for smooth trim lines, good style, easy-keeping qualities, sturdiness, endurance, and docility—the last without sacrifice of spirit and courage. The average height is 15-2 hands and the average weight is 1,050 pounds. Representative animals of the breed, however, may range from 14-2 to 16 hands in height and from 800 to 1,200 pounds in weight.

Palomino (Fig. 5)

Palomino horses must be golden in color and have light-colored manes and tails. White markings on the face or below the knees or hocks are acceptable. The preferred height is 14-2 to 16 hands and the preferred weight, 1,000 to 1,200 pounds.

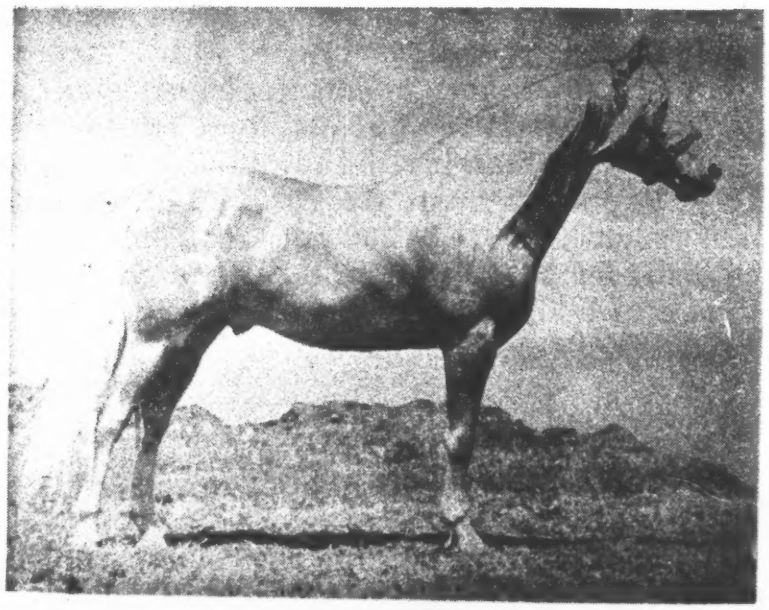

Fig. 5. Palomino stallion

Genetic studies of the Palomino indicate that the color is probably unfixable—that is, it cannot be made true through breeding—no matter how long or how persistent the effort.

Quarter Horse (Fig. 6)

Quarter horses are stout in build, but should not be the extreme "bulldog" type. They seldom exceed 15 hands in height; they weigh 1,000 to 1,200 pounds. The head is somewhat short and is distinctive because of the small, alert ears and heavily muscled cheeks and jaw. Their build makes them ideal stock horses—agile and speedy animals that have enough weight and power to hold heavy steers that have been roped. They have a calm disposition even during a roundup.

Certain families are being selected for great speed at short distances and are being used primarily for racing.

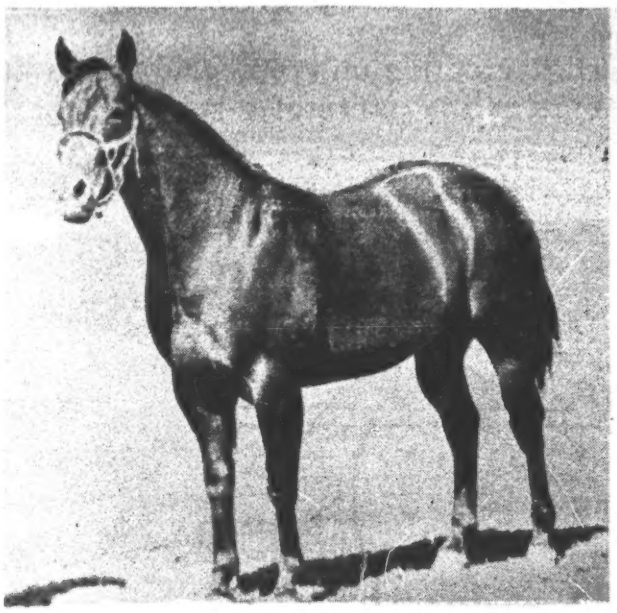

Fig. 6. Quarter Horse stallion

Shetland Pony (Fig. 7)

While ponies are normally classified in a class by themselves, this one breed will be described briefly in this light-horse publication.

Shetland Ponies are less than 11-2 hands in height—most are less than 10-2 hands. There are two distinct types—one resembles a small draft horse and the other a small road-type horse. They may be almost any of the horse colors, both broken and solid. Shetland Ponies are noted for their good dispositions.

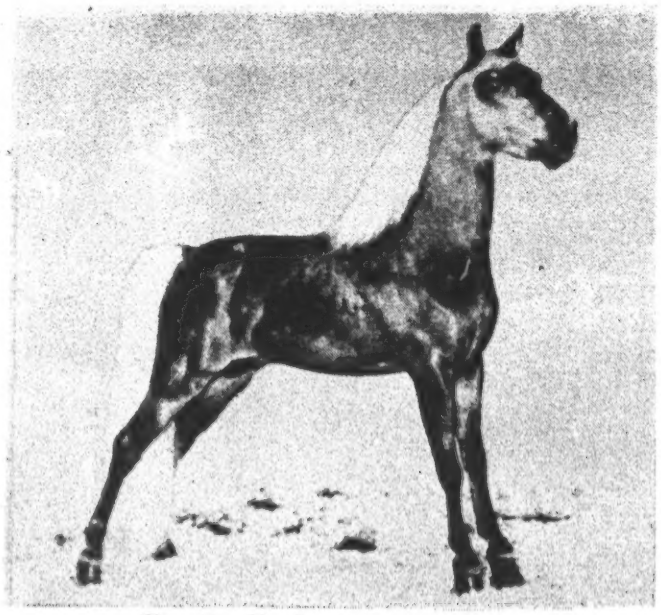

Fig. 7. Shetland Pony stallion

Standardbred (Fig. 8)

While animals of this breed are generally smaller, longer bodied, less leggy, and less refined than Thoroughbreds, they show more substance and ruggedness and have more docile dispositions. They range in weight from 900 to 1,300 pounds, and in height from 15 to 16 hands.

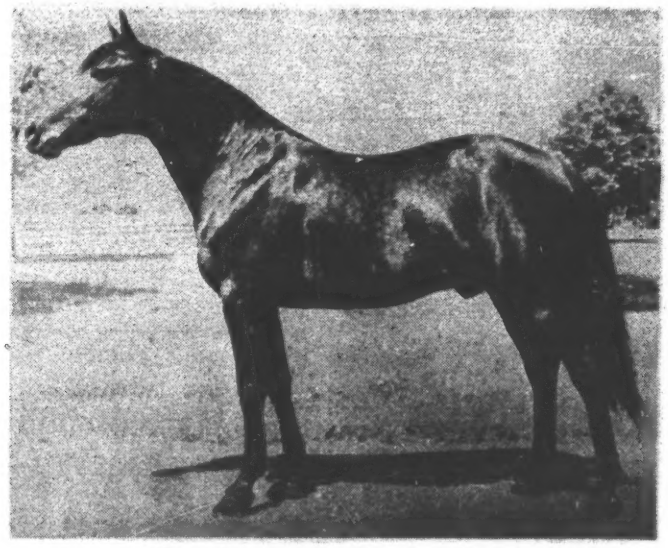

Fig. 8. Standardbred stallion

Thoroughbred (Fig. 9)

Thoroughbreds possess a high degree of quality and refinement and are built for speed. Their bodies are long, deep chested, rather narrow, upstanding, and often a bit angular. They are active, energetic, and nervous. They are 15 to 17 hands high. In racing trim, Thoroughbreds may weigh 900 to 1,025 pounds; stallions in breeding condition may weigh up to 1,400 pounds or more.

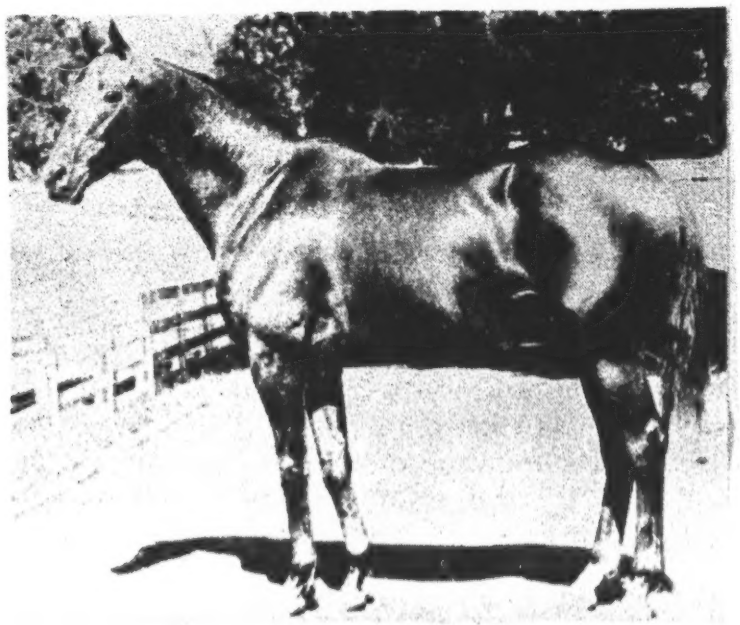

Fig. 9. Thoroughbred stallion

2. WHAT SHOULD I LOOK FOR WHEN SELECTING LIGHT HORSES?

Horses, like other classes of livestock, may be selected on type, pedigree, and/or performance or progeny testing. While the latter two are very important for certain uses, the emphasis in this publication will be on type alone.

When selecting on type, you should know the names of the parts of a horse (Fig. 10),

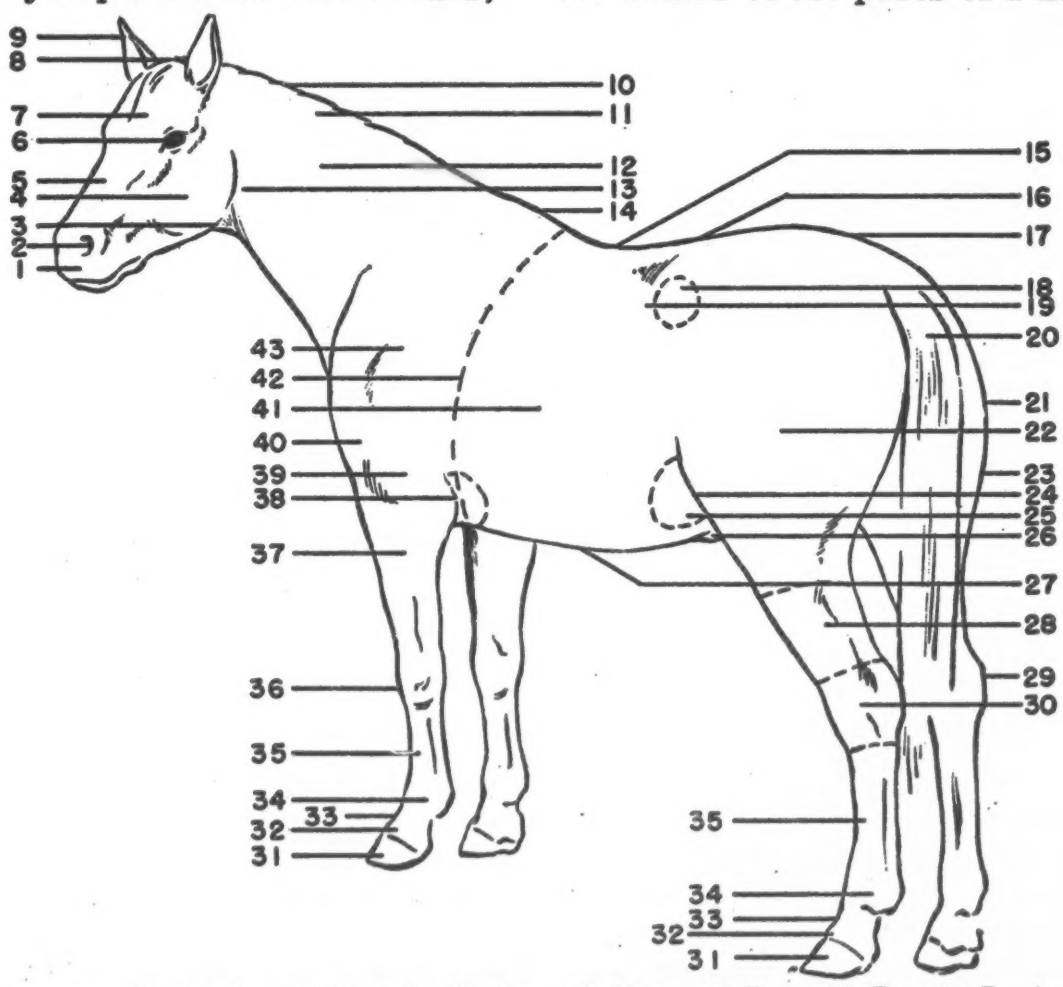

Fig. 10. Parts of a horse. (1) Muzzle, (2) Nostril, (3) Jaw, (4) Cheek, (5) Face, (6) Eye, (7) Forehead, (8) Poll, (9) Ear, (10) Mane, (11) Crest, (12) Neck, (13) Throatlach, (14) Wither, (15) Back, (16) Loin, (17) Croup, (18) Hip, (19) Coupling, (20) Tail, (21) Point of the buttocks, (22) Thigh, (23) Quarter, (24) Stifle, (25) Rear flank, (26) Sheath, (27) Underline, (28) Gaskin, (29) Point of hock, (30) Hock, (31) Foot, (32) Coronet, (33) Pastern, (34) Fetlock, (35) Cannon, (36) Knee, (37) Forearm, (38) Point of elbow, (39) Arm, (40) Point of shoulder, (41) Ribs, (42) Heart girth, (43) Shoulder.

have in mind an image of the ideal-type animal, and be able to compare your animal with the ideal. Some of the characteristics of the ideal type, as well as some of the common faults, are given in Table 1.

Other items to be considered along with type are gaits and certain blemishes and unsoundnesses.

Gaits

A gait is a natural or acquired way of walking or running, characterized by a distinctive rhythmic movement of the feet and legs.

The gaits of light horses, especially show and racing stock, are very important. Three-gaited horses may include the walk, trot, and gallop or the walk, trot, and canter, depending upon the type of horse. Five-gaited horses must perform two additional gaits. A brief description of the most common gaits are as follows:

Walk is a slow, natural gait of four beats in which each foot leaves and strikes the ground at separate intervals (Fig. 11). The walk should be springy, regular, and true.

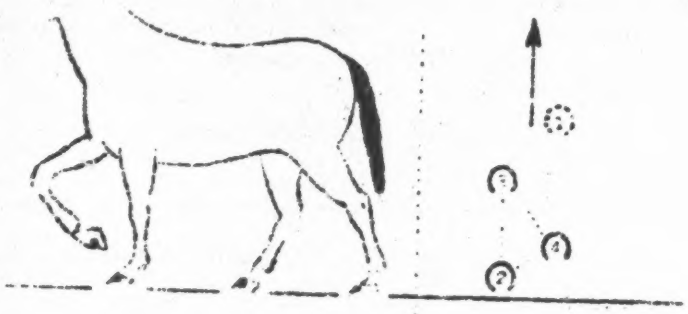

Fig. 11. The walk is the natural, slow gait of horses.

Trot is a rapid, natural two-beat diagonal gait in which the front foot and the opposite hind foot take off together and strike the ground simultaneously (Fig. 12).

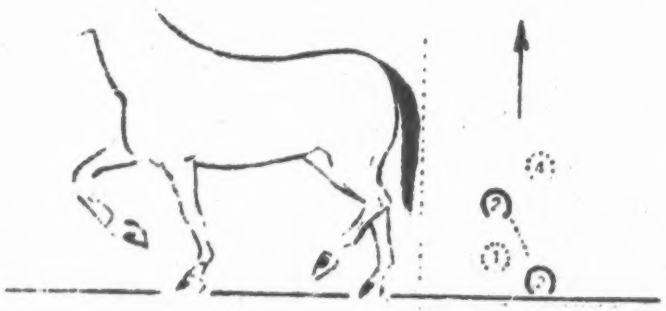

Fig. 12. The trot is the natural, rapid gait of horses.

All four feet are off the ground at the same time for a brief moment, making the horse seem to float through the air.

This gait varies considerably with different breeds. The trot of the Standardbred is characterized by length and rapidity of individual strides, while that of the Hackney shows extreme flexion of the knees and hocks that produces a high-stepping show gait.

Run or gallop is a fast, three-beat gait during which two diagonal legs are paired and strike the ground together between the successive beats of the other two unpaired legs (Fig. 13). All four feet are off the ground for a brief interval. The two unpaired legs that act independently—the forefoot with which the horse leads and the diagonal hindfoot—naturally bear more weight and are subject to more fatigue than the paired legs that act jointly.

In the gallop, propulsion is chiefly in the hindquarters, although the forequarters sustain a tremendous jar as the horse lands. The gallop is the fast natural gait of horses.

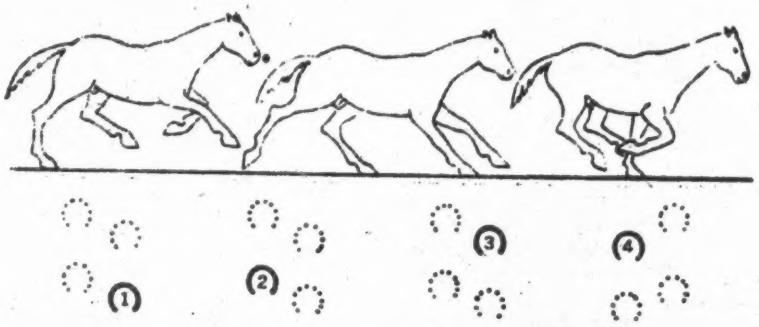

Fig. 13. The gallop is the natural, fast, three-beat gait of horses.

Canter is a slow, restrained gallop or run (Fig. 14). Like the gallop, it is a three-beat gait, and it puts unusual wear on the leading forefoot and its diagonal hindfoot. It is impor-

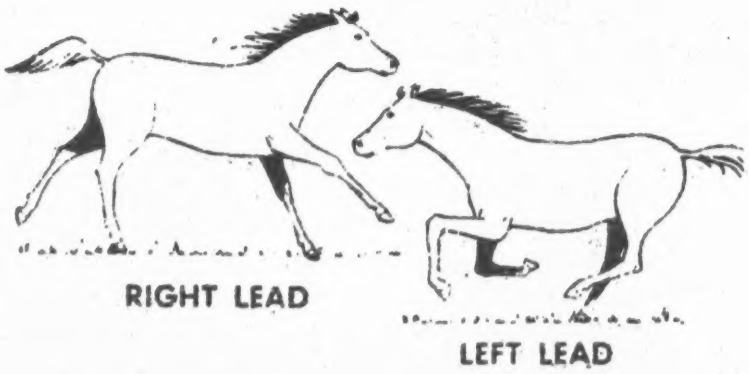

Fig. 14. The canter is a slow, restrained gallop.

Table 1. Light Horse Selection Guide

What to look for	Ideal type	Common faults
Front view:		
1. Head	1. Head well proportioned to rest of body, refined, clean cut, with chiseled appearance; broad, full forehead with great width between eyes; jaw broad and strongly muscled; ears medium size, well carried, and attractive.	1. Plain headed; weak jaw.
2. Femininity or masculinity	2. Refinement and femininity in brood mare;bo ldness and masculinity in stallion.	2. Mares lacking femininity; stallion lacking masculinity.
3. Chest capacity	3. Deep, wide chest	3. Narrow chest.
4. Set of front legs	4. Straight, true, and squarely set front legs	4. Crooked front legs.
Rear view:		
1. Width of croup and through rear quarters.	1. Wide and muscular over croup and through rear quarters.	1. Lacking width and length over croup and muscling through rear quarters.
2. Set of hind legs	2. Straight, true, and squarely set hind legs	2. Crooked hind legs.
Side view:		
1. Style and beauty	1. High carriage of head, active ears, alert disposition, and beauty of conformation.	1. Lacking style and beauty.
2. Balance and symmetry	2. All parts well developed and nicely blended together	2. Lacking in balance and symmetry.
3. Neck	3. Fairly long neck; carried high; clean cut about throat latch; with head well set on.	3. Short, thick neck; ewe necked.
4. Shoulders	4. Sloping shoulders (about a 45° angle)	4. Straight in shoulders.
5. Topline	5. Short, strong back and loin, with long, nicely turned and heavily muscled croup, and high, well-set tail; withers clearly defined and of same height as high point over croup.	5. Sway backed; steep croup.
6. Coupling	6. A short coupling as denoted by last rib being close to hip.	6. Long in coupling.
7. Middle	7. Ample middle due to long, well-sprung ribs	7. Lacking middle.
8. Rear flank	8. Well let down in rear flank	8. High cut rear flank or "wasp waisted."
9. Arm, forearm, and gaskin	9. Well-muscled arm, forearm, and gaskin	9. Light-muscled arm, forearm, and gaskin.
10. Legs, feet, and pasterns	10. Straight, true, and squarely set legs; pasterns sloping about 45°; hoofs large, dense, and wide at heels.	10. Crooked legs; straight pasterns; hoofs small, shelly, and contracted at heels.
11. Quality	11. Plenty of quality, as denoted by clean, flat bone, well-defined joints and tendons, refined head and ears, and fine skin and hair.	11. Lacking quality.
12. Breed type (size, color, shape of body and head, and action) true to breed represented.	12. Showing plenty of breed type	12. Lacking breed type.
Soundness:		
1. Soundness and freedom from defects in conformation that may predispose unsoundness.	1. Sound and free from blemishes	1. Unsound; blemished (wire cuts, capped hocks).
Action:[1]		
1. At walk	1. Easy, prompt, balanced; a long step, with each foot carried forward in a straight line; feet lifted off ground.	1. Short step, with feet not lifted off ground.
2. At trot	2. Rapid, straight, elastic trot with joints well flexed	2. Winging, forging, and interfering.
3. At canter	3. Slow, collected canter, which is readily executed on either lead.	3. Fast and extended canter.

[1] The 3 most common gaits are given here. Five gaited horses must perform 2 additional gaits. In selecting for gait, (1) observe horse at each intended gait, and (2) examine trained horses while performing at use for which they are intended.

tant to frequently change the lead. A well-trained horse will do this easily at the will of the rider.

In the show ring, the lead should be toward the inside of the ring, and the lead is changed by reversing direction of travel (when the ringmaster calls for "reverse and canter"). This gait should be executed in such a slow collected manner that the animal may perform in a relatively small circle.

Pace is a fast two-beat gait in which the front and hind feet on the same side start and stop together (Fig. 15). The feet rise just above the ground level. All four feet are off the ground for a split second and the horse appears to float forward.

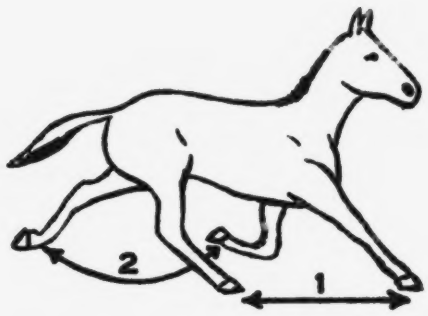

Fig. 15. The pace is a fast, two-beat gait.

The pace is faster than the trot but slower than the run or gallop. It allows for a "quick getaway" but it produces an objectionable side or rolling type of motion. This gait is not suited to travel in mud or snow; a smooth, hard footing and easy draft are necessary for its best execution.

The pace once was popular in England but lost in favor soon after the development of the Thoroughbred early in the eighteenth century.

Rack is a fast, brilliant, flashy, unnatural, four-beat gait in which each foot strikes the ground separately at equal intervals; known originally as the "single foot." The rack is easy on the rider but hard on the horse. It is, undoubtedly, the most popular and flashy gait in the American show ring. On the tanbark, greater speed at the rack is requested with the command "rack on."

Defects in movement

The feet of a horse should move straight ahead parallel to an imaginary center line drawn in the direction of travel. Any movement other than this may be considered a defect.

Some defects are:

Cross-firing. A "scuffing" on the inside of the diagonal forefeet and hindfeet. This is generally confined to pacers.

Dwelling. A noticeable pause in the flight of the foot, as though the stride was completed before the foot reaches the ground. This is most noticeable in trick-trained horses.

Forging. Striking forefoot with toe of hindfoot.

Interfering. Striking fetlock or cannon with the opposite foot. This is most often done by base-narrow, toe-wide, or splay-footed horses.

Lameness is a defect noticeable by an animal favoring an affected foot when standing. The animal also attempts to ease the load on the ailing foot in walking and the characteristic bobbing of the head occurs as the affected foot strikes the ground.

Paddling is the throwing the front feet outward as they are picked up. This is most common in toe-narrow or pigeon-toed horses.

Pounding is a heavy contact with the ground instead of desired light, springy movement.

Rolling is an excessive lateral shoulder motion, characteristic of horses with protruding shoulders.

Scalping. The hairline at top of hindfoot hits toe of forefoot as it breaks over.

Speedy cutting. The inside of diagonal fore and hind pastern make contact, as sometimes seen in fast-trotting horses.

Stringhalt. Excessive flexing of hind legs. This is most easily detected when a horse is backed.

Trappy. A short, quick, choppy stride. This is a tendency of horses with short, straight pasterns and straight shoulders.

Winging is an exaggerated paddling, particularly noticeable in high-going horses.

Blemishes and unsoundnesses

Anything abnormal about the body or movement of a horse may be considered an unsound-

ness. From a practical standpoint, however, abnormalities may be divided between those that do and those that do not affect serviceability.

Blemishes include the abnormalities that do not affect serviceability—such as wire cuts, rope burns, nail punctures, shoe boils, or capped hocks.

Unsoundnesses include more serious abnormalities that affect serviceability. Fig. 16 shows the location of common blemishes and unsoundnesses.

Consider the use to which you intend to put the animal before you buy a blemished or unsound horse.

Stable vices

Stable vices are bad habits of the horse in confinement. They may detract from the value of the animal.

Cribbing. A horse that bites or sets his teeth against the manger or some other object while sucking air is said to be cribbing. This causes hard keeping and a bloated appearance. Horses with this vice are subject to colic.

A common remedy for cribbing is a strap buckled snugly around the horse's neck in a way that will compress the larynx when the head is flexed, but that will not cause any discomfort when the horse is not indulging in the vice.

Halter pulling. This term is applied to a tied horse that pulls back on its halter rope.

Kicking. A true stable kicker apparently kicks just for the satisfaction it gets out of striking something with its hind feet. Unusual excitement or injury may cause a gentle horse to kick.

Tail rubbing. Persistent rubbing of the tail against the side of the stall or some other object is objectionable. Parasites, such as lice or rectal worms, may cause this. A "tail board" or parasite control helps break animals of this habit. A tail board is a board projecting from the wall of the stall high enough to strike just below the point of the buttock, instead of the tail, of the rubbing horse.

Bolting. Horses that eat too rapidly are said to be "bolting." This can be controlled by adding chopped hay to the animal's grain ration, or by putting stones as big as baseballs in its feed box.

Weaving. A horse's rhythmic swaying back and forth while standing in the stall is known as weaving.

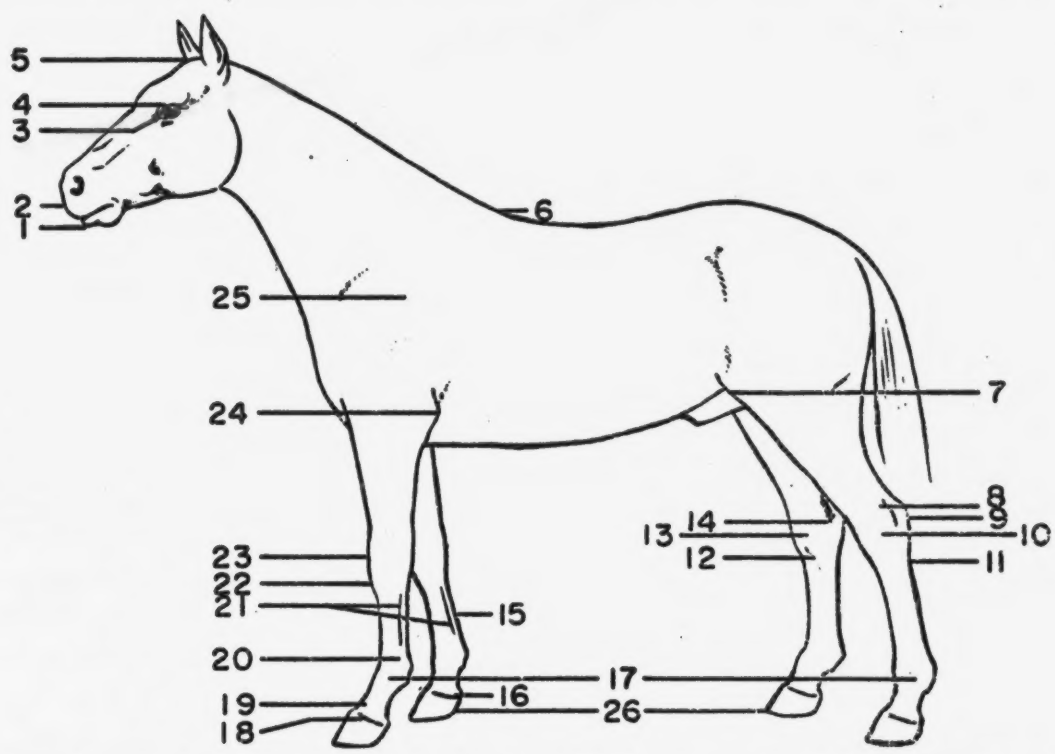

Fig. 16. Common unsoundnesses in horses. (1) Undershot jaw, (2) Parrot mouth, (3) Blindness, (4) Moon blindness, (5) Poll evil, (6) Fistulous withers, (7) Stifled, (8) Thoroughpin, (9) Capped hock, (10) Stringhalt, (11) Curb, (12) Bone spavin or jack, (13) Bog spavin, (14) Blood spavin, (15) Bowed tendons, (16) Sidebones, (17) Cocked ankles, (18) Quitter, (19) Ring bone, (20) Windpuffs, (21) Splints, (22) Knee sprung, (23) Calf kneed, (24) Capped elbow, (25) Sweeney, (26) Contracted feet, corns, founder, thrush, quarter or sand crack, scratches, or grease heel, (General) Heaves, hernia, roaring, or thick wind.

Other vices. Other vices that may be difficult to cope with, especially in older animals, are: balking, backing, rearing, shying, striking with the front feet, a tendency to run away, and objecting to harnessing, saddling, or grooming. Many of these bad habits are caused by incompetent handling, however.

3. HOW SHOULD I FEED LIGHT HORSES?

Feeding practices vary from one locality to another—and even among horsemen. The size of individual horses, the use to which they are put, and the size of the enterprise also makes a difference.

Feeds

Because horses have small digestive tracts, they cannot eat as much roughage as cattle. Feeds should be selected that will provide energy but not add surplus body weight or large, paunchy stomachs.

A light-horse feeding guide is given in Table 2. In selecting rations, compare them with commercial feeds. If you use small quantities or have little storage room, you may find it more satisfactory to buy ready-mixed feeds.

More than one kind of hay makes for variety and appetite appeal. In season, any good pasture can replace part or all of the hay unless work or training conditions make substitution impractical.

Good-quality oats and timothy hay have always been considered standard feeds for light horses. Feeds of similar nutritive properties can be interchanged in the ration as price relationships warrant. This makes it possible to obtain a balanced ration at lowest cost. Some of these feeds are grains (oats, corn, barley, wheat, and sorghum), protein supplements (linseed meal, soybean meal, and cottonseed meal), and hays of many varieties.

During winter months, add a few sliced carrots to the suggested ration, an occasional bran mash, or a small amount of linseed meal. Also, use bran mash or linseed meal to regulate the bowels.

The proportion of concentrates should be increased and the roughages decreased as energy needs rise with the greater amount, severity, or speed of work. A horse that works at a trot needs considerably more feed than one that works at a walk. For this reason, draft animals that perform most of their work at a walk, require somewhat less grain and more hay in proportion to body weight than light horses that travel faster. Also, from an esthetic standpoint, large stomachs that result from high roughage rations are less objectionable on draft animals than on light horses.

The rations given in Table 2 are suited equally to light horses, draft horses, and mules. For light horses, use the upper limits of grain and the lower limits of hay. Keep the total allowance of concentrates and hay within the range of 2.0 to 2.5 pounds daily per 100 pounds live weight.

Minerals

The common horse ration of grass, grass hay, and farm grains is usually deficient in calcium, but adequate in phosphorus. Also, salt is almost always deficient, and many horse rations do not contain sufficient iodine. Thus, horses usually need special mineral supplements.

On the average, a horse will consume about 3 ounces of salt daily or 1 1/3 pounds per week, although the salt requirements vary with work and temperature.

The salt requirements, and any calcium or phosphorus requirements not met by feeds, can best be supplied by allowing free access to a two-compartment box containing minerals. One compartment should have salt (iodized in iodine-deficient areas), and the other should contain a mixture of 2 parts steamed bone meal (or other calcium-phosphorus supplement) and 1 part salt (the salt is for palatability). It is important, however, that the Ca/P ratio of horse rations be maintained at not less than 1:1. Narrower ratios may cause osteomalacia (softening of the bones) in mature

Table 2. Light Horse Feeding Guide

Age, sex, and use	Daily allowance	Kind of hay	Suggested grain rations		
			Rations No. 1	Rations No. 2	Rations No. 3
Stallions in breeding season (weighing 900 to 1,400 pounds).	¾ to 1½ pounds grain per 100 pounds live weight, together with a quantity of hay within same range.	Grass-legume mixed; or ⅓ to ½ legume hay, with remainder grass hay.	*Pounds* Oats 55 Wheat 20 Wheat bran 20 Linseed meal 5	*Pounds* Corn 35 Oats 35 Wheat 15 Wheat bran 15	*Pounds* Oats (alone).
Pregnant mares (weighing 900 to 1,400 pounds).	¾ to 1½ pounds grain per 100 pounds live weight, together with a quantity of hay within same range.	Grass-legume mixed; or ⅓ to ½ legume hay, with remainder grass hay (straight grass hay may be used first half of pregnancy).	Oats 80 Wheat bran 20	Barley 45 Oats 45 Wheat bran 10	Oats 95 Linseed meal 5
Foals before weaning (weighing 100 to 350 pounds with projected mature weights of 900 to 1,400 pounds).	½ to ¾ pound grain per 100 pounds live weight, together with a quantity of hay within same range.	Legume hay.	Oats 50 Wheat bran 40 Linseed meal 10	Oats 30 Barley 30 Wheat bran 30 Linseed meal 10	Oats 80 Wheat bran 20
			Rations balanced on basis of following assumption: Mares of mature weights of 600, 800, 1,000, and 1,200 pounds may produce 36, 42, 44, and 49 pounds of milk daily.		
Weanlings (weighing 350 to 450 pounds).	1 to 1½ pounds grain and 1½ to 2 pounds hay per 100 pounds live weight.	Grass-legume mixed; or ⅓ to ½ legume hay, with remainder grass hay.	Oats 30 Barley 30 Wheat bran 30 Linseed meal 10	Oats 70 Wheat bran 15 Linseed meal 15	Oats 80 Linseed meal 20
Yearlings, 2d summer (weighing 450 to 700 pounds).	Good, luxuriant pastures (if in training or for other reasons without access to pastures, the ration should be intermediate between the adjacent upper and lower groups).				
Yearlings, or rising 2-year-olds, 2d winter (weighing 700 to 1,000 pounds).	½ to 1 pound grain and 1 to 1½ pounds hay per 100 pounds live weight.	Grass hay.	Oats 80 Wheat bran 20	Barley 35 Oats 35 Bran 15 Linseed meal 15	Oats (alone).
Light horses at work; riding, driving, and racing (weighing 900 to 1,400 pounds).	*Hard use.*—1¼ to 1⅓ pounds grain and 1 to 1¼ pounds hay per 100 pounds live weight. *Medium use.*—¾ to 1 pound grain and 1 to 1¼ pounds hay per 100 pounds live weight. *Light use.*—⅖ to ½ pound grain and 1 to 1¼ pounds hay per 100 pounds live weight.	Grass hay.	Oats (alone).	Oats 70 Corn 30	Oats 70 Barley 30
Mature idle horses; stallions, mares, and geldings (weighing 900 to 1,400 pounds).	1½ to 1¾ pounds hay per 100 pounds live weight.	Pasture in season; or grass-legume mixed hay.	(With grass hay, add ¾ pound of a high protein supplement daily.)		

Note: With all rations and for all classes and ages of horses, provide free access to separate containers of (1) salt (iodized salt in iodine-deficient areas) and (2) a mixture of 1 part salt and 2 parts steamed bone meal or other suitable calcium-phosphorus supplement.

horses. The latter condition may develop when rations with a Ca/P ratio of 0.8 to 1 are fed 6 to 12 months, and it will progress rapidly when the ratio is 0.6 to 1.

A good commercial mineral mixture may be fed if desired.

Vitamins

Certain vitamins are necessary to the growth, development, health, and reproduction of horses. The vitamins most commonly deficient are A and D. Also, indications are that vitamin E and some of the B vitamins (riboflavin and perhaps thiamine) are required by the horse. While these are all necessary for proper health, vitamin deficiencies in horses are the exception rather than the rule.

High-quality, leafy, green forages plus plenty of sunshine usually gives horses all the vitamins they need. Horses get carotene (which the animal can convert to vitamin A) and riboflavin from green pasture, (not over a year old), and grass or legume silage. They get vitamin D from exposure to sunlight, and from feeding on sun-cured hay.

Severe deficiency of vitamin A may cause night blindness, reproductive difficulties, poor or uneven hoof development, respiratory symptoms, and incoordination. There is also some evidence that deficiency of this vitamin may cause or contribute to certain leg bone weaknesses. When any of the deficiency symptoms appear, add dehydrated alfalfa or grass or a vitamin A supplement to the ration.

A deficiency in vitamin D, calcium, or phosphorus may cause rickets in foals. This can be prevented by exposing the animal to direct sunlight as much as possible, by allowing it free access to a suitable mineral mixture, or by providing it good-quality, sun-cured hay or lush pasture grown on well-fertilized soils. In northern areas lacking in adequate sunshine, many horsemen add a vitamin D supplement, such as cod liver oil or irradiated yeast, to the foals' ration.

Horses seem to require vitamin E, but most practical rations contain sufficient quantities of it. Rather than buy and use costly vitamin E concentrates because of a possible deficiency, add them to the ration only on the advice of a competent nutritionist or veterinarian.

Under some conditions, there is evidence that alpha tocopherol succinate (a relatively stable form of vitamin E) is effective in (1) increasing the conception rate of mares; (2) improving the breeding behavior, sex drive, sperm quality, and condition of stallions; and (3) improving the stamina, temperament, feed consumption, and track performance of racehorses. Where needed, the recommended daily doses of alpha tocopherol succinate in the feed are: Stallions and brood mares, 600 to 1,000 I.U. beginning a few weeks before breeding; and racehorses in training, 2,000 I.U.

A deficiency of riboflavin may cause moon blindness (periodic ophthalmia), but this is not the only factor in producing the condition (sometimes moon blindness follows leptospirosis in horses). Prevent moon blindness, caused by lack of riboflavin, by feeding green hays and green pastures, feeds high in riboflavin, or by adding crystalline riboflavin to the ration at the rate of 40 mg. per horse per day. A thiamine deficiency has been observed in horses fed on poor-quality hay and grain. Although thiamine is synthesized in the lower gut, the amount absorbed may not always meet the full requirements. Other vitamins of the B complex may be essential. Healthy horses usually get enough of them either in natural rations or by synthesis in the intestinal tract, primarily the caecum. When neither green pasture nor high-quality dry roughage is available, B vitamins may be provided by adding distiller's dried solubles, dried brewer's yeast, or animal liver meal to the ration.

Water

Horses should have ample quantities of clean, fresh, cool water. They will drink 10 to 12 gallons daily—the amount depending on the weather, amount of work done, and rations fed.

Free access to water is desirable. When this is not possible, water horses at approximately the same time each day.

Opinions vary as to the proper time and method of watering horses, but all agree that regularity and frequency are desirable. Most horsemen, however, agree that water may be given either before, during, or after feeding.

Frequent, small waterings between feedings are desirable during warm weather, or when the animal is being put to hard use. Do not allow a horse to drink heavily when he is hot, because he may founder. Do not allow a horse to drink a large amount of water just before going to work.

Pastures

Good pasturage is the cornerstone of successful horse production. Great horse-breeding centers are characterized by lush pastures produced on fertile soils. In season, there is no finer forage for horses.

A temporary pasture grown in a regular crop rotation is preferable to a permanent pasture that may be parasite infested.

Since horses are less likely to bloat than cattle or sheep, legume pastures are excellent for them. Specific grass or grass-legume mixtures vary widely from one area to another according to differences in soil, temperature, rainfall, and other natural factors.

Be sure horse pastures are well drained, that shade, water, and minerals are available, and that pits, stumps, poles, tanks, and places dangerous to horses are guarded.

4. WHAT CARE SHOULD I GIVE LIGHT HORSES?

Care of the feet

The value of a horse lies chiefly in its ability to move—hence the saying, "No foot, no horse." The important points in the care of a horse's feet are to keep them clean, prevent them from drying out, and trim them so they retain proper shape and length. The names of the parts of a horse's foot are shown in Fig. 17.

Clean the horse's feet regularly, with the hoof pick. Work from the heel toward the toe. Be sure to clean out the depressions between the frog and bars. While you are cleaning the feet, also inspect for loose shoes and thrush. Thrush is a disease of the foot, characterized by a pungent odor. It causes a softening of tissues in the cleft of the frog or in the junction between the frog and bars. This disease produces lameness and, if not treated, can be serious.

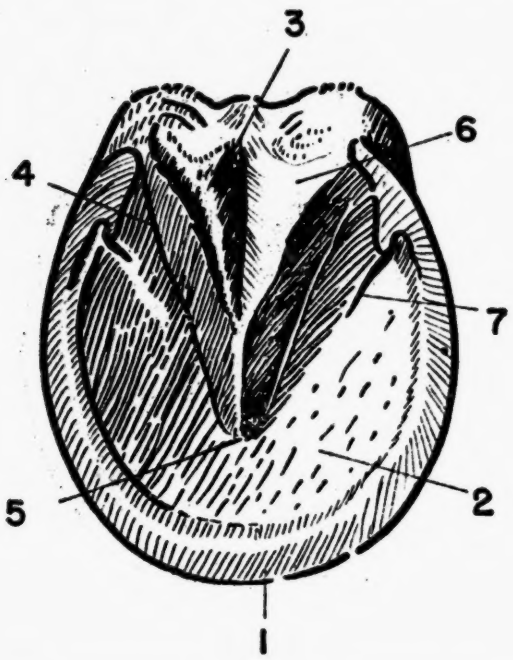

Fig. 17. The parts of the foot of the horse are: (1) Bearing edge of the hoof wall. (2) Sole. (3) Median furrow of the frog. (4) Lateral Furrow of the frog. (5) Apex of the frog. (6) Branch of the frog. (7) Bar.

Hoofs which occasionally become dry and brittle, may split and produce lameness. The frog loses its elasticity and is no longer effective as a shock absorber. If the dryness is prolonged, the frog shrinks in size and the heel contracts. Prevent such drying by wetting the ground around the watering tank. If the hoofs of a shod horse become too dry, either pack them in wet clay once or twice a week after the horse has been used or attach burlap sacks around them. Keep the sacks moistened. A leather sole with tar and oakum packing beneath it may be used unless the horse travels over cinders. After the hoof has absorbed enough moisture, brush on a hoof dressing, such as neat's-foot oil, sweet oil, or linseed oil. Remove the oil before soaking again.

Trim the feet so that the horse stands square and plumb. This will prevent strain on the tendons and help prevent deformity, improper action, and unsoundness.

The healthy hoof grows 3/8 to 1/2 inch per month. If the hoof is not trimmed, the

wall will break off and will not wear evenly. To prevent this, trim the hoofs regularly, about once a month, whether the horse is shod or not. Use nippers to trim off the horn. Then, level the wall with a rasp.

Fig. 18 shows the proper posture of the hoof and incorrect postures caused by hoofs grown too long either in toe or heel. The slope is considered normal when the toe of the hoof and the pastern have the same direction. This angle should be kept always in mind and changed only as a corrective measure. If it should become necessary to correct uneven wear of the hoof, correct gradually over a period of several trimmings.

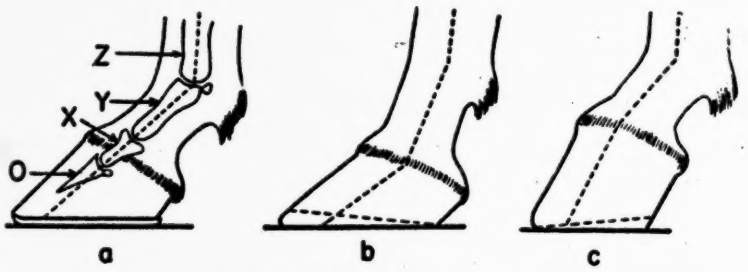

Fig. 18. (a) Hoof that is properly trimmed with a normal food aris: O is coffin bone; X is short pastern bone; Y is long pastern bone; and Z is cannon bone. (b) Toe is too long, causing the foot axis to break backward. (c) Heel is too long, causing the foot axis to break forward.

Trim the hoof near the level of the sole. Otherwise, it will split off if the horse remains unshod. Trim the frog carefully. Remove any ragged edges that might allow filth to accumulate in the crevices. Trim the sole sparingly, if at all.

Never rasp the walls of the hoof. This removes the periople, or thin varnishlike outer layer provided by nature as a protective coating that prevents evaporation.

Shoe horses to be used on hard surfaces to prevent the wall from wearing down to the sensitive tissues beneath. A correctly shod horse is a more efficient performer. Shoes may be used to change gaits and action, to correct faulty hoof structure or growth, and to protect the hoof itself from such conditions as corns, contraction, or cracks.

Racing "plates" are used on running horses to aid in gripping the track.

Reshoe or reset shoes at 4- to 6-week intervals. Shoes that are left on too long, may cause the hoofs to grow out of proportion. This may throw the horse off balance.

An unshapely hoof causing uneven wear may cause foals to grow unsound limbs. Faulty limbs may be helped or even corrected by regular and persistent trimming. This practice also tends to educate the foal, making it easier to shoe at maturity. If the foal is run on pasture, you may need to trim the feet long before weaning time. Check the feet every 4 to 6 weeks. Trim a small amount each time rather than an excessive amount at longer intervals.

Before trimming the feet, inspect the foal while it is standing squarely on a hard surface. Then watch it walk and trot. Careless trimming may strain the foal's tendons.

Some common faults that may be corrected by trimming are:

Splayfoot (front toes turned out, heels turned in) can be helped or corrected by trimming the outer half of the foot.

Pigeon Toe (front toes turned in, heels turned out—opposite of splayfoot) can be helped or corrected by trimming the inner half of the foot more than the outer half.

Quarter Crack (a vertical crack on the side of the hoof) usually can be corrected if the hoof is kept moist and the toes shortened.

Cocked ankles (standing bent forward on the fetlocks—usually hind fetlocks) can be helped or corrected by lowering the heels. Cocked ankles will not occur if foals are allowed to get ample exercise and are not overfed, and the foal's heels are kept trimmed so that there is plenty of frog pressure.

Contracted heels (close at heels) can be spread apart if the heels are lowered and the frog allowed to carry more of the animal's weight.

Bedding

Select bedding material by availability and price, absorptive capacity, and potential value as a fertilizer. Bedding should not be dusty, too coarse, or too easily kicked aside.

Cereal straw or wood shavings usually make the best bedding material.

A soft, comfortable bed should insure proper rest. The animal will be much easier to groom if its bedding is kept clean.

A minimum daily allowance of clean bedding is 10 to 15 pounds per animal.

Exercise

Let your horses exercise as much as possible on pasture. They will develop strong, sound feet and legs from outdoor exercise. If no pasture is available, exercise mature animals for an hour or two a day under the saddle or in harness.

Horses with bad feet or faulty tendons may not be able to exercise on roads or under the saddle. Allow such animals to exercise in a large paddock, or on a 30- or 40-foot rope, or by leading.

5. WHAT BUILDINGS AND EQUIPMENT ARE NECESSARY?

Buildings and equipment for horses should be adequate, but need not be elaborate.

Fences

A preferred type of horse fence is constructed of poles or of 2-inch lumber. Avoid poles or lumber with projections that can cause injury.

Woven wire, or a combination of woven wire with one or more barbed wires at the top, may be used when the enclosure is not crowded. Barbed wire fence, however, is always hazardous to horses.

Stable

One or two riding horses can be stabled in a barn with other animals, or in a building used primarily for storage. Figs. 19 and 20 show one design of a building for light horses. Working drawings of this or a similar barn may be obtained from the Agricultural Engineering Dept. at the University. Table 3 gives some average dimensions of stalls, mangers, etc.

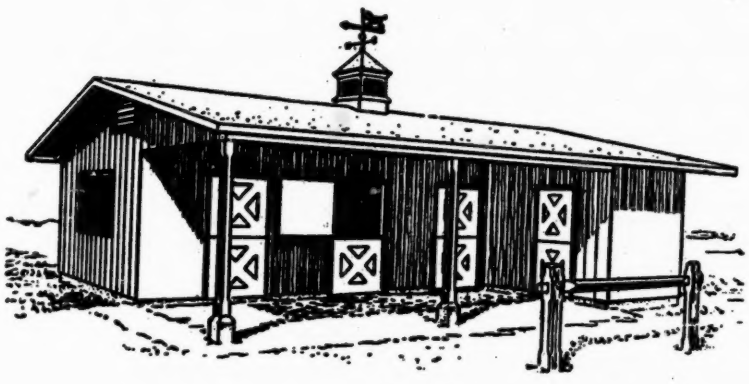

Fig. 19. One design of a light-horse barn.

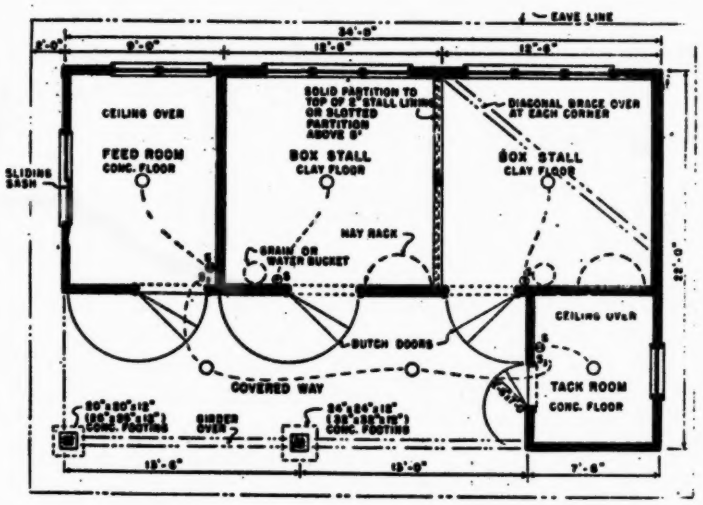

Fig. 20. Plan for barn shown in Fig. 19.

Table 3. Space Requirements of Buildings and Equipment for Horses

Type and age of animal	Stalls					Hay manger		Grain box				Water
	Dimensions tie stall, including manger	Dimensions box stall, including manger	Height of ceiling	Height of doors	Width of doors	Width	Height at throat	Width	Length	Depth of sides	Height at throat	Per head per day
Mature animals (mare or gelding).	5′ wide; 12′ to 14′ long.	10′ x 10′ to 12′ x 12′.	8′ to 12′.	8′	4′	28″	38″ to 42″.	12″ to 16″.	24″ to 30″.	8″ to 10″.	38″ to 42″.	12 gallons.
Brood mares	----------	12′ x 12′ or larger.	do	do	do	do	do	do	do	do	do	Do.
Foals to 2-year-olds.	----------	10′ x 10′	do	do	do	24″	32″ to 36″.	10″ to 16″.	do	6″ to 8″.	32″ to 36″.	6 to 8 gallons.
Stallions [1]	----------	14′ x 14′	do	do	do	28″	38″ to 42″.	12″ to 16″.	do	8″ to 10″.	38″ to 42″.	12 gallons.

[1] Stallions either should be worked daily or provided with a 2- to 4-acre grassy paddock.

This unit was taken primarily from U. S. Dept. Agr. Farmers' Bul. 2127, "Light Horses."

NOTES and REFERENCES

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Foreword

The Vocational Curriculum Development and Research Center annually publishes a catalog of materials which are available to the state vocational-technical and trade schools of Louisiana.

This catalog is divided into four sections, Trade Preparatory Training Courses, Apprentice Training Courses, Trade Extension Training Courses and Supervisory Personnel Development Courses. Each course is described as to its format, how it is to be ordered, what instructors aids are available, the required bibliography, and a detailed outline of the material.

The catalog is punched for a three ring binder. It is recommended that it be placed in a binder so that new material can be readily added or revised material be replaced conveniently.

We hope this material will be of use to the various schools.

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9. Introduction to Management
10. Listening
11. Report Writing
12. Understanding Human Nature
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The Auto Mechanics Course (Trade Preparatory) was published in 1948-49 and was revised in 1955, 1958 and again in 1963. This course is available in loose form with the Related Study Assignment, Job and Math stapled together and in book form.

Book I	
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Book IV	Units XVI - XX

Answer Book
Complete for Units I - XX

The following Instructor's Aids are available:
Progress Chart
Individual folder type

The references for the Auto Mechanics (Trade Preparatory) Course are the following:

Title	Source
GENERAL REPAIR TOOLS FOR AUTOMOBILE MECHANICS	Delmar Publishers Inc. Mountainview Avenue Albany 5, New York
Glenn, Harold T. AUTOMECHANICS	Charles A. Bennett Co., Inc. 237 N. Monroe Street Peoria, Illinois
Crouse, William H. AUTOMOTIVE MECHANICS 3rd and 4th Editions	McGraw-Hill Book Co. 330 West 42nd Street New York 36, New York

References (Continued)

Title	Source
MOTOR SERVICE'S AUTOMOTIVE ENCYCLOPEDIA	Goodheart-Willcox Co. 1322 South Wabash Ave. Chicago 5, Illinois
BARRETT BRAKE SERVICE, BOOK I	Barrett Brake Equipment 21st and Cass St. Louis, Missouri
Stockel, Martin W. AUTO MECHANICS FUNDAMENTALS	Goodheart-Willcox Co. 18250 Harwood Ave. Homewood, Illinois
Stieri BASIC WELDING PRINCIPLES	Prentice-Hall Englewood Cliffs New Jersey

A detailed outline of the Auto Mechanics Course (Trade Preparatory) follows:

Unit I - Benchwork

Math	1	Addition of Whole Numbers
Math	1A	Subtraction of Whole Numbers
Math	1B	Linear Measurement
R.S.A.	1	Hand Tools and How to Use
Job	1	Identify Assigned Tools
Math	2	Scale Practice
R.S.A.	2	Bolts and Nuts Specifications
Job	2	Identify Bolts and Nuts
Math	3	Addition of Scale Measurements
R.S.A.	3	Files and Filing
Job	3	Make a Drill Gauge
Math	4	Subtraction of Scale Measurements
R.S.A.	4	Twist Drills
Job	4	Sharpen a Twist Drill
Math	5	Multiplication of Whole Numbers
R.S.A.	5	Drilling and Tapping
Job	5	Reading the Micrometer
Job	5A	Make Internal Thread Block
Math	6	Division of Whole Numbers
R.S.A.	6	Threading
Job	6	Make a Stud
Math	7	Reducing Fractions to Lowest Terms
R.S.A.	7	Installing Studs and Removing Broken Studs
Job	7	Remove Broken Stud by Drilling
Job	7A	Remove Broken Stud with Extractor
Job	7B	Repair Damaged Threads by Installing Heli-coil

Unit I - Benchwork (Continued)

Math	8	Changing Improper Fractions to Mixed Numbers
R.S.A.	8	Solder, Soldering, and Soldering Coppers
Job	8	Soldering
Job	8A	Make a Bolt and Nut Tray
Job	8B	Wire Splicing and Soldering
Math	9	Changing Mixed Numbers to Improper Fractions
R.S.A.	9	Grinding a Screwdriver
Job	9	Grind a Screwdriver
R.S.A.	10	Tubing
R.S.A.	10A	Flex Tubing (Hose)
Job	10	Tubing, Cutting, Flaring, and Bending

Unit II - Preventive Maintenance

R.S.A.	1	Lubricating Oils
Job	1	Drain Crankcase and Refill
R.S.A.	2	Engine Lubrication
Job	2	Remove and Replace Element in Oil Filter
R.S.A.	3	Air Cleaners
Job	3	Remove, Clean, Refill, and Replace Air Cleaner
R.S.A.	4	Lubrication
Job	4	Lubricate Automobile

Unit III - Front and Rear Wheel Service

R.S.A.	1	Front Wheel Service
Job	1	Remove, Lubricate, and Adjust Front Wheel Bearing
R.S.A.	2	Grease Seals and Rear Wheel Bearings
Job	2	Remove and Install Rear Wheel Bearings and Grease Seal

Unit IV - Shock Absorbers and Springs

R.S.A.	1	Operating Principles of Shock Absorbers and Stabilizer
Job	1	Remove and Replace a Direct-Acting Type Shock Absorber
Job	1A	Remove and Replace Stabilizer
R.S.A.	2	Springs and Shackles
Job	2	Remove and Replace Rear Springs
Job	2A	Remove and Replace Front Coil Spring
R.S.A.	3	Rear Coil Springs, Torsion Bars, Air Level Suspension
Job	3	Remove and Replace Rear Coil Spring
Job	3A	Remove and Replace Torsion Bars and Adjust Front Suspension Height

Unit V - Steering and Front End Alignment

R.S.A.	1	Tie Rod Ends and Toe-in
Job	1	Remove and Replace Tie Rod Ends and Adjust Toe-in

Unit V - Steering and Front End Alignment (Continued)

R.S.A.	2	Steering Gear Adjustments
Job	2	Overhaul Gemmer Steering Gear and Adjust
Job	2A	Overhaul and Adjust a Saginaw Steering Gear
R.S.A.	3	Power Steering
Job	3	Checking a Power Steering Unit
R.S.A.	4	Principles of Front End Geometry
Job	4	Align Front Wheels, Caster, Camber and Toe-in
R.S.A.	5	Wheel Balancing
Job	5	Balance Wheel
R.S.A.	6	Reaming
Job	6	Rebush Spindle (Pressed in Bushings)
R.S.A.	7	Front End Alignment on Ball Joint Suspension
Job	7	Front Wheel Alignment on Ball Joint Suspension
Job	7A	Remove and Replace Front Suspension Ball Joint
Job	7B	Remove and Replace Upper and Lower Control Arms

Unit VI - Brakes

R.S.A.	1	Brake Shoes and Lining
Job	1	Adjust Hand Brakes
R.S.A.	2	Brake Adjustments
Job	2	Adjust Brakes (Minor)
R.S.A.	3	Principles of Hydraulic Brake Systems
Job	3	Bleed Hydraulic Brake System and Replenish Brake Fluid
R.S.A.	4	Hydraulic Master Cylinders and Wheel Cylinders
Job	4	Remove and Recondition Wheel Cylinders
Job	4A	Remove and Recondition a Master Cylinder
Job	4B	Replace Broken Brake Line
R.S.A.	5	Brake Drums
Job	5	Turn Brake Drum
Job	5A	Reline Brakes, and Adjust (Bendix)
R.S.A.	6	Power Brakes
Job	6	Remove and Recondition a Power Brake Unit and Replace
Job	6A	Reline Brake and Adjust (Lockheed)

Unit VII - Universal Joints, Drive Shafts, and Rear Axle

R.S.A.	1	Universal Joints and Drive Shafts
Job	1	Remove and Repair a Universal Joint (Cross and Two Yoke Type)
Job	1A	Remove and Repair a Universal Joint (Ball and Trunnion Type)
Job	1B	Remove and Replace Rear Axle
R.S.A.	2	Principles of the Differential
Job	2	Disassemble, Assemble and Adjust Rear End
Job	2A	Disassemble and Adjust Rear End (Chrysler Products)

Unit VII - Universal Joints, Drive Shafts, and Rear Axle (Continued)

R.S.A.	3	Differential Service
Job	3	Overhaul Rear End
R.S.A.	4	Traction Drive
Job	4	Remove and Overhaul Safe-T Track Rear Axle

Unit VIII - Clutch and Transmission

R.S.A.	1	Principles of the Clutch
Job	1	Adjust Clutch Pedal Free Play
R.S.A.	2	Clutch Service
Job	2	Remove and Replace Clutch
R.S.A.	3	Principles of the Transmission
Job	3	Adjust Gearshift Linkage
R.S.A.	4	The Synchromesh Transmission
Job	4	Disassemble and Assemble Transmission (Ford)
Job	4A	Disassemble and Assemble Transmission (Chevrolet)
Job	4B	Disassemble and Assemble Transmission (Pontiac)
R.S.A.	5	Transmission Troubles
Job	5	Remove, Overhaul and Replace Transmission
R.S.A.	6	Overdrive
Job	6	Remove, Overhaul and Replace Overdrive
R.S.A.	7	Roto-Hydra-Matic Transmission
Job	7	Adjust Control Linkage on a Roto-Hydra-Matic Transmission
Job	7A	Disassemble and Assemble Roto-Hydra-Matic Transmission
R.S.A.	8	Controlled Coupling or Super Hydra-Matic Transmission
Job	8	Disassemble and Assemble a Controlled Coupling Transmission
R.S.A.	9	Powerglide Transmission Service Adjustments
Job	9	Powerglide Transmission Linkage Adjustment
R.S.A.	10	The Powerglide Transmission
Job	10	Disassemble and Repair Powerglide Transmission
R.S.A.	11	Cruise-O-Matic Band and Throttle Linkage Adjustment
Job	11	Adjust Throttle Linkage and Bands on Cruise-O-Matic Transmission
R.S.A.	12	The Cruise-O-Matic Transmission
Job	12	Disassemble and Repair a Cruise-O-Matic Transmission
R.S.A.	13	The Torqueflite Transmission
Job	13	Disassemble and Repair Torqueflite Transmission
R.S.A.	14	Transmission-Push Button Controls
Job	14	Push Button Control Cable Adjustment

Unit IX - Fuel System

R.S.A.	1	Fuel Gauges and Fuel Pumps
Job	1	Test Fuel Level Gauge
Job	1A	Replace Gas Lines and Flexible Gasoline Connection
Job	1B	Check Fuel Pump Pressure, Vacuum and Volume
Job	1C	Overhaul Fuel Pump, Install on Engine, and Test
R.S.A.	2	Principles of Carburetion
R.S.A.	2A	Carburetor Circuits
Job	2	Remove, Disassemble, Clean and Repair a Carburetor (Carter BBS)
R.S.A.	3	Carburetor Circuits (Rochester)
Job	3	Remove, Disassemble, Clean and Repair a Carburetor (Rochester Model BC)
Job	3A	Remove, Disassemble, and Repair a Ford V-8 Carburetor
R.S.A.	4	Four Barrel Carburetor
Job	4	Remove, Disassemble and Repair a Four-Barrel Carburetor (Rochester 4GC)
R.S.A.	5	Choke Control and Manifold Heat Control
Job	5	Free Up Heat Control Valve
R.S.A.	6	Fuel Injection
Job	6	Solder Leak in Fuel Tank

Unit X - Ignition System

R.S.A.	1	Basic Principles of Electricity
R.S.A.	1A	Battery Service
Job	1	Service a Battery
R.S.A.	2	High Tension Cables and Spark Plugs
Job	2	Service Spark Plugs, High Tension Wires and Distributor Cap
R.S.A.	3	Ignition System
Job	3	Remove and Replace Distributor Points and Set Ignition Timing
Job	3A	Tune Up Checks and Adjustment. (Vacuum, Dwell, Timing, Compression, Coil, Condenser, Spark Plugs, Distributor Resistance, and Ignition Primary Circuit Resistance)

Unit XI - Generators and Regulators

R.S.A.	1	Generators
R.S.A.	1A	Generator Service
Job	1	Remove, Disassemble, Repair and Replace a Generator
R.S.A.	2	Generator Regulators
Job	2	Check and Adjust a Voltage Regulator
R.S.A.	3	Alternators (A.C. Generators)
Job	3	Testing Alternator Output (A.C. Generator)

Unit XII - Starting Motors

R.S.A.	1	Starting Motor Fundamentals, Cables, Controls and Drives
Job	1	Install New Starter Cables and Solenoid Switch
R.S.A.	2	Starter Maintenance and Test
Job	2	Check Starter Insulated Circuit, Solenoid Resistance, Battery Capacity, and Starter Amperage Draw
Job	2A	Install and Test Field Windings for Open Circuits and Grounds
Job	2B	Remove, Overhaul and Replace Starter

Unit XIII - Cooling System

R.S.A.	1	Functions of the Cooling System
Job	1	Remove, Inspect, Test and Replace Water Pump, Thermostat, Fan Belt, and Pressure Cap
R.S.A.	2	Flushing Cooling System
Job	2	Remove, Solder, Test, And Replace Radiator
R.S.A.	3	Antifreeze
Job	3	Install and Test Antifreeze

Unit XIV - Engine Overhaul (Benchwork)

R.S.A.	1	Engine Fundamentals and Components
Job	1	Clean Engine with Cold (or Hot) Degreasing Solution
R.S.A.	2	Oil Pumps and Pressure Regulators
Job	2	Remove, Inspect, and Replace Oil Pump
Job	2A	Clean Oil Pressure Relief Valve
Job	2B	Remove and Replace Expansion Plug
R.S.A.	3	Valve Operating Mechanisms
Job	3	Remove, Reface and Replace Rocker Arms
R.S.A.	4	Servicing Valves
Job	4	Grind Valve on I-Head Engine
R.S.A.	5	Valve Timing
Job	5	Remove and Replace Timing Gear or Chain
R.S.A.	6	Engine Bearing, Crankshaft and Camshaft
R.S.A.	6A	Piston Pins and Bushings
Job	6	Remove Old and Fit New Piston Pin and Bushing, and Align Connection Rod
R.S.A.	7	Piston, Rings and Cylinders
R.S.A.	7A	Cylinder Reconditioning
Job	7	Rebore Cylinder
Job	7A	Overhaul Engine Completely

Unit XV - Engine Repairs

Job	1	Remove Engine From Car and Replace it
Job	2	Adjust New Connecting Rod Bearing with Engine in Car (Precision Insert Type)
Job	3	Adjust Main Bearings with Engine in Car
Job	4	Grind Valves on I-Head Engine in Car

Unit XVI - Lights and Horns

R.S.A.	1	Lights and Lighting Circuits
Job	1	Install Headlight Sealed Beam and Focus Headlights
Job	1A	Test for Short, Open and Ground Circuit at Headlight
Job	1B	Install Dimmer Switch
Job	1C	Install Stop Light Switch
Job	1D	Install Headlight Switch
Job	1E	Install New Wiring Harness
R.S.A.	2	Horns, Switches, and Relays
Job	2	Install New Horns and Relay
Job	2A	Test for Open and Short in Horn that will not Blow
Job	2B	Install New Horn Wiring Circuit
R.S.A.	3	Turn Signals and Back-up Lights
Job	3	Servicing Turn Signals and Back-up Lights

Unit XVII - Automobile Accessories

R.S.A.	1	Accessory Equipment
Job	1	Install Heater
Job	1A	Remove and Install Speedometer
Job	1B	Remove, Clean, Adjust, and Replace Vacuum Windshield Wiper Motor
Job	1C	Install Mufflers and Tail Pipes and Adjust Brackets
R.S.A.	2	Electric Wiper Motors
Job	2	Remove, Clean, Inspect, Replace and Adjust Electric Wiper
R.S.A.	3	Power Seats
Job	3	Remove and Replace Power Front Seat Adjuster
R.S.A.	4	Air Condition Service
Job	4	Check for Leaks, Repair Leaks and Recharge Air Conditioning System on Chevrolet
Job	4A	Remove and Replace Air Conditioner Dryer-Receiver Tank on Chevrolet
Job	4B	Remove and Replace Air Conditioning Thermostatic Expansion Valve on Chevrolet
Job	4C	Replace Air Conditioner Compressor Seal on Chevrolet

Unit XVIII Welding-Oxyacetylene

R.S.A.	1	Setting Up Equipment
Job	1	Set Up Oxyacetylene Welding Apparatus
R.S.A.	2	Welding Steel
Job	2	Run Beads, Flat Position 1/8" Material
Job	2A	Flat Position Butt Weld 1/8" Material
R.S.A.	3	Flame Cutting
Job	3	Hand Cut 1/2" Material

Unit XVIII - Welding-Oxyacetylene (Continued)

R.S.A.	4	Bronze Welding
Job	4	Flat Position Butt Welding 1/8" Material
Job	4A	Bronze Weld Cast Iron Plate

Unit XIX - Arc Welding

R.S.A.	1	Equipment and Striking an Arc
Job	1	Set Up Welding Machine and Strike Arc
Job	1A	Run Continuous Stringer Beads, Flat Position 1/4" Material
Job	1B	Lap Joint Weld Flat Position 1/4" Material

Unit XX - Shop Practices

R.S.A.	1	Frame and Body
Job	1	Remove and Replace Door Lock; Adjust
Job	1B	Adjust Striker Plate
Job	1C	Align Doors

The Cabinetmaking Course was published in 1952. It is available in the following forms:
For students the material is stapled in individual packages. Related Study Assignments, Jobs, Job Information Sheets, Auxiliary Jobs, Tests and Math are included in Book 1 - Unit 1.

Related Study Assignments, Jobs, and Job Information Sheets are included in Book 2 - Units 2, 3, 4.

Answer Book
Complete for tests and math

The following instructor's aids are available:
Individual Folder Type

There are no references since all needed information is given in the Job Information Sheets.

A detailed outline of the Cabinetmaking Course follows:

Unit I - Furniture

Job	1	End Table Legs
J.I.S.	1	The Crosscut Saw
R.S.A.	1	Wood Screws
Math.	1	How to Use the Rule
Test	1	
Job	2	Stretchers for End Table
J.I.S.	2	Hand Rip Saw
R.S.A.	2	Wood Glue
Math.	2	Calculating Board Feet and Cost
Test	2	
Job	3	End Table Top and Assembly
J.I.S.	3	Dividers and Their Use
R.S.A.	3	Clamps and Clamping
Math.	3	Calculating Sheet Products and Their Cost
Test	3	
Job	4	Chair
J.I.S.	4	The Jointer and Its Use
R.S.A.	4	Nails
Math.	4	Laying Out a 45° Angle
Test	4	
Job	5	Night Table
J.I.S.	5	Preparation of Uniform Stock, Etc.
R.S.A.	5	Making a Template (The Cabriole Leg)
Math.	5	Addition of Fractions
Test	5	

Course Outline (Continued)

Unit I - Furniture (Continued)

Job	6	Step Table
J.I.S.	6	Drawer Construction (Flush Type)
R.S.A.	6	Making a Bill of Material
Math.	6	Subtraction of Fractions
Test	6	
Job	7	Bookcase
J.I.S.	7	Radial Saw
R.S.A.	7	Coated Abrasives
Math.	7	Division of Fractions
Test	7	
Job	8	Cocktail Table
J.I.S.	8	Basic Furniture Units of Construction
R.S.A.	8	Cabinetmaking Hardware - Hinges
Math.	8	The Decimal System
Test	8	
Job	9	Pembroke Table
J.I.S.	9	Making Rule Joint
R.S.A.	9	Wood Seasoning
Math	9	Simple Percentage
Test	9	
Job	10	Chest of Drawers
J.I.S.	10	Drawer Guides
R.S.A.	10	Plywood
Math.	10	Personal Checks and Drafts
Test	10	
Job	11	China Cabinet
J.I.S.	11	Lathe and Lathe Operations
R.S.A.	11	Grading of Lumber
Math.	11	Interest and Taxes
Test	11	
Job	12	Desk
J.I.S.	12	Woodworking Joints
R.S.A.	12	Lumbering
Personal and Social Problems		
Test	12	
Job	13	Special Project (Selected by the Student)
R.S.A.	13	Bearings and Power Transmission
R.S.A.	14	Evolution of Furniture
R.S.A.	15	Louisiana Woods Suitable for Cabinetmaking
Test	13	

Course Outline (Continued)

Unit I - Furniture (Continued)

Auxiliary Job 14: Sharpening Handsaws

Auxiliary Job 15: Attaching Sanding Disc

Auxiliary Job 16: Care of Electric Motors

Auxiliary Job 17: Sharpening Bevel Edge Tools

Auxiliary Job 18: Sharpen Circular Saws

Auxiliary Job 19: Replacing Jointer Knives

Auxiliary Job 20: Changing Circular Saw Blade

Auxiliary Job 21: Pulley Ratios and Machine Speeds

Auxiliary Job 22: Sharpening Auger Bits

Auxiliary Job 23: Dressing Abrasive Wheels

Auxiliary Job 24: Replacing Band and Small Saw Blade

Unit II - Wood Finishing

R.S.A. 16: Preparation of Surface

R.S.A. 17: Varnish Brushes

R.S.A. 18: Spraying Equipment

R.S.A. 19: Finishing Abrasives

R.S.A. 20: Stains

J.I.S. 1: Applying Oil Stains

J.I.S. 2: Applying Water Stain

R.S.A. 21: Crack Fillers

R.S.A. 22: Wood Fillers

J.I.S. 3: Applying Filler

Course Outline (Continued)

Unit II - Wood Finishing (Continued)

R.S.A. 23: Sealers

R.S.A. 24: Shellac

J.I.S. 4: Applying Shellac

R.S.A. 25: Turpentine

R.S.A. 26: Varnish

J.I.S. 6: Applying Lacquer Sealers

J.I.S. 7: Applying Lacquer

R.S.A. 28: Linseed and Tung Oils

J.I.S. 8: Oil Finish

J.I.S. 9: A New Finish

J.I.S. 10: Bleaching Wood

R.S.A. 29: Enamels

R.S.A. 30: Characteristics of Wood Affecting Finish

R.S.A. 31: Pigments

Unit III - Custom Work

Job 1: Kitchen Cabinet Base
R.S.A. 32: Hardware, Trim, Its Application and Miscellaneous Items
R.S.A. 33: Covering Materials
Cabinetmaking Drawing, Plates 1-19

Job 2: Kitchen Cabinet Top
R.S.A. 34: New Materials
Cabinetmaking Drawing, Plates 20-44

Job 3: Dining Corner Cabinet
Cabinetmaking Drawing, Plates 45-52

Unit IV - Production Work

Supplementary Hand Jobs

Unit I - Furniture

Job	1:	Lawn Table
J.I.S.	1:	Layout and Cut a Cross Lap Joint
Test	1	
Job	1-A:	Colonial Bench
J.I.S.	1-A:	Bench Vise and Stops
R.S.A.	1-A:	The Shop
Test	1-A:	
Job	1-B:	Utility Stand
J.I.S.	1-B:	Layout and Cut Duplicate Parts
Test	1-B:	
Job	1-C:	Lawn Chair
Test	1-C:	
Job	2:	End Table
J.I.S.	2:	Lay Out and Cut Tapers with Jack Plane
Test	2:	
Job	3:	Cobbler's Bench
J.I.S.	3:	To Cut A Rabbet with a Rabbet Plane
Test	3:	

The Carpentry Course (Trade Preparatory) was written and published in 1955. The course was revised in 1958 and again in 1963. Instructors may secure the material in book form (4 books; R.S.A.'s, Jobs, Tests, and Answers). Student material is stapled in loose form, that is, each job with the corresponding related material. The material is to be ordered by Unit and Job number. An individual permanent record folder is also available.

The references for the Carpentry (Trade Preparatory) Course are listed below.

Title	Source
HAND WOODWORKING TOOLS	Delmar Publishers Inc. Mountainview Avenue Albany 5, New York
F. S. Crispin DICTIONARY OF TECHNICAL TERMS	The Bruce Publishing Co. 540 North Milwaukee St. Milwaukee 1, Wisconsin
C. Thomas Olivo BASIC MATHEMATICS SIMPLIFIED	Delmar Publishers Inc. Mountainview Avenue Albany 5, New York
PRACTICAL PROBLEMS IN MATHEMATICS FOR CARPENTERS	Delmar Publishers Inc. Mountainview Avenue Albany 5, New York
Ramsey and Sleeper ARCHITECTURAL GRAPHIC STANDARDS	John Wiley and Sons, Inc. 440 Park Ave. South New York 16, New York
French and Svensen MECHANICAL DRAWING	McGraw-Hill Book Company, Inc. 330 West 42nd Street New York 36, New York
BLUEPRINT READING AND SKETCHING CARPENTRY TRADES RESIDENTIAL	Delmar Publishers Inc. Mountainview Avenue Albany 5, New York
CONCRETE FORM CONSTRUCTION	Delmar Publishers Inc. Mountainview Avenue Albany 5, New York
FRAMING, SHEATHING AND INSULATION	Delmar Publishers Inc. Mountainview Avenue Albany 5, New York

References (Continued)

Title	Source
Wilson and Werner SIMPLIFIED ROOF FRAMING	McGraw-Hill Book Company, Inc. 330 West 42nd Street New York 36, New York
INTERIOR AND EXTERIOR TRIM	Delmar Publishers Inc. Mountainview Avenue Albany 5, New York
Wilson and Werner SIMPLIFIED STAIR LAYOUT	Delmar Publishers Inc. Mountainview Avenue Albany 5, New York
THE USE OF HAND TOOLS AND PORTABLE MACHINERY	Delmar Publishers Inc. Mountainview Avenue Albany 5, New York
PORTABLE POWER TOOLS	Delmar Publishers Inc. Mountainview Avenue Albany 5, New York
ARMSTRONG INSTALLATION MANUAL	Armstrong Cork Company Lancaster, Pennsylvania

A detailed outline of the Carpentry (Day Preparatory) Course follows.

Unit I Hand Tools and Their Uses

R.S.A. 1 - Measuring Tools, Bench Vise and Stops
Job 1 - Flower Pot Base, Octagon Top
R.S.A. 2 - Layout Tools, Testing Tools, and Sawing Tools
Job 2 - Flower Pot Base, Bottom Cross Pieces (Legs)
R.S.A. 3 - Bench Planes, Edge Cutting Tools and Mallets
Job 3 - Make 3 Tapered Table Legs
R.S.A. 4 - Boring Tools
Job 4 - Mortise Table Legs
R.S.A. 5 - Smoothing Tools and Coated Abrasives
Job 5 - Stretchers For End Table
R.S.A. 6 - Woodworking Joints and Moldings, Wood Glues, and Clamps and Clamping
Job 6 - To Make An End Table
R.S.A. 7 - Miter Box and Fasteners Corrugated
Job 7 - Picture Frame, Size 8" x 10"

Course Outline (Continued)

Unit I (Continued)
- R.S.A. 8 - The Compass Saw and Coping Saw
- Job 8 - Make Book Ends
- R.S.A. 9 - Hand Router Plane, Dadoes, Plywood, and Grading
- Job 9 - Flower Box
- R.S.A. 10 - Sawhorses, Lumbering, Wood Seasoning, and Grading of Lumber
- Job 10 - Make a Sawhorse
- R.S.A. 11 - To Be Selected By Instructor
- R.S.A. 12 - To Be Selected By Instructor

Unit II Drafting
- R.S.A. 1 - Introductory Drafting Unit of Carpentry
- Job 1 - Basic Lines
- R.S.A. 2 - The Language of Drawing and Learning to Draw
- Job 2 - Law Out Sheet, Horizontal and Vertical Lines
- R.S.A. 3 - Lettering
- Job 3 - Technique of Lettering
- Job 3A - Six Squares, Dividing Into Angles
- R.S.A. 4 - Lines and Dimensions
- Job 4 - Lines and Dimensions
- R.S.A. 5 - Geometrical Construction
- Job 5 - Geometric Problems
- Job 5A - Dial Plate
- R.S.A. 6 - Theory of Shape Description
- Job 6 - Slotted Block, 2-View
- Job 6A - Tenon
- R.S.A. 7 - Reading and Making Drawings
- Job 7 - Offset Spacer, 3-View
- R.S.A. 8 - Hidden Lines
- Job 8 - End Stop
- Job 8A - Inkwell Base
- Job 8B - Tool Post Slide
- Job 8C - V-Guide and Wedge
- R.S.A. 9 - Sections
- Job 9 - Protected Bearing
- Job 9A - Stuffing Box Gland
- Job 9B - Yoke
- Job 9C - Lever Arm
- R.S.A. 10 - Auxiliary Views and Revolutions
- Job 10 - Tapered Wedge
- R.S.A. 11 - Principles of Size Description
- Job 11 - Hollow Molding
- R.S.A. 12 - Technique of the Finished Drawing
- Job 12 - Adjustable Bracket
- Job 12A - Shaft Support

Course Outline (Continued)

Unit II (Continued)

R.S.A. 13 - Sheet Metal Drafting (Isometric)
Job 13 - Truncated Square Prism
Job 13A - Transition Piece
Job 13B - Truncated Cylinder
R.S.A. 14 - Pictorial Drawing
Job 14 - Isometric Figures
R.S.A. 15 - Production Illustration
Job 15 - Isometric Offset Block
Job 15A - Dovetail Figures
Job 15B - Isometric Cube
R.S.A. 16 - Screws, Bolts and Other Fastenings
Job 16 - Machine Bolt
R.S.A. 17 - Architectural Drawings
Job 17 - Floor Plan Garage
R.S.A. 18 - Architectural Drafting
Job 18 - Foundation and Detail of Roof Construction
R.S.A. 19 - Architectural Drafting
Job 19 - Front Elevation
Job 19A - Side Elevation

Unit III Foundations

R.S.A. 1 Surveying Instruments
Job 1 - Set Up and Level the Builder's Transit or Level
Job 1A - Find the Difference of Level of Two Points
Job 1B - Run a Straight Line
R.S.A. 2 - Principles of Laying Out Building Lines
Job 2 - Locate a Building on a Lot
R.S.A. 3 - Principles of Erecting and Leveling Batter Boards
Job 3 - Erect Batter Boards
R.S.A. 4 - Description, Construction and Erection of Continuous Wall Footing Forms
Job 4 - Build and Set a Section of Continuous Footing Form
R.S.A. 5 - Description, Construction and Erection of Pier Footing Forms
Job 5 - Build a Pier Footing Form
R.S.A. 6 - Description, Construction and Setting of Concrete Foundation Form Walls and How to Provide for Openings
Job 6 - Build and Set a Section of Double Wall Form
R.S.A. 7 - Description of and How to Suspend Anchor Bolts in Concrete Forms
Job 7 - Suspend Anchor Bolts in Concrete Forms
R.S.A. 8 - Description, Construction and Setting of Concrete Pier Forms
Job 8 - Build a Concrete Pier Form

Course Outline (Continued)

Unit III (Continued)

R.S.A. 9 - Description, Construction and Setting of Concrete Step Forms
Job 9 - Build and Set a Concrete Step Form
R.S.A. 10 - Description of and Setting Forms for Concrete Floors and Sidewalks
Job 10 - Build a Section of Concrete Sidewalk Form
Job 11 - To Be Selected By Instructor

Unit IV Frame Construction

R.S.A. 1 - Description of Types of Sill Construction and How to Frame and Install Sills
Job 1 - Lay Out, Cut and Assemble Solid Sills
R.S.A. 2 - Description of Floor Joists and How to Install
Job 2 - Lay Out and Install Floor Joists
R.S.A. 3 - How to Lay Out, Cut and Install Bridging
Job 3 - Lay Out, Cut and Install Bridging
R.S.A. 4 - Description of Methods of Laying Subfloors
Job 4 - Lay Subfloor Diagonally to Floor Joists
R.S.A. 5 - How to Lay Out and Cut Plates to Length
Job 5 - Locate, Lay Out and Cut Plates
R.S.A. 6 - How to Lay Out and Cut Studs for Side Walls
Job 6 - Lay Out and Cut Studs for a Single Story Building
R.S.A. 7 - Corner Posts
Job 7 - Build a Corner Post
R.S.A. 8 - How to Frame Walls in a Balloon Frame; Description of and How to Frame Openings in the Outside Walls of a Balloon Frame; and How to Frame Walls in the Platform and Modern Braced Frame
Job 8 - Assemble Wall Sections
R.S.A. 9 - Bracing
Job 9 - Bracing a Wall Section
R.S.A. 10 - Description of and How to Frame Interior Partitions
Job 10 - Assemble and Erect an Inside Partition
R.S.A. 11 - How to Space the Second and Attic Floor Joists
Job 11 - Install Ceiling Joists
R.S.A. 12 - Description of Methods of Applying Sheathing
Job 12 - Apply Outside Wall Sheathing
R.S.A. 13 - Description and Function of Insulating Materials
Job 13 - Install Insulating Material
Job 14 - To Be Selected By the Shop Instructor

Course Outline (Continued)

Unit V Roof Framing, Sheathing and Shingles

R.S.A. 1 - Terms, Types, and Principles of Roof Framing; Description of Methods of Laying Out a Common Rafter; and Steel Square Common Rafter Table
R.S.A. 1A - The Framing Square and The Rafter
Job 1 - Lay Out and Cut a Common Rafter Using the Step-off Method
R.S.A. 2 - How to Erect a Gable Roof, and Light Wood Framing Details
Job 2 - Frame a Gable Roof
R.S.A. 3 - How to Lay Out, Cut and Install Gable Studding
Job 3 - Lay Out, Cut, and Install Gable Studs
R.S.A. 4 - Determining the Length of a Collar Tie
Job 4 - Lay Out, Cut, and Install Collar Ties
R.S.A. 5 - Description of Methods of Laying Out Hip Rafters and Steel Square Hip Rafter Table
Job 5 - Lay Out and Cut a Hip Rafter
R.S.A. 6 - Method of Laying Out Hip Jack Rafters and Steel Square Hip Jack Rafter Table
Job 6 - Lay Out and Cut a Hip Jack Rafter
R.S.A. 7 - How to Erect a Hip Roof
Job 7 - Frame a Hip Roof
R.S.A. 8 - Description of Methods of Laying Out Valley Rafters; and Steel Square Valley Rafter Table
Job 8 - Lay Out and Cut a Valley Rafter
R.S.A. 9 - Method of Laying Out a Valley Jack Rafter; Method of Laying Out a Valley Cripple Jack Rafter; and Steel Square Valley Jack Rafter Table
Job 9 - Lay Out and Cut a Valley Jack Rafter
R.S.A. 10 - Method of Laying Out the Hip-Valley Cripple Jack Rafter and Steel Square Hip-Valley Cripple Rafter Table
Job 10 - Lay Out and Cut a Hip Valley Cripple Jack Rafter
R.S.A. 11 - How to Erect an Intersecting Gable Roof
Job 11 - Frame an Intersecting Roof
R.S.A. 12 - Types of Window Screens
Job 12 - Apply Roof Sheathing
R.S.A. 13 - Methods of Applying Roll Roofing
Job 13 - Apply Roofing Felt
R.S.A. 14 - Description of Composition Roof Covering and How to Apply Strip Shingles
Job 14 - Apply Strip Shingles

Course Outline (Continued)

Unit VI Exterior Trim

R.S.A. 1 - Description and Construction of Window Frames
Job 1 - Build a Window Frame
R.S.A. 2 - How to Assemble and Install Window Frames
Job 2 - Install a Window Frame
R.S.A. 3 - Description and Types of Aluminum Window Units and Installation Instruction
Job 3 - Install an Aluminum Window Unit
R.S.A. 4 - Types of Door Frames
Job 4 - Build an Exterior Door Frame
R.S.A. 5 - How to Build and Install Door Frames
Job 5 - Install an Exterior Door Frame
R.S.A. 6 - Description of Common Types of Cornices and How to Build
Job 6 - Apply Box Cornice
R.S.A. 7 - Description and Application of Corner Boards
Job 7 - Apply Corner Boards
R.S.A. 8 - Louvers in Frame Walls
Job 8 - Build and Install a Louver
R.S.A. 9 - Description and Application of Exterior Side Wall Covering
Job 9 - Apply Bevel Siding
R.S.A. 10 - Stair Types, Terms and Principles and Stair Layout
Job 10 - Lay Out, Cut and Assemble a Set of Steps
R.S.A. 11 - The Miter Box and Saw
Job 11 - Build a Miter Box
R.S.A. 12 - Types of Window Screens
Job 12 - Build, Fit and Hang a Window Screen
R.S.A. 13 - How to Fit Full Surface Hinges and How to Apply Mortise Locks
Job 13 - Build, Fit and Hang a Screen Door
Job 14 - To Be Selected by the Shop Instructor

Unit VII Interior Trim

R.S.A. 1 - Description and Laying Finish Floors and Wood Flooring
Job 1 - Lay Finish Flooring
R.S.A. 2 - Methods of Hanging Window Sash, How to Fit Window Sash, and Wood Double Hung and Wood Casement Windows
Job 2 - Install Window Sash
R.S.A. 3 - Description and How to Apply Window Trim
Job 3 - Apply Interior Window Trim
R.S.A. 4 - Description of Window Hardware
Job 4 - Apply Window Hardware

Course Outline (Continued)

Unit VII (Continued)

R.S.A. 5 - Types of Door Frames and How to Install Door Frames
Job 5 - Build and Install an Interior Door Frame
R.S.A. 6 - Description of Interior and Exterior Doors; How to Fit a Door; and Stock Wood Doors
Job 6 - Fit and Hang a Door
R.S.A. 7 - Description of Finish Hardware and How to Apply Mortise Locks
Job 7 - Install a Mortise Lock
R.S.A. 8 - How to Build Stairs with Housed and Open Stringers and Description and How to Fit Newel Posts and Hand Rails
Job 8 - Lay Out, Cut and Assemble a Stair
R.S.A. 9 - Types and Installation of Baseboards
Job 9 - Install Baseboards
Job 9A - Install Shoe Moulding
Job 10 - To Be Selected by the Shop Instructor

Unit VIII Portable Power Tools and Their Uses

R.S.A. 1 - Description, The Circular Handsaw and Portable Saw Blades; Care of Circular Saw Blades; and Methods of Using The Portable Circular Saw
R.S.A. 1A - Description of Kitchen Cabinets and How to Build and Install a Kitchen Cabinet
Job 1 - Build and Install Kitchen Base Cabinet
R.S.A. 2 - Description, The Radial Arm Saw; General Instructions for Operation and Adjustment of the Radial Arm Saw; and Methods of Using the Radial Arm Saw
R.S.A. 2A - Description of Kitchen Wall Cabinets and How to Build Wall Cabinets
Job 2 - Build and Install Kitchen Wall Cabinets With a Drop Ceiling
R.S.A. 3 - Description, The Electric Router; Description of Router Bits and Methods of Inserting Bits in the Collet and Assemble Motor Into Router Base; and Basic Routing Cuts
R.S.A. 3A - How to Construct Cabinet Drawers and How to Assemble a Cabinet Drawer
Job 3 - Construct and Assemble Cabinet Drawers
R.S.A. 4 - Description, The Portable Power Block Plane and Methods of Using the Portable Power Block Plane
R.S.A. 4A - How to Fit Cabinet Doors
Job 4 - Fit Cabinet Doors

Course Outline (Continued)

Unit VIII (Continued)

R.S.A. 5 - Description, The Portable Electric Hand Drill; Drills and Bits; and Safety Precautions in Using the Portable Electric Hand Drill
R.S.A. 5A - How to Apply Cabinet Hardware
Job 5 - Apply Cabinet Hardware
R.S.A. 6 - Description, The Portable Sabre Saw and Blades; How to Install Sabre Saw Blades and Base Insert; Methods of Using the Portable Sabre Saw
R.S.A. 6A - Installing Counter Surfaces With Metal Trim and Cove Metal
Job 6 - Fit and Apply Laminated Plastic Counter Top
R.S.A. 7 - The Portable Electric Power Plane; Safe Methods in Using the Portable Electric Power Plane and How to Use the Electric Portable Power Plane
R.S.A. 7A - Description of Mantel Shelves and How to Build Mantel Shelves
Job 7 - Build and Install a Mantel Shelf
R.S.A. 8 - Description, The Portable Belt Sander and General Procedures for Using the Belt Sander
R.S.A. 8A - Selection of Abrasive Belts
R.S.A. 8B - Methods of Building and Installing Built-In-Bookcases
Job 8 - Build a Book Case
R.S.A. 9 - Description, Finishing Sanders; Selection and Installation of Abrasives; and Care and Use of the Finishing Sander
R.S.A. 9A - Description of Corner Cabinets
Job 9 - Corner Cabinets
R.S.A. 10 - Reciprocating Saws and Methods of Operating the Reciprocating Saw
R.S.A. 10A - How to Build and Install a Medicine Cabinet
Job 10 - Medicine Cabinet
R.S.A. 11 - Description of Linen Closet
Job 11 - Linen Closet
R.S.A. 12 - Description, The Hinge Butt Templet; Description, The Lock Mortiser; Description, The Lock Face Templet
R.S.A. 12A - Description of Clothes Closets
Job 12 - Linen Closet

The Map Drafting and Related Computations section of the Civil Engineering Technology Course was written in 1964 and is available in bound form. The course is composed of 12 sections in one book, and a Field Book. A detailed outline of this course is given below.

Section 1 Introduction

Section 2 Directions of Lines

Section 3 Plotting Angles

Section 4 Plotting Traverses

Section 5 Latitudes and Departures

Section 6 Calculation of Areas

Section 7 Route Surveys with Circular Curves

Section 8 Topographic Maps

Section 9 Profiles and Cross Sections

Section 10 Area Maps

Section 11 Reproduction of Drawings

Section 12 Assignments and Directions for Exercises

Field Survey Notes

This compendium of Electrical Diagrams may be used in any situation requiring the use of such circuits. It is not designed to be limited to any one particular curriculum. It is recommended that it be used as a reference when and where needed. Other uses may develop depending on the requirements of a job and the ability of the student. Additional diagrams will probably be added to future editions of this reference if usage indicates that this is desirable.

A list of diagrams follows:

Signal Circuits . . . . . 20 Diagrams

Lighting Circuits . . . . . 26 Diagrams

Industrial Control Circuits . . . . . 26 Diagrams

Appliance Circuits . . . . . 5 Diagrams

The Farm Mechanics Course is available in loose leaf form. The references for the courses will be listed in the separate courses. The instructors will request jobs from the following courses as they see fit:

Carpentry
Electricity
Machine Shop
Plumbing
Small Engine Repair
Tractor Repair and Maintenance
Welding

A detailed outline of the Farm Mechanics Course follows:

CARPENTRY

Unit I - Hand Tools (Required)

Job 1: Use Layout Tools
Job 2: Use Wood Cutting Tools
Job 3: Use Boring and Driving Tools
Job 4: Lay out and Construct a Sawhorse
Job 5: Lay out and Construct a Shoulder Box
Job 6: Lay out a House

R.S.A. 1: Measuring and Layout Tools
R.S.A. 2: Wood Boring Tools
R.S.A. 3: Wood Cutting Tools
R.S.A. 4: Wood Cutting Tools (Continued)
R.S.A. 5: Driving Tools
R.S.A. 6: Nails, Screws, and other Fasteners
R.S.A. 7: Lumber

Unit II - Foundations (Required)

Job 1: Build Bulkhead Forms for a Footing
Job 2: Build Bulkhead Forms for a Slab
Job 3: Mix, Pour and Darby a Concrete Slab

R.S.A. 1: Concrete Formwork
R.S.A. 2: Mixing Concrete

Unit III - Framing (Optional)

Job 1: Install Wood Sills
Job 2: Install Floor Joists
Job 3: Install Floor Joist Headers and Bridging
Job 4: Construct a Subfloor
Job 5: Lay out, Assemble and Fasten Lower Plates (Soles)
Job 6: Lay out, Fabricate and Raise Wall Frames
Job 7: Lay out and Construct Ceiling Joists
Job 8: Lay out, Cut and Erect Common Rafters

Course Outline (Continued)

Unit III - Framimg (Optional) (Continued)

Job 9: Lay out, cut and Erect Hip, Valley, Hip Jack, and Valley Jack Rafters
Job 10: Sheathe a Wall

R.S.A. 1: Wood sills, floor joists, bridging and headers
R.S.A. 2: Subfloors
R.S.A. 3: Frame Lay Out (Plates)
R.S.A. 4: Wall Frames
R.S.A. 5: Ceiling Joists and Headers
R.S.A. 6: Common Rafters
R.S.A. 7: Hip Rafters, Hip Jack Rafters
R.S.A. 8: Valley and Valley Jack Rafters
R.S.A. 9: Sheathing

Unit IV - Exterior Trim (Optional)

Job 1: Lay out and Construct a Window Frame
Job 2: Lay out and Construct a Door Frame
Job 3: Set a Window and Door Frame
Job 4: Set a Sash
Job 5: Hang and Lock a Door
Job 6: Hang Finished siding

R.S.A. 1: Window and Door Frames
R.S.A. 2: Setting Frames
R.S.A. 3: Hanging and Locking Doors
R.S.A. 4: Setting Sash
R.S.A. 5: Siding

ELECTRICITY

Unit I - Bell Wiring (Required)

Job 1: Install a door bell or chime

R.S.A. 1: Care and use of hand tools
R.S.A. 2: Principles of electric circuit sketching
R.S.A. 3: Wire connections and soldering

Unit II - Indicating Instruments (Required)

Job 1: Connect a voltmeter, ammeter

R.S.A. 1: Principles of Meters
R.S.A. 2: Care of meters
R.S.A. 3: Reading a watt hour meter

Course Outline (Continued)

Unit III - Wiring to Existing Circuits (Optional)

Job 1: Install one light, one S.P. switch and receptacle using No. 12 nonmetallic sheath cable (Have Students make Sketch)

R.S.A. 1: Introduction to National Electric Code R.S.A. No. 9 Book I Unit I
R.S.A. 2: Polarity identification of systems and circuits R.S.A. No. 4 Book III Unit I
R.S.A. 3: Selection of wire size and current carrying capacity Book I Unit III R.S.A. 7
R.S.A. 4: Circuit sketching
R.S.A. 5: Determine connected load
R.S.A. 6: Types of Fasteners R.S.A. 7 Book I Unit I
R.S.A. 7: Non-metallic cable wiring R.S.A. 8 Book III Unit I

Unit IV - Wiring to New Circuits (Optional)

Job 1: Install one procelain flush chain receptacle, one pendant light with type C lamp cord on lighting circuit and receptacle outlet on an appliance circuit (Have students make sketch)

R.S.A. 1: Types of fuses and circuit breakers and their use. R.S.A. 8 Book I Unit III
R.S.A. 2: Circuit planning
R.S.A. 3: Circuit sketching
R.S.A. 4: Determining illumination
R.S.A. 5: Types of boxes, box covers, and methods of installation R.S.A. 3 Book III Unit I

Unit V - Wiring Between Buildings (Optional)

Job 1: Install one light using two three-way switches from house to barn (Have students make sketch)

R.S.A. 1: Determining number of conductors in conduit or tubing
R.S.A. 2: Grounding
R.S.A. 3: Current carrying capacity of conductors run in free air or in conduit or tubing
R.S.A. 4: Calculation and use of charts in determining tensile strength and voltage drop.
R.S.A. 5: Types of service brackets and wire holders and their use
R.S.A. 6: N.E.C. requirements on outside wiring

Course Outline (Continued)

Unit VI - Wiring (Meter Pole) (Optional)

Job 1: Install a three wire meter service and a two wire feeder between pole and barn and 3 wire feeder between pole and dwellings (Have students make sketch)

R.S.A. 1: Determine service conductor and switch sizes
R.S.A. 2: Locating the meter pole
R.S.A. 3: Branch circuits and service entrance

Unit VII - Motors (Required)

Job 1: Disassemble, clean and reassemble split phase motor

R.S.A. 1: Simple motor
R.S.A. 2: Principle of split phase motor

Unit VIII - Motors (Optional)

Job 1: Mount and connect a split phase dual-voltage reversible motor 110V or 220 V

R.S.A. 1: Calculation of pulley sizes
R.S.A. 2: Determine H.P. of motor to do a job
R.S.A. 3: Principle of capacitor motors
R.S.A. 4: Methods of equipment grounding

Unit IX - Motors (Optional)

Job 1: Disassemble, clean and reassemble repulsion motor and reverse

R.S.A. 1: Principle of repulsion motors
R.S.A. 2: Principle of 3 phase motor
R.S.A. 3: Principle of wound rotor motor

Unit X - Motors (Required)

Job 1: Trouble shooting on motors and motor controllers

R.S.A. 1: Types and operating principles of motor Controller

MACHINE SHOP

Unit I - Lathe

Job 1: Turn a Shaft

Course Outline (Continued)

Unit I - Lathe (Continued)

Job 2: Turn a Threading Blank
Job 3: Threading a Blank
Job 4: Drilling
Job 5: Boring
Job 6: Internal Threads

R.S.A. 1: Principles of the Lathe
R.S.A. 2: Lathe Holding Devices
R.S.A. 3: Cutting Tools
R.S.A. 4: Knurling
R.S.A. 5: Shoulder Turning and Necking
R.S.A. 6: Filing and polishing
R.S.A. 7: Drilling and Reaming
R.S.A. 8: Tapping
R.S.A. 9: Screw Threads Standard
R.S.A. 10: Internal Threading

PLUMBING

Job 1: Setting grade lines for house sewer
Job 2: Thread and connect pipe
Job 3: Cut, bend, and flare copper tubing
Job 4: Cutting and joining cast iron pipe

R.S.A. A: Background of the plumbing trade
R.S.A. 1: Cesspools
R.S.A. 2: Septic tanks
R.S.A. 3: Purification and disposal of discharged effluent, the filter trench and the distribution field
R.S.A. 4: Tools and procedures for cutting and threading pipe
R.S.A. 5: Tools, methods, and fittings for joining copper tubing
R.S.A. 6: Materials used for sewage and vent pipes: Terra cotta; cast iron; galvanized and copper pipe

SMALL ENGINES

Unit I - Basic Repair Skills

R.S.A. 1: Fastening Devices, Calipers, and Thread Gages
Job 1: Identify Bolts and Nuts

R.S.A. 2: Drills, Taps, and Dies
R.S.A. 2A: Tools
Job 2: Make Internal Thread Block and Studs

Course Outline (Continued)

Unit I - Basic Repair Skills (Continued)

R.S.A. 3: Installing Studs and Removing Broken Studs
Job 3: Remove a Broken Stud

R.S.A. 4: Soldering
Job 4: Make a Solder Joint

R.S.A. 5: Hand Tools and How to Use
Job 5: Identify Hand Tools

R.S.A. 6: Tubing
Job 6: Single Flare Copper Tubing

Unit II - Engine Overhaul

R.S.A. 1: Starting, Stopping, and Storing Small Engines
Job 1: Start and Stop Engine (4 Stroke Cycle)

R.S.A. 2: Principles of Operation, Four Stroke Cycles and Two Stroke Cycle

R.S.A. 3: Cooling and Lubrication
Job 2: Clean Air Cooling System (Any Make)

R.S.A. 4: Operation, Repair, Timing, and Adjustment of Valves
Job 3: Reface Valves and Seats (Head and Valve Cover Removed)
Job 4: Remove Old and Install New Valve Seat Insert
Job 5: Counterbore Cylinder for Valve Seat Insert (Valves Removed)

R.S.A. 5: Cylinders
R.S.A. 5A: The Micrometer
Job 6: Hone Cylinder For Oversize Piston, (Aluminum)
Job 7: Hone Cylinder For Oversize Piston, (Cast Iron)

R.S.A. 6: Pistons, Rings and Pins
Job 8: Remove and Replace Connecting Rod, Piston, and Piston Rings (Briggs & Stratton 8 BH)
Job 9: Remove and Replace Connecting Rod, Piston, and Piston Rings, (Briggs and Stratton Model 8)

R.S.A. 7: Connecting rods, Crank and Camshafts, Bearings and Seals
Job 10: Check and Align Connecting Rod
Job 11: Remove and Replace Connecting Rod, Piston, and Piston Rings, (Clinton Model VS 800)
Job 12: Remove Old and Install New Crankshaft Seals and Bearings (Plain Type)

Course Outline (Continued)

Unit II - Engine Overhaul (Continued)

Job 13: Overhaul Engine, Briggs & Stratton 8 B-H with Rewind Starter

Job 14: Complete Engine Overhaul, Briggs & Stratton Model 8

Job 15: Complete Engine Overhaul, Clinton Model VS 800

Job 16: Complete Engine Overhaul, Clinton Model AVS 400

Job 17: Complete Engine Overhaul, Lauson Model V17

Job 18: Complete Engine Overhaul, Power Products Type 710112

Unit III - Starting Mechanisms

R.S.A. 1: Manual Starters
Job 1: Disassemble and Repair, Rewind Starter, Briggs & Stratton 8 B-H
Job 2: Disassemble and Repair Rewind, Clinton A VS 400 (Fairbanks Morse)
Job 3: Repair Recoil Starter, Lauson V-17

Unit IV - Magneto Ignition

R.S.A. 1: Magnetism and Electricity
Job 1: Repair Ignition System, Briggs & Stratton 8 B-H
Job 2: Repair Ignition System, Briggs & Stratton Model 8
Job 3: Repair Ignition System, Clinton VS 800

R.S.A. 2: Magneto Construction and Operation
Job 4: Repair Ignition System, Clinton AVS-400
Job 5: Repair Ignition System, Lauson V-17, Wico Magneto
Job 6: Repair Ignition System, Power Products Type 710112, Phelon Magneto

Unit V - Fuel System

R.S.A. 1: Carburetion and Fuel System
Job 1: Repair and Adjust Carburetor and Governor, Briggs & Stratton 8 BH (Float Type)
Job 2: Repair and Adjust Carburetor and Governor, Briggs and Stratton, Model 8 (Gravity Feed Carburetor, Air Vane Governor)

Course Outline (Continued)

Unit V - Fuel System (Continued)

R.S.A. 2: Governors
R.S.A. 3: Repair and Adjust Carburetor and Governor, Clinton VS 800 (Carter Type N)

Job 4: Repair and Adjust Carburetor and Governor, Clinton A VS 400; Clinton Carburetor Type LMG - 13

Job 5: Repair and Adjust Carburetor and Governor, Lauson V 17, Walbro Carburetor

Job 6: Repair and Adjust Carburetor and Governor, Power Products Type 710112, Tillotson Carburetor Series MT 33A

Job 7: Repair Diaphragm Carburetor, Tillotson HL Series

Unit VI - Applications

R.S.A. 1: Types and Construction of Outboard Lower Units
Job 1: Repair Water Pump and Gear Case Assembly, Johnson Model CD

Job 2: Repair Water Pump and Gear Case, Scott-Atwater 5 H.P., 1954 and up (Powerhead Removed)

R.S.A. 2: Small Engine Clutches
Job 3: Remove and Repair Centrifugal Clutch, Clinton Direct

TRACTOR MAINTENANCE AND REPAIR

Unit I - Preventive Maintenance Fundamentals

PACKAGE #1

Math 1 The Steel Rule
R.S.A. 1 Fastening Devices, Calipers, and Thread Gages
Job 1 Identify Bolts and Nuts

PACKAGE #2

R.S.A. 2 Drills, Taps, and Dies
Job 2 Make Internal Thread Block and Studs
J.I.S. 1 Tools (For use with Job 2)

Course Outline (Continued)

Unit I - Preventive Maintenance Fundamentals - (Continued)

PACKAGE #3

R.S.A.	3	Installing Studs and Removing Broken Studs
Job	3	Remove a Broken Stud
Math	2	Addition and Subtraction of Scale Measurements

PACKAGE #4

R.S.A.	4	Soldering
Job	4	Make a Solder Joint

PACKAGE #5

Job	5	Start, Operate and Stop Tractor

PACKAGE #6

R.S.A.	5	Hand Tools and How to Use
Job	6	Identify Hand Tools

PACKAGE #7

R.S.A.	6	Tire Service
Job	7	Remove, Repair, and Replace Tire and Tube

PACKAGE #8

Math	3	Addition and Subtraction of Whole Numbers
R.S.A.	7	Lubrication
Job	8	Lubricate Tractor

PACKAGE #9

R.S.A.	8	Lubricating Oils and Oil Filters
Job	9	Drain, Flush, Refill Crankcase and Service Oil Filter

PACKAGE #10

R.S.A.	9	Battery Service
Job	10	Service a Battery

PACKAGE #11

R.S.A.	10	Cooling Systems
Job	11	Flush Cooling System

Course Outline (Continued)

Unit II - Front Axle and Steering Gear

PACKAGE #12

R.S.A.	11	Front Wheel Service
Job	12	Remove, Repack, and Adjust Front Wheel Bearings
Math	4	Multiplication in Whole Numbers

PACKAGE #13

R.S.A.	12	Front Axles
Job	13-B	Set Toe-In (Ford, 8N)
Job	13-C & E	Set Toe-In (Farmall, Super-A and Case, LA)
Math	5	Division of Whole Numbers

PACKAGE #14

R.S.A.	13	Reamers and Reaming
Job	14-B	Renew Spindle Bushings (Ford, 8N)
Job	14-C	Rebush Steering Knuckles (Farmall, Super-A)
Job	14-E	Renew Kingpin Bushings (Case, LA)
Job	15-B	Renew Axle Pin Bushing (Ford, 8N)
Job	15-C	Renew Axle Pivot Shaft Bushings (Farmall Super-A)
Job	15-E	Renew Axle Pivot Shaft Bushing (Case L.A.)
Math	6	Changing Fractions

PACKAGE #15

Job	16-A	Renew Vertical Spindle Bushing (John Deere-B)
Job	17-A	Repair Roll-O-Matic (John Deere-B)
Job	18-D	Renew Front Wheel Felt Washers (Allis-Chalmer, W.C.)
R.S.A.	14	Steering Gears and Adjustment
Job	19-A	Adjust Steering Gear (John Deere-B)

PACKAGE #16

Job	19-B	Adjust Steering Gear (Ford, 8N)
Job	19-D	Adjust Steering Gear (Allis-Chalmers, W.C.)
Job	19-E	Adjust Steering Gear (Case, LA)
R.S.A.	15	Tie Rod Ends and Universal Joints
Job	20-B	Overhaul Steering Gear (Ford, 8N)
Job	20-C	Overhaul Steering Gear (Farmall, Super-A)
Job	20-E	Overhaul Steering Gear (Case, LA)

Unit III - Cooling System

PACKAGE #17

R.S.A.	16	Radiators and Radiator Service

Course Outline (Continued)

Unit III - Cooling System (Continued)

PACKAGE #17

Math	7	Addition and Subtraction of Fractions
Job	21	Remove and Repair Radiator

PACKAGE #18

R.S.A.	17	Fans and Fan Drives
Math	8	Multiplication of Fractions
Job	22-A	Repair Fan Assembly (John Deere-B) (Hood and Radiator Removed)
Job	22-C	Repair Fan Assembly (Farmall Super-A)
Job	23-A	Check and Repair Ventilator Pump (John Deere-B) (Fan Assembly Removed)

PACKAGE #19

Math	9	Division of Fractions
R.S.A.	18	Water Pumps
Job	24-B	Remove, Repair, and Replace Water Pump (Ford 8N)
Job	24-D	Remove, Repair, and Replace Water Pump (Allis-Chalmer WC)
Job	24-E	Remove, Repair, and Replace Water Pump (Case LA)

PACKAGE #20

R.S.A.	19	Thermostats, Shutters, and Temperature Gages
Job	25	Remove, Check, and Replace Thermostat (Radiator Drained)

Unit IV - Attachments

PACKAGE #21

R.S.A.	20	Power Take-offs and Drawbars
Job	26-C	Remove, Repair, and Replace Power Take-Off (Farmall, Super-A) (To be performed with Job No. 27-C)
Job	26-D	Remove, Repair, and Replace Power Take-Off (Allis-Chalmers W.C.)
Job	26-E	Remove, Repair, and Replace Power Take-Off (Case LA)

PACKAGE #22

Math	10	Pulley Speeds and Sizes
R.S.A.	21	Belt Pulleys and Pulley Speeds

Course Outline (Continued)

PACKAGE #22

Job	27-B	Remove, Repair, and Replace Belt Pulley (Ford 8N)
Job	27-C	Remove, Repair, and Replace Belt Pulley (Farmall, Super-A) (To be performed with Job No. 26-C)
Job	27-D	Remove, Repair, and Replace Belt Pulley (Allis-Chalmers W.C.)

PACKAGE #23

Math	11	The Decimal System
R.S.A.	22	Lighting Systems, Lights and Light Switches
Job	28-A	Install Lighting Attachment (John Deere-B)
Job	28-B	Install Lighting System (Ford 8N)
Job	28-C	Install Lighting System (Farmall, Super-A)
Job	28-D	Install Lighting System (Allis-Chalmers, W.C.)
Job	28-E	Install Lighting System (Case, LA)

PACKAGE #24

Math	12	Addition and Subtraction of Decimal Fractions
R.S.A.	23	Basic Hydraulic Principles and General Power Lift Operation
R.S.A.	23-A	Powr-Trol and Power Lift (John Deere, B)*
R.S.A.	23-B	Hydraulic Control Unit (Case L.A.)
R.S.A.	23-C	Touch-Control System (Farmall, Super A)
R.S.A.	23-E	Hydraulic Control Unit (Case L.A.)
Job	26-B	Remove and Repair Power Take-Off Shaft (Ford 8N)
Job	29-A	Repair Powr-Trol (John Deere-B)
Job	29-B	Remove, Repair, and Replace Hydraulic Control (Ford, 8N)
Job	29-C	Remove, Repair, and Replace Touch Control (Farmall, Super-A)
Job	29-D	Remove, Repair, and Replace Mechanical Lift (Allis-Chalmers, W.C.)
Job	29-E	Remove, Repair, and Replace Hydraulic Control Unit (Case, LA)

Unit V - Rear Axle, Final Drive, and Brakes

PACKAGE #25

Math	13	Multiplication of Decimal Fractions
R.S.A.	24	Bearings, Seals and Closures
Job	30-C	Remove, Repair and Reassemble Final Drive (Farmall, Super-A)
Job	30-D	Disassemble, Repair, and Reassemble Final Drive (Allis-Chalmers, WC)
R.S.A.	25	Tractor Final Drives
Job	33-D	Remove, Repair, and Replace Brakes (Allis Chalmers W.C.) (Final Drive Disassembled)

Course Outline (Continued)

PACKAGE #26

R.S.A. 26	Types of Rear Axles and Their Adjustment
Job 31-A	Remove and Renew Rear Axle Bearings or Seals (John Deere-B)
Job 31-B	Remove and Renew Rear Axle Bearings or Seals (Ford 8N)
Job 31-E	Remove and Renew Rear Axle Bearings or Seals (Case, LA)

PACKAGE #27

Math 14	Division of Decimals
R.S.A. 27	Brakes
Job 32-A	Adjust Brakes (John Deere-B)
Job 32-B	Adjust Brakes (Ford 8N)
Job 32-C	Adjust Brakes (Farmall, Super-A)
Job 32-D	Adjust Brakes (Allis Chalmers, WC)
Job 32-E	Adjust Brakes (Case, LA) (Mechanical-Internal Expanding)
Job 32-E	Adjust Hydraulic Brakes (Case, LA) (Minor Adjustment)
Job 32-E	Adjust Hydraulic Brakes (Case, LA) (Major Adjustment)
Job 32-X	Adjust Disc Type Brakes (All Models)
Job 33-A	Remove, Repair, and Replace Brakes (John Deere-B)
Job 33-B	Disassemble, Repair and Reassemble Brakes (Ford 8N) (Wheel and Brake Drum Removed)
Job 33-E	Remove, Repair, and Replace Brakes (Case, LA)
Job 33-E	Disassemble, Repair, and Reassemble Brakes (CASE, LA) (Hydraulic Brakes
Job 33-X	Remove, Repair, and Replace Disc Brakes (All Models)

Unit VI - Differential

PACKAGE #28

Math 15	Changing Common Fractions to Decimals
Math 16	The Micrometer
R.S.A. 28	Ring Gear and Pinion Adjustments
Job 34-C	Adjust Ring Gear and Pinion (Farmall, Super-A) (Final Drive Removed)
Job 34-D	Adjust Ring Gear Backlash (Allis-Chalmers, WC)
R.S.A. 29	Differential Construction and Operation
Job 35-A	Remove, Repair, and Reassemble Differential (John Deere-B)
Job 35-B	Remove, Repair, and Reassemble Differential (Ford, 8-N)

Course Outline (Continued)

PACKAGE #28

Job 35-C	Remove, Repair, and Reassemble Differential (Farmall, Super-A)
Job 35-D	Remove, Repair and Reassemble Differential (Allis Chalmers, WC.)
Job 35-E	Remove, Repair, and Reassemble Differential (Allis Chalmers, WC.)
Job 36-D	Disassemble, Repair, and Reassemble Torque Tube (Allis-Chalmers, WC.)
R.S.A. 30	Getting and Holding a Job

Unit VII - Transmissions

PACKAGE #29

R.S.A. 31	Transmission Shifter Mechanism
Job 37-A1	Disassemble, Repair, and Reassemble Shifter Mechanism (John Deere-B) (Differential Removed) (Serial No. B-9600 to B-201000)
Job 37-A2	Disassemble, Repair, and Reassemble Shifter Mechanism (John Deere-B) (Differential Removed) (Serial No. B-201000 and Up)
Job 37-B	Disassemble, Repair, and Reassemble Shifter Mechanism (Ford, 8-N) (Differential Removed)
Job 37-C	Remove, Repair, and Replace Shifter Mechanism (Farmall, Super-A)
Job 37-D	Remove, Repair, and Replace Shifter Mechanism (Allis-Chalmers, WC.)
Job 37-E	Repair and Replace Shifter Mechanism (Case, LA.) (Differential Removed)

PACKAGE #30

Math 17	Gear Ratios
R.S.A. 32	Transmissions
R.S.A. 32-A1	Transmission Construction and Operation (John Deere-B, Serial No. B-96000 to B-201000)
Job 38-A1	Disassemble, Repair, and Reassemble Transmission (John Deere-B) (Differential and Shifter Mechanism Removed) (Serial No. B-96000 to B-201000)
R.S.A. 32-A2	Transmission Construction and Operation (John Deere-B) (Serial No. 201000 and up)
R.S.A. 38-A2	Disassemble, Repair, and Reassemble Transmission (John Deere-B) (Serial No. B-201000 and Up) (Differential and Shifter Mechanism Removed)

Course Outline (Continued)

PACKAGE #30

R.S.A.	32-B	Transmission Construction and Operation (Ford, 8-N)
Job	38-B	Disassemble, Repair, and Reassemble Transmission (Ford, 8-N) (To be Performed with Job No. 37-B)
Job	38-C	Disassemble, Repair, and Reassemble Transmission (Farmall, Super A.) (Differential and Torque Tube Removed)
Job	38-D	Remove, Repair, and Replace Transmission (Allis-Chalmers, W.C.) (Differential and Torque Tube Removed)
Job	38-E	Disassemble, Repair, and Reassemble Transmission (Case, LA) (Differential and Shifter Mechanism Removed)
Job	26-A	Remove and Repair Power Shaft (John Deere-B)

Unit VIII - Clutches

PACKAGE #31

R.S.A.	33	Types of Clutches; Care and Operation
Math	18	Simple Percentage
Job	39-A	Repair and Adjust Clutch, Farmall A, B, or C
Job	39-B	Repair and Adjust Clutch, Allis-Chalmers WD
Job	39-C	Repair and Adjust Clutch, Ford 8N
Job	39-D	Repair and Adjust Clutch, John Deere B

Unit IX - Fuel Systems

PACKAGE #32

R.S.A.	34	Fuel Supply and Replace Carburetor
Job	40-A	Remove, Repair, and Replace Carburetor, Farmall A, B, or C
Job	40-B	Remove, Repair, and Replace Carburetor, Allis-Chalmers WD.
Job	40-C	Remove, Repair, and Replace Carburetor, Ford 8N
Job	40-D	Remove, Repair, and Replace Carburetor, John Deere B

PACKAGE #33

R.S.A.	35	Governors, Types and Operations
Math	19	Discount
Job	41-A	Remove, Repair, and Replace Governor, Farmall A, B, or C
Job	41-B	Remove, Repair, and Replace Governor, Allis Chalmers WD

Course Outline (Continued)

PACKAGE #33

Job	41-C	Remove, Repair, and Replace Governor, Ford 8N
Job	41-D	Remove, Repair, and Replace Governor, John Deere B

Unit X - Magneto Ignition

PACKAGE #34

R.S.A.	36	Magnetism and Electricity
R.S.A.	37	Magneto Construction and Operation
Job	42-A	Disassemble, Repair and Reassemble Magneto, Farmall A, B, or C

PACKAGE #35

R.S.A.	38	Impulse-Starter Couplings; Timing and Care of the High-Tension Magneto
Math	20	Personal Checks and Drafts
Job	42-B	Disassemble, Repair and Reassemble Magneto, Allis-Chalmers WD
Job	42-C	Disassemble, Repair and Reassemble Magneto, (John Deere B)

Unit XI - Battery Ignition

PACKAGE #36

R.S.A.	39	Types and Requirements of Battery Ignition Systems
Job	43-B	Disassemble, Repair, and Reassemble Distributor, Allis-Chalmers WD

PACKAGE #37

R.S.A.	40	Coils, Condensers, Contact Points, Distributor, and Spark Plugs
Job	43-C	Disassemble, Repair, and Reassemble Face Mounted Distributor, Ford 8N
Job	43-D	Disassemble, Repair, and Reassemble Angle Mounted Distributor, Ford 8N
Job	43-E	Remove, Clean, Adjust and Replace Spark Plugs

Unit XII - Cranking Motors

PACKAGE #38

R.S.A.	41	Operating Principles of Cranking Motors and Drives
Math	21	Work Orders and Bills
Job	44	Remove, Overhaul, and Replace Cranking Motor

Course Outline (Continued)

Unit XIII - Generators

PACKAGE #39

R.S.A.	42	Generator Construction and Operation
Job	45	Remove, Disassemble, Repair and Replace a Generator

PACKAGE #40

R.S.A.	43	Cutout Relays and Step-voltage Controls
Math	22	Keeping Accounts
Job	46	Remove, Check, and Adjust Step-Voltage Control

Unit XIV - Engines

PACKAGE #41

R.S.A.	44	Engine Fundamentals
Job	47	Clean Engine With Cold or Hot Degreasing Solution
Job	48	Remove and Replace Expansion Plug

PACKAGE #42

R.S.A.	45	Valve Types and Construction
R.S.A.	46	Valve Mechanisms
Job	49	Reface Rocker Arms

PACKAGE #43

R.S.A.	47	Valve Service
Job	50	Remove, Clean, and Replace Rocker Arms
Job	51	Grind Valves on I-Head Engine
Job	52	Grind Valves on L-Head Engine

PACKAGE #44

R.S.A.	48	Pistons, Piston Rings, Cylinders and Sleeves
Job	58	Remove Old and Install New Piston Rings
Job	59	Remove Old and Install New Cylinder Sleeves, Dry Type
Job	60	Remove and Install Cylinder Sleeve, Wet Type
Job	61	Rebore Cylinder
Job	62	Hone Cylinder and Fit Piston

PACKAGE #45

R.S.A.	49	Piston Pins and Bushings, Connecting Rods, Crankshaft and Main Bearings

Course Outline (Continued)

PACKAGE #45

Job 53 Remove Old and Fit New Piston Pins and Bushings
Job 54 Install New Ring Gear on Flywheel
Job 55 Adjust Connecting Rod Bearings With Engine in Tractor, John Deere (Shim Type)
Job 56 Install New Connecting Rod Bearings With Engine in Tractor (Insert Type)
Job 57 Adjust Main Bearings, John Deere B

PACKAGE #46

R.S.A. 50 Engine Lubrication Systems
Job 63 Remove, Inspect, and Replace Oil Pump

PACKAGE #47

Job 64 Overhaul Engine Completely (Except John Deere)

PACKAGE #48

Job 65 Overhaul Engine Completely, John Deere B

WELDING

Unit I - Welding - Oxyacetylene

Job No. 1: Safety Rules for Oxyacetylene Welding
Mathematics
Related-Technical Information

Job No. 2: Set Up Oxyacetylene Welding Equipment
Mathematics
Related-Technical Information

Job No. 3: Regulate Oxygen and Acetylene Pressure and Light a Torch
Mathematics
Related-Technical Information

Job No. 4: The Cutting Torch and Flame Cutting Steel
Mathematics
Related-Technical Information

Job No. 5: Flat Welding Without Filler Rod
Mathematics
Related-Technical Information

Course Outline (Continued)

Job No. 6: Flat Welding with Filler Rod (All Joints)
Mathematics
Related-Technical Information

Job No. 7: Vertical Welding (All Joints)
Mathematics
Related-Technical Information

Job No. 8: Vee Butt (Overhead)
Mathematics
Related-Technical Information

Job No. 8A: Fillet Weld (Overhead)
Mathematics
Related-Technical Information

Job No. 9: Butt Weld, Forehand - Backhand (Horizontal)
Mathematics
Related-Technical Information

Job No. 10: Bronze Weld Steel
Mathematics
Related-Technical Information

Job No. 11: Bronze Weld Cast Iron
Mathematics
Related-Technical Information

Job No. 12: Low Temperature Brazing
Mathematics
Related-Technical Information

Job No. 13: Welding Aluminum
Mathematics
Related-Technical Information

Job No. 14: Special Projects
Mathematics
Related-Technical Information

Job No. 15: Butt Weld Pipe (Roll)
Mathematics
Related-Technical Information

Job No. 16: Butt Weld Pipe Fixed Position Bellhole
Mathematics
Related-Technical Information

Job No. 17: Butt Weld Pipe Fixed Position Horizontal
Mathematics
Related-Technical Information

Course Outline (Continued)

Unit II - Welding - Arc

Job No. 1: Shop Safety
Blueprint Reading
Mathematics
Related-Technical Information

Job No. 2: Use and Care of Equipment
Blueprint Reading
Mathematics
Related-Technical Information

Job No. 3: Stringer Beads (Flat)
Blueprint Reading
Mathematics
Related-Technical Information

Job No. 4: Continuous Stringer Beads
Blueprint Reading
Mathematics
Related-Technical Information

Job No. 5: Weave Beads
Blueprint Reading
Mathematics
Related-Technical Information

Job No. 6: Tee Joint (Flat)
Blueprint Reading
Mathematics

Job No. 7: Outside Corner Joint (Flat)
Blueprint Reading
Mathematics
Related-Technical Information

Job No. 8: V-Butt Joint - Back-up Strip (Flat)
Blueprint Reading
Related-Technical Information

Job No. 9: V-Butt Joint - Open (Flat)
Blueprint Reading
Related-Technical Information

Job No. 10: Lap Joint (Horizontal)
Blueprint Reading
Related-Technical Information

Job No. 11: Tee Joint - Stringer Beads (Horizontal)
Blueprint Reading
Related-Technical Information

Course Outline (Continued)

Job No. 12: Tee Joint - Weave Bead (Horizontal)
Blueprint Reading
Related-Technical Information

Job No. 13: Stringer Beads on Horizontal Plate (Horizontal)
Blueprint Reading
Related-Technical Information

Job No. 14: V-Butt Joint - Back-up Strip (Horizontal)
Blueprint Reading

Job No. 15: V-Butt Joint - Open (Horizontal)
Blueprint Reading

Job No. 16: Stringer Beads - Travel Down (Vertical)
Blueprint Reading
Related-Technical Information

Job No. 17: Lap Joint - Travel Down (Vertical)
Blueprint Reading
Related-Technical Information

Job No. 18: Stringer Beads, Travel Up (Vertical)
Blueprint Reading

Job No. 19: Weave Beads, Vertical Position
Blueprint Reading

Job No. 20: Lap Joint, Vertical Position
Blueprint Reading

Job No. 21: Tee Joint, Vertical Position
Blueprint Reading

Job No. 22: Outside Corner Joint, Vertical Position (Vertical)
Blueprint Reading

Job No. 23: V-Butt Joint - Back-up Strip (Vertical)
Blueprint Reading

Job No. 24: V-Butt Joint - Open (Vertical)
Blueprint Reading

Job No. 25: Stringer Beads (Overhead)
Blueprint Reading

Job No. 26: Weave Beads

Job No. 27: Lap Joint (Overhead)

Course Outline (Continued)

Job No. 28: Tee Joint - Stringer Beads (Overhead)

Job No. 29: Tee Joint, Overhead - Weaved Bead Technique

Job No. 30: V-Butt Joint, Backup Strip (Overhead)

Job No. 31: V-Butt Joint, Open (Overhead)

Job No. 32: Butt Joint, Pipe (Roll Weld)
Layout
Related-Technical Information

Job No. 33: Butt Joint Pipe (Fixed Position)
Layout
Related-Technical Information

Job No. 34: Butt Weld Pipe (Horizontal Position)
Layout
Related-Technical Information

Job No. 35: Two Piece 90° Turn
Layout
Related-Technical Information

Job No. 36: Tee Weld
Layout
Related-Technical Information

Job No. 37: "Y" In Fixed Position
Layout

The Fundamental Electrical Course was published in 1955 and revised in 1962. It is available in the following forms:

Book I
- Related Study Assignments Units I & II
- Jobs Units I & II

Book II
- Related Study Assignments Units III, IV, & V
- Jobs Units III, IV, & V

Book III
- Related Study Assignments Unit VI
- Jobs Unit VI

Book IV
- Related Study Assignments Units VII, VIII, & IX
- Jobs Units VII, VIII, & IX

Book V
- Related Study Assignments Units X & XI
- Jobs Units X & XI

Mathematics
- All Math is included in the Related Study Assignment Books I - V

Test Books

Book I	Units I & II
Book II	Units III, IV, & V
Book III	Unit VI
Book IV	Units VII, VIII, IX, X, & XI

Answer Book
- Complete for tests and math

The following instructor's aids are available:
- Progress Chart
- Individual folder type

The references for the Electrician Course are the following

Title	Source
Hausmann, Erich SWOOPE'S LESSONS IN PRACTICAL ELECTRICITY	D. Van Nostrand Co., Inc., 120 Alexandria Street Princeton, New Jersey
Loper, Orla E. DIRECT CURRENT FUNDAMENTALS	Delmar Publishers, Inc. Mountainview Avenue Albany 5, New York

References (Continued)

Title	Source
Uhl, Dunlap, and Flynn INTERIOR ELECTRIC WIRING AND ESTIMATING--RESIDENTIAL	American Technical Society 848 East 58th Street Chicago 37, Illinois
Richter, H. P. PRACTICAL ELECTRICAL WIRING	McGraw-Hill Book Company, Inc. 330 West 42nd Street New York 36, New York
THE NATIONAL ELECTRICAL CODE	The National Board of Fire Underwriters 85 John Street New York 38, New York
Cooke, Nelson M. BASIC MATHEMATICS FOR ELECTRONICS	McGraw-Hill Book Company, Inc. 330 West 42nd Street New York 36, New York
DUAL ELEMENT FUSE CATALOG	Bussman Mfg. Division University at Jefferson St. Louis 7, Missouri
250) 700) Manual - Instruction Sheets --Rotating Electrical Machinery (Navy Common Core) --Crow Rotating Electric Machine - Zitzman	Universal Scientific Co., Inc. 1312 S. Thirteenth Street Vincennes, Indiana
Duff, John R. BASIC ELECTRICITY 2 (A. C. FUNDAMENTALS)	Delmar Publishers, Inc. Mountainview Avenue Albany 5, New York
Nadon, John M. and Gelmine, Bert J. INDUSTRIAL ELECTRICITY	D. Van Nostrand Co., Inc. 120 Alexander Street Princeton, New Jersey
WESTINGHOUSE LIGHTING HANDBOOK	Westinghouse Electric Supply Company 1299 Northside Drive, N. W. Atlanta 2, Georgia
Rasch, William Edward PRACTICAL ELECTRICAL MATHEMATICS	D. C. Heath and Co. 285 Columbus Avenue Boston 16, Massachusetts

References (Continued)

Title	Source
Rosenberg, Robert ELECTRIC MOTOR REPAIR	Holt, Rinehart and Winston, Inc. 383 Madison Avenue New York 17, New York
Crouse, William H. AUTOMOTIVE ELECTRICAL EQUIPMENT	McGraw-Hill Book Company, Inc. 330 West 42nd Street New York 36, New York
DELCO-REMY, 12 Volt Electrical Equipment for 1958 Cars, DR-5210	Delco-Remy Division General Motors Corporation Anderson, Indiana
STEEL ELECTRICAL RACEWAYS	American Iron and Steel Institute 150 East Forty-second Street New York 17, New York
Abbott, Arthur L. THE NATIONAL ELECTRICAL CODE HANDBOOK	McGraw-Hill Book Company, Inc. 330 West 42nd Street New York 36, New York
Graham, Kennard C. NATIONAL ELECTRICAL CODE AND BLUEPRINT READING	American Technical Society 848 East 58th Street Chicago 37, Illinois
CHROMALOX ELECTRIC COMFORT HEATING	Edwin L. Wiegand Co. 7500 Thomas Blvd. Pittsburgh 8, Pa.
NEMA MANUAL FOR ELECTRIC HOUSE HEATING	National Electrical Mfgs. Association 115 East 44 Street New York 17, New York
ELECTRICAL BLUEPRINT READING AND SKETCHING-RESIDENTIAL	Delmar Publishers, Inc. Mountainview Avenue Albany 5, New York
Crouse, William H. ELECTRICAL APPLIANCE SERVICING	McGraw-Hill Book Co. 330 West 42nd Street New York 36, New York
Gibbs, J. B. TRANSFORMER PRINCIPLES AND PRACTICE	McGraw-Hill Book Co., Inc. 330 West 42nd Street New York 36, New York

References (Continued)

Title	Source
ELECTRICAL METERMAN'S HANDBOOK Terms and Definitions	Edison Electric Institute 420 Lexington Avenue New York 17, New York
Braymer, Daniel H. and Roe, A. C. REWINDING SMALL MOTORS	McGraw-Hill Book Company, Inc. 330 West 42nd Street New York 36, New York
Veinott, Cyril G. FRACTIONAL HORSEPOWER ELECTRIC MOTORS	McGraw-Hill Book Company, Inc. 330 West 42nd Street New York 36, New York
Heine, Dunlap, and Jones HOW TO READ ELECTRICAL BLUEPRINTS	American Technical Society 848 East 58th Street Chicago 37, Illinois
Van Valkenburgh, Nooger, Neville, Inc. BASIC SYNCHROS AND SERVOMECHANISMS	John F. Rider Publisher, Inc. 116 West 14th Street New York 11, New York
Crow, Leonard R. LEARNING ELECTRICITY AND ELECTRONICS EXPERIMENTALLY	Educational Publishers, Inc. St. Louis, Missouri
GENERAL DESCRIPTION FOR D. C. VARIABLE DRIVE	Fidelity Instrument Corporation 100 E. Boundary Avenue York, Pennsylvania
DESCRIPTION OF OPERATION AND SERVICE INSTRUCTIONS, MODEL F-29B SPEED REGULATOR	Fidelity Instrument Corporation 100 E. Boundary Avenue York, Pennsylvania

A detailed outline of the Fundamental Electrical Course follows.

Unit I - Fundamental Theory of Electricity

R.S.A.	1	Care and Use of Hand Tools and Equipment
Job	1	Identify Hand Tools in Your Shop
R.S.A.	2	Hack Saws, Hack Saw Blades, Vise, and Ruler
Job	2	Cut Conduit and Wire to Specified Length
R.S.A.	3	Electron Theory and Static Charges
Job	3	Prove Laws of Electrical Charges and Effects of Static Charges
R.S.A.	4	Electric Current and Electron Flow
Job	4	Produce Electron Movement and Current Flow

Unit I - Fundamental Theory of Electricity (Continued)

R.S.A.	5	Voltage, Current, Resistance and Conductance
R.S.A.	6	Properties of Magnets and Magnetic Fields
Job	6	Determine the Polarity of Magnets and the Existence of Magnetic Field
R.S.A.	7	Electromagnetism and Electromagnets
Job	7A	Perform Oersted's Experiment of Magnetic Effects of an Electric Current
Job	7B	Make an Electromagnet and Study its Characteristics
R.S.A.	8	Means of Developing Electromotive Forces
Job	8	Produce E.M.F. by Three Different Methods
R.S.A.	9	Primary Cells
Job	9	Testing Voltage and Amperage of a Dry Cell, and Methods of Connecting Dry Cells
R.S.A.	10	Secondary Cells
Job	10	Construct and Test Secondary or Storage Cells

Unit II - Principles of Direct Current

R.S.A.	1A	Care and Use of Power Operated Tools
Job	1A	Installing Fasteners in Masonry Construction
R.S.A.	1B	Types of Fasteners
Job	1B	Installing Fasteners in Masonry Construction
R.S.A.	2	Tap Drill Figures
Job	2	Lay Out Plate For Drilling
Job	3	Figure Tap Drill Sizes
Job	4	Drilling
Job	5	Taps and Tapping
R.S.A.	3	Types of Wire and Cable and The Use of The American Wire Gauge and Micrometer
R.S.A.	4	Wire Connections and Soldering
Job	6	Make a Rat-tail Splice, a Tap Splice and a Fixture Splice
Job	7	Make a Western-Union Splice and a Cable Splice
Job	8	Soldering Wires in Terminal Lugs
R.S.A.	5	Mathematics - Ohm's Law--Series Circuits
Job	9	Construct a Series Circuit and Take Voltage and Ammeter Readings
R.S.A.	6	Mathematics - Ohm's Law--Parallel Circuits
Job	10	Construct a Parallel Circuit and Take Voltage and Ammeter Readings
R.S.A.	7	Mathematics - Ohm's Law--Series Parallel Circuits
Job	11	Construct a Series Parallel Circuit and Take Voltage and Ammeter Readings
R.S.A.	8	Circuit Sketching, Cells in Series, Parallel and Series-Parallel
Job	12	Connect Cells in Series, Parallel and Series and Parallel and Take Voltage Reading

Unit II - Principles of Direct Current (Continued)

R.S.A.	9	Low Voltage Signal Circuits
Job	13A	Connect 2 Vibrating Bells in Parallel, Using 1 Push Button and 2 Cells in Series
Job	13B	Wire a Department Return-Call Bell Circuit, Using Single-Contact Push Buttons
Job	13C	Connect and Install a Department Return-Call System Using Four Department Bells and One Master Bell With Eight Single-Contact Push Buttons
Job	13D	Connect a Six-Point Manual-Reset Annunciator to be Controlled from Six Single-Contact Push Buttons
R.S.A.	10	Fuses and Circuit Breakers
Job	14	Test for Blown Fuses in Fuse Panel, Using a Test Socket and a Lamp Bulb
R.S.A.	11	Power in Direct Current Circuits
Job	15	Determine the Power in a D.C. Circuit
R.S.A.	12	Principles of Dynamo-Electric Machines
Job	16	Construct a Direct Current Generator
R.S.A.	13	Problems Concerning Conductors
Job	17A	Learn How Electrical Resistance Varies With the Kind of Material Used
Job	17B	Learn How the Resistance of a Conductor Varies With Its Length
Job	17C	Measure Voltage Drop in a Circuit
R.S.A.	14	Direct Current Meters
Job	18	Construct an Experimental Ammeter

Unit III - Principles of Alternating Current

Math	1	Introduction to Trigonometry
Math	2	Trigonometric Functions
Math	3	Tables of Functions
Math	4	Solution of Right Triangles
Math	5	Periodic Functions
Math	6	Elementary Plane Vectors
R.S.A.	1A	Alternating Currents and Voltages
R.S.A.	1B	Care and Use of Portable Meters and Indicating Devices
Job	1	Assemble, Connect and Test Run a Single Phase Alternator
R.S.A.	2	Alternating Current Meters
Job	2	Convert a D'Arsonval Meter Movement to Measure Alternating Current Voltage
R.S.A.	3A	Study the Oscilloscope
Job	3A	Operation of the Oscilloscope
R.S.A.	3B	Study Voltage Calibrator
Job	3B	Use of the Voltage Calibrator
R.S.A.	4	Resistance and Power in AC Circuits
Job	4	Watts and Power Factor Resistor Circuits
R.S.A.	5A	Inductance
R.S.A.	5B	Inductance in AC Circuits

Unit III - Principles of Alternating Current (Continued)

Job	5	Watts and Power Factor of Inductor Circuits
R.S.A.	6A	Capacitance
R.S.A.	6B	Capacitance in AC Circuits
Job	6	Watts and Power Factor of Capacitors
R.S.A.	7A	Impedance in AC Series Circuits
Job	7A	Watts and Power Factor of Series Inductance, Capacitance Circuit
R.S.A.	7B	Resistance, Inductance and Capacitance in AC Parallel Circuits
Job	7B	Watts and Power Factors of Parallel Inductance, Capacitance Circuit
R.S.A.	7C	Series-Parallel AC Circuits
R.S.A.	8	Study the Capacitance or Condenser Tester
Job	8	Capacitor Testing
Job	9A	Inductor-Resistor Phase Shift Circuit
Job	9B	Capacitor-Resistor Phase Shift Circuit
R.S.A.	10A	Power Factor
R.S.A.	10B	Power in Single Phase Circuits
Job	10A	Check Power Factor of a Single Phase Load (Leading and Lagging)
Job	10B	Check Power Factor of Single Phase Motor Full Load
R.S.A.	11	Principles of Alternating Current
Job	11A	Connect and Meter the Current and Voltage in a 3-Phase Star Connected Circuit
Job	11B	Connect and Meter the Current and Voltage in a 3-Phase Delta Connected Circuit
R.S.A.	12	Power Transformers
Job	12	Assemble, Connect and Test Input and Output of Single Phase Transformer
R.S.A.	13	Instrument Transformers
Job	13A	Connect Potential Transformers for Metering
Job	13B	Connect Current Transformers for Metering

Unit IV - Lighting

R.S.A.	1	Facts About Lighting
Job	1	Measure Light With Light Meter
R.S.A.	2	Types of Lamps
Job	2	Construct Single-Lamp Fluorescent Light
R.S.A.	3	Computing Electric Light and Power Bills
Job	3	Read Meter and Calculate Bill

Unit V - Motors and Generators

R.S.A.	1	Direct Current Generators
Job	1	Construct a Separately-Excited D.C. Generator
R.S.A.	2	Direct Current Motors
Job	2	Construct a Series-Wound D.C. Generator and Motor

Unit V - Motors and Generators (Continued)

Job	3	Construct a Shunt Wound D.C. Generator and Motor
Job	4	Disassemble and Clean Commercial Type Shunt Motor or Generator
Job	5	Construct a Compound Wound Generator and Motor
Job	6	Disassemble and Clean Commercial Type Compound Wound Generator or Motor
R.S.A.	3	The Growler
Job	7	Armature Testing With a Growler
R.S.A.	3A	Generators
Job	8	Test a Compound Motor for Grounds and Open Circuit
Job	9	Experiment on Resistance Testing of a D.C. Compound Motor
Job	10	Determine the horsepower of A.C. and D.C. Electric Motors
R.S.A.	4	Principles of Alternating Current Motors
Job	11	Construct an A.C. Induction Motor--Four Pole--Split Phase--Starting Winding
Job	12	Construct an A.C. Split Phase Motor-Capacitor Start, Also Capacitor Start, Capacitor Run
Job	13	Construct an A.C. Shaded Pole Motor
Job	14	Construct a 3-Phase Induction Motor, 6-Pole, 12-Coil Field
R.S.A.	5	Automotive Generator Service
Job	15	Disassemble and Repair Automotive Generator

Unit VI - Wiring Methods

R.S.A.	1	General Provisions of the National Electrical Code
Job	1	Connect a Light Controlled by a Single Pole Toggle Switch
R.S.A.	2	General Requirements for Wiring Methods
Job	2	Connect Two Lights in Series Controlled by a Single Pole Toggle Switch. Exposed Knob Method
R.S.A.	3	Types of Boxes, Box Covers, Box Extensions and Methods of Installation
Job	3	Connect Two Lights in Parallel Controlled by a Single Pole Toggle Switch. Exposed Knob Method.
R.S.A.	4	Polarity Identification of Systems and Circuits
Job	4	Connect a Ceiling Light Controlled by a Single Pole Toggle Switch. Concealed Knob and Tube.
R.S.A.	5	Types of Cables and Fittings
Job	5	Connect One Ceiling Light and One Receptacle, Each Controlled by a Single Pole Toggle Switch, Concealed Knob and Tube
R.S.A.	6	Branch Circuits and Service Entrance
Job	6	Install a Two Wire Service Entrance Using Two Wire Entrance Cable, a Socket Type Meter Base, and a Six Circuit-Breaker Panel

Unit VI - Wiring Methods (Continued)

R.S.A.	7	Non-Metallic Cable or Romex Wiring
Job	7	Install Two Circuits Using Non-Metallic Cable (Romex)
R.S.A.	8	Armored Cable Wiring
Job	8A	Install a 3-Wire Service Entrance, Use 3-Wire Entrance Cable, Socket Type Meter Base and a Six-Circuit Breaker Panel
Job	8B	Install 3 Circuits Using Armored Cable (BX)
R.S.A.	9	Schematic Diagraming and Wiring Plans
Job	9	Install Two Circuits Using Romex Cable
R.S.A.	10	Installing Surface Metal Raceway
Job	10A	Installing Surface Metal Raceway Install No. 200 Wiremold From Existing Baseboard Receptacle, to Single Pole Toggle on Wall to Control Ceiling Light
Job	10B	Installing Surface Metal Raceway Install No. 1900 Wiremold From Existing Baseboard Receptacle to an Extension of 5 Receptacles
R.S.A.	11	Bending Conduit and Tubing with Hand Benders
Job	11	Bend Conduit and Electrical Metallic Tubing
R.S.A.	12	Installing Conduit
Job	12A	Install a 3-Wire Service Entrance Using 1" Conduit and a Six-Circuit Breaker Panel
Job	12B	Installing Conduit Install 2 Circuits Using 1/2" Conduit
R.S.A.	13	Methods of Pulling Conductors in Raceways
Job	13	Pull Wires into Conduit and Connect
R.S.A.	14	Use of N.E.C. Tables for Calculating the Number of Conductors in Conduit or Tubing
Job	14	Install a Ceiling Light Controlled by Two 3-Way Switches. Install Two 120-Volt Receptacles. Install a Three Wire 240-Volt Circuit
R.S.A.	15	Building Structures and Architectural Symbols
Job	15	Install 1/2" E.M.T. and Wire
R.S.A.	16	Wiring in Hazardous Locations
Job	16	Hazardous and Non-hazardous Installation
R.S.A.	17	Installing Wireways, Busways, Auxiliary Gutters, and Cellular Metal Raceways
Job	17	Installing Square-Duct and Wiring Using a Square-Duct Wiring Trough. Install From a Main Switch 3 Motors of Different Sizes Each Controlled by a Separate Switch
R.S.A.	18	Garages, Service Stations, and Bulk Storage Plants
Job	18	Wiring in Inflammable Areas
R.S.A.	19	Installation Practice of Lighting Fixtures
Job	19	Wire With Romex
R.S.A.	20	Practical Blueprint Reading
Job	20	Submit Bid on Single-Family Dwelling
R.S.A.	21	Application of Home Heating
Job	21	Electric Bathroom Heater Installation

Unit VI - Wiring Methods (Continued)

R.S.A.	22	Remote Control Switching
Job	22	Wiring Remote Controlled Lighting Low Voltage Switching
R.S.A.	23	Cooking Appliances
Job	23	Install Electric Range Circuit, Energize and Trouble Shoot
R.S.A.	24	Electric Hot Water Heaters and Gas Furnace Controls
Job	24	Install Low-Voltage-Control Circuit for Gas Furnace
R.S.A.	25	Metering Polyphase Circuits With and Without Instrument Transformers
Job	25A	Connect Voltmeter and Ammeter With the Voltmeter Reading Line Voltage Only
Job	25B	Connect Wattmeter in a Single-Phase Circuit
R.S.A.	26	Illumination Design Data for Interiors
Job	26	Measure Length and Width of Wiring Booth and Figure the Number and Size of Fixtures Needed to Produce Approximately 60 Foot Candles of Lighting, 4-Feet From the Floor
R.S.A.	27	Calculations for Illuminating an Industrial Shop
Job	27	Plan and Lay Out Lighting in Shop Building by the "Lumen Method of Calculation."
R.S.A.	28	Calculating Wiring for an Industrial Shop
Job	28	Submit Bid for Complete Wiring of the Two School Shops
R.S.A.	29	Calculating, Wiring, and Illumination for Paint Shop and Finishing Room
Job	29	Submit Bid for Complete Wiring of Paint Shop and Finishing Room
R.S.A.	30	Characteristics and Working Principles of Fluorescent Lamps
Job	30	Reconnect a Two-Lamp (40 Watts Each) Fluorescent Pre-heat Type Fixture
R.S.A.	31	Circuit Sketching - Fluorescent Lamps
Job	31	Reconnect a Two-Lamp (40 Watts Each) Instant Start Fluorescent Type Fixture
R.S.A.	32	N.E.C. Requirements for Lighting Fixtures, Signs and Outline Lighting
Job	32	Calculate Wiring for Light and Power for Grocery Store
R.S.A.	33	Estimating Material for Roughing-in a Single Family Dwelling
Job	33	Estimate Cost of Material and Labor for Family Dwelling

Unit VII - Direct Current Motor Control

R.S.A.	1	Manual Starting Rheostats for Direct Current Motors
Job	1	To Study the Connections and Operation of a Three-Terminal Starting Rheostat

Unit VII - Direct Current Motor Control (Continued)

Job	2	Install and Connect Shunt Motor, Safety Switch and Three-Terminal Starting Box. All Wiring to be Done in Rigid Conduit
Job	3	Wire and Connect a Compound D.C. Motor to a Three-Terminal Starting Box and Safety Switch. All Wiring is to be in Rigid Conduit According to Your Own Layout
Job	4	Wire and Connect a Compound D.C. Motor to a Four-Terminal Starting Box and Safety Switch. All Wiring is to be in E.M.T. According to Your Own Layout
R.S.A.	2	Manual Speed Controllers for Direct Current Motors
Job	5	Manual Speed Controller Connections and Operation
Job	6	Load - Speed Test of a Shunt Motor
Job	7	Load - Speed Test of a Compound Motor
Job	8	Efficiency of a D.C. Motor
R.S.A.	3	Drum Controllers
Job	9	Connect a Shunt Motor to a Three-Terminal Starting Rheostat and Reversing Switch
Job	10	Connect a Compound Motor to a Four-Terminal Starting Rheostat and Reversing Switch
Job	11	Connect a Shunt Motor to a Drum Reversing Switch
Job	12	Connect a Start-Stop Station to a D.C. Full Voltage Starter and Shunt Motor
Job	13	Connect Two Start-Stop Stations to a D.C. Full Voltage Starter and Shunt Motor
Job	14	Connect Three Start-Stop Stations to a D.C. Full Voltage Starter and a Compound Motor
Job	15	Automatic Acceleration of D.C. Motors
Job	16	Definite Time Method of Acceleration of a D.C. Motor
Job	17	Connect a Start-Job-Stop Station to a Reduced Voltage Magnetic Starter and Compound Motor
Job	18	Connect a Reduced-Voltage Magnetic Starter Equipped With Dynamic Braking to a Compound Motor
Job	19	Automatic Acceleration With Dynamic Braking and Reversing
R.S.A.	4	Automatic Motor Control

Unit VIII - Alternating Current Motors Controllers and Alternators

R.S.A.	1	Insulating Materials and Wire
Job	1	Measure Thickness of Slot Insulation Paper and Wire Size Before and After Insulation has Been Removed
R.S.A.	2	Split Phase Motors
Job	2	Rewind and Test a Split-Phase Motor
R.S.A.	3	Capacitor Motors
Job	3	Rewind and Test a Capacitor-Start Motor

Unit VIII - Alternating Current Motors Controllers and Alternators (Continued)

R.S.A.	4	Current Relays
Job	4	Install and Connect a Current Relay
R.S.A.	5	Voltage Relay
Job	5	Install and Connect a Voltage Relay
R.S.A.	6	Repulsion Induction Motor
Job	6	Repair Repulsion-Induction Motors
R.S.A.	7	Three-Phase Motors
Job	7	Rewind and Connect a Three-Phase Fractional Horsepower Motor
R.S.A.	8	N.E.C. Specifications for Motors and Controllers
Job	8	Calculate Wiring for Three-Phase Motor and Controller
R.S.A.	9	Wiring for Motors
Job	9	Installation of Magnetic Starter and Raceway for a 3 H.P. Three-Phase Motor
R.S.A.	10	Across-the-Line Magnetic Starters
Job	10	Wire and Connect Control for Installed Magnetic Starter and Motor
R.S.A.	11	Reversing Magnetic Starter
Job	11	Install Wires and Connect Reversing Magnetic Starter
R.S.A.	12	Reduced Voltage Starter
Job	12	Wire and Connect Starting Compensator to Motor
R.S.A.	13	Drum, Two Speed and Quick Stop Controller
Job	13	Connect Wiring of Two Speed Controller to Motor
R.S.A.	14	Synchronous Drive and Indicating Systems
Job	14	Connect a Synchro Generator and Motor
R.S.A.	15	Alternators
Job	15	Connect and Test a Three-Phase Alternator
R.S.A.	16	Synchronizing and Phasing Alternators
Job	16	Phasing out and Connect Two Alternators in Parallel
R.S.A.	17	Calculating Necessary Data for Wiring Wound Rotor Motors
Job	17	Connect Wiring of Wound Rotor

Unit IX - Transformer Principles and Practices

R.S.A.	1	Power Transformers
Job	1	Build a Simple Transformer
R.S.A.	2	Checking Polarity of Transformers
Job	2	Connect a Single Phase Transformer With Series-Parallel Secondary for Polarity Check
R.S.A.	3	Single Phase Transformer Connections
Job	3A	Connect a Single Phase Transformer With Series-Parallel Secondary for Series Operation and Take Voltage Readings
Job	3B	Connect a Single Phase Transformer With Series-Parallel Secondary for Parallel Operation and take Voltage Readings

Unit IX - Transformer Principles and Practices (Continued)

R.S.A.	4	Special Application of Transformers
Job	4	Connect Two Single Phase Transformers in Parallel and Take Voltage Readings
Job	5	Make a Sketch of a Common Type Single-Phase Distribution Transformer Used as a Booster
R.S.A.	5	Three Phase Transformer Connections
Job	6	Connect Three Single Phase Transformers for 3-Phase, Four Wire, Wye-Wye Operation, and Take Voltage Readings
Job	7	Connect 3 Single Phase Transformers for 3 Phase, Four Wire, Wye-Delta Operation and Take Voltage Readings
Job	8	Connect 3 Single-Phase Transformers For 3-Phase, Four Wire, Delta-Delta Operation and Take Voltage Readings
Job	9	Connect 3 Single-Phase Transformers for 3 Phase, Four Wire, Delta-Wye Operation and Take Voltage Readings.
Job	10	Connect Two Single-Phase Transformers for 3-Phase Open Delta Operation and Take Voltage Readings
R.S.A.	6	Metering Single Phase Circuits Without Instrument Transformers
Job	11	Make a Neat Sketch of a Type S, 3-Wire, Single Phase, Self-Contained Meter Connected to a Load Center. Identify the current and potential coils and their connections. Explain in writing the functions of the meter parts.
R.S.A.	7	Instrument Transformers
Job	12	Make a Sketch of a Potential Transformer Connected to a Voltmeter. Show a 20 to 1 Voltage Ratio and Explain all Parts on Your Sketch.
R.S.A.	8	Metering Single Phase Circuits With Instrument Transformers
Job	13	Make a Neat Sketch of a Single Unit Current Transformer Connected to a Type S Meter Socket Metering a 3 Wire Line. Name All Parts on Your Sketch.
Job	14	Make a Sketch of a Three-Wire Single-Phase Service Being Metered Using Instrument Current Transformer For Both Type A and S Meters
Job	15	Make a Sketch of a Three Wire Line Using a 2 Wire Transformer
R.S.A.	9	Metering Polyphase Circuits With and Without Instrument Transformers
Job	16	Make a Sketch of a Type S Meter Self-Contained, Measuring Energy in a Three Phase Delta Circuit. Show all Connections and Name All Coils

Unit IX - Transformer Principles and Practices (Continued)

Job	17	Make a Sketch and Show the Connections for a Polyphase Watt Hour Meter on a 3-Phase, 3-Wire Circuit, Using Both Instrument Current and Potential Transformers. Show Potential Instrument Transformers Connected Open Delta
Job	18	Make a Sketch of Metering a 4-Wire Wye Circuit With a 3 Phase, 3 Element Meter. Show Potential Transformers Connected Wye-Wye. Name all Coils on Your Sketch.

Unit X - Fundamental Electronics

R.S.A.	1	Vacuum Tubes as Rectifiers
Job	1	Build and Study a Vacuum Tube Rectifier
R.S.A.	2	Solid State Rectifiers
Job	2	Construct a Selenium Rectifier Circuit
R.S.A.	3	Rectifier Filters
Job	3	Construct Filter for Rectifier
R.S.A.	4	Triode Tube
Job	4	Study Characteristics of Triode Tube
R.S.A.	5	Operation Gas Filled Tube
Job	5	Connect and Test a Three Phase Rectifier
R.S.A.	6	Thyratron Tube
Job	6	Test an Automatic Battery Charger
R.S.A.	7	Photo-Cells and Controls
Job	7	Connect and Test a Phototube Relay
R.S.A.	8	Electronic Motor Controls
Job	8	Connect and test an Electronic Control for D.C. Shunt Motor
R.S.A.	9	Magnetic Amplifier Control in D.C.
Job	9	Connect and Test Magnetic Motor Control for D.C. Shunt Motor
R.S.A.	10	Magnetic Amplifier Control A.C.
Job	10	Connect and Test Magnetic Amplifier for 3-Phase Motor Control
R.S.A.	11	Amplidyne Drive System
Job	11	Assemble an Amplidyne Drive System, Test and Operate

Unit XI - Welding and Cutting

R.S.A.	1	Functions and Operating Principles of Oxy-acetylene, Regulators, Blowpipes, and Accessories
Job	1	To Set Up Oxy-Acetylene Cutting Equipment
R.S.A.	2	Setting Up Oxy-Acetylene Equipment
Job	2	To Cut Steel Plate With Oxy-Acetylene Cutting Torch
R.S.A.	3	Oxy-Acetylene Cutting
Job	3	To Make Beads on Flat Plate Without Using Filler Rod
R.S.A.	4	Oxy-Acetylene Welding
Job	4	To Deposit Beads on Flat Plate Using Filler Rod

Unit XI - Welding and Cutting (Continued)

Job	5	To Make a Butt Weld on Mild Steel Strips in Flat Position
Job	6	To Bronze Weld Lap Joint of Mild Steel Strips
Job	7	To Silver Solder a Lap Joint of Copper
Job	8	To Strike an Arc and Deposit Beads on Flat Plate With Shielded-Arc Electrodes
R.S.A.	5	Characteristics of Arc Welding
Job	9	To Deposit Weave Bead on Flat Plate Between Stringer Bead Using Straight Polarity Electrodes
R.S.A.	6	Types of Electrodes
R.S.A.	7	Characteristics of Inert Gas Welding
Job	10	To Make a Tee Joint in Flat Position Using Straight Polarity Electrodes
Job	11	To Start The Arc and Run Stringer Bead on Aluminum Plate
Job	12	To Deposit Stringer Beads on Flat Aluminum Plate Using Filler Metal

Drafting is a study of the fundamental science or language of graphic expression. The exact thinking necessary to visualize or form mental pictures of intricate shapes, and describe them with lines, requires concentrated mental effort and application.

The course in Industrial Drafting herein outlined is designed for beginners, with aims to develop the ability of the student in the language and operations of drafting as well as present the latest developments in industry. The outline is offered in the form of instructional material and problems, for full understanding and ability in drafting comes only through application of principles in a variety of progressively difficult experiences.

The course as outlined covers thirty-one units with one hundred forty problems, to be completed in approximately 1560 clock hours of instruction. The outline has fifteen units with eighty problems in the first part, and sixteen units with sixty problems in the second part.

It is anticipated that the necessary mathematics which the student will require in the various assignments and problems will be incorporated in and taught concurrently with the practical exercises of each lesson.

The references for the Industrial Drafting are the following:

Title	Source
French and Svenson MECHANICAL DRAWING	McGraw-Hill Book Company 330 West 42nd Street New York 36, New York
Giesecke, Mitchell & Spencer TECHNICAL DRAWING	Macmillan Book Co. 60 5th Avenue New York 11, New York
French and Vierich ENGINEERING DRAWING	McGraw-Hill Book Co. 330 West 42nd Street New York 36, New York

A detailed outline of Industrial Drafting follows.

PART I - Instructional Material

A. Basic Operations
   1. Select grade of pencil
   2. Sharpen a drawing pencil
   3. Make erasures
   4. Keep drawing clean
   5. Fasten paper to board
B. Use of instruments
   1. Mark off measurements from scale
   2. Draw horizontal lines
   3. Draw vertical lines
   4. Lay out drawing sheet
   5. Draw to scale
   6. Draw inclined lines at standard angles
   7. Draw lines parallel to any given line
   8. Draw circles and arc
   9. Set off equal distances on a line with dividers
   10. Mark off angles from a protractor
C. Lettering
D. Geometric Construction
   1. Bisect a line
   2. Divide a line into any number of equal parts
   3. Bisect an angle
   4. Draw an arc tangent to non-parallel lines
   5. Draw an arc tangent to a straight line and an arc
   6. Draw an arc tangent to two arcs
   7. Draw a tangent to two unequal circles
E. Freehand Sketching
   1. Sketch straight lines freehand
   2. Sketch circles and arcs
   3. Make a planning sketch
F. Conventional Lines
   1. Represent visible outlines
   2. Represent hidden lines
   3. Show centers and axes by center lines
   4. Draw extension and dimension lines
   5. Make arrowheads
   6. Draw and identify line of section by cutting plane line
   7. Draw section lines
   8. Draw break lines
G. Dimensioning and Notes
   1. Dimensioning a prism, hexagon, octagon, pyramid
   2. Dimension a circle
   3. Dimension a cylindrical part
   4. Dimension arcs
   5. Dimension a conical part
   6. Dimension round end shapes, round holes
   7. Dimension angles

G. Dimensioning and Notes (Continued)
   8. Dimension an irregular curve, irregular part
   9. Dimension details of a part
   10. Dimension over-all size
   11. Dimension and specify tapers
   12. How to place notes
H. Graphic Representation
   1. Determine the required views
   2. Center views on the sheet
   3. Draw the required views of a two-view drawing
   4. Develop a third view from two views
I. Orthographic Projection
   1. Project the principal view of a prismatic solid
   2. Draw an auxiliary view
J. Sectional Views
   1. Draw a full sectional view
   2. Draw a half sectional view
   3. Draw a partially broken out sectional view
K. Detail and Assembly Drawings
   1. Make detail drawing
   2. Make assembly drawing from detail drawing
L. Pattern Drawings
   1. Laying out square or rectangular pattern
   2. Laying out cylindrical pattern
   3. Laying out radial-shaped patterns
   4. Intersection of a cylinder with a flat plane
   5. Intersection of cylinders with like diameters
   6. Intersection of cylinders with unlike diameters
   7. Angle intersection of cylinders of like diameters
   8. Angle intersection of cylinders of unlike diameters
   9. Square and rectangular intersection
   10. Rectangular 90° duct elbow
   11. Transition of rectangular to round section
M. Gears
   1. Make conventional working drawing of gears
N. Fasteners
   1. American Standard 60° V-thread
   2. Bolt
   3. Stud
   4. Set screws
   5. Carriage bolts
   6. Machine bolts
   7. Stove bolts
   8. Wood screws
   9. Self-tapping screws
O. Pictorial Drawings
   1. Isometric drawings
   2. Oblique drawings
   3. Cabinet drawing
   4. Parallel perspective drawings
   5. Angular perspective drawings

Part I - Problems

A. Basic Operations
   Plate 1. Fasten paper to board
B. Use of instruments
   Plate 1. Lay out drawing sheet
   Plate 2. Horizontal lines, vertical lines, inclined lines at standard angles, lines parallel to any given line
   Plate 3. Circles and arcs, set off equal distances on line with dividers, mark angles from protractor
C. Lettering
   Plate 4. Lettering
D. Geometric Construction
   Plate 5. Geometric Construction
E. Freehand sketching
   Plate 6. Sketch straight lines, sketch circles and arcs
   Plates 7, 8, 9. Make a planning sketch
F. Conventional lines
   Plate 10. Conventional lines
G. Dimensioning and Notes
   Plate 11. Dimensioning
H. Graphic Representation
   Plates 12, 13, 14. Two view drawings
   Plates 15, 16, 17, 18, 19. Develop third view from two views
I. Orthographic Projection
   Plates 20, 21, 22, 23. Project principal view of prismatic solid
   Plates 24, 25, 26. Auxiliary view
J. Sectional Views
   Plates 27, 28, 29, 30, 31, 32. Sectional Views
K. Detail and Assembly Drawings
   Plates 33, 34, 35, 36, 37. Assembly drawings
   Plates 38, 39. Make detail drawing
L. Pattern Drawings
   Plates 40, 41, 42. Laying out rectangular pattern
   Plates 43, 44, 45. Intersection of cylinder with like diameter
   Plates 46, 47. Rectangular 90° duct elbow
   Plate 48. Transition of rectangular to round section
M. Gears
   Plates 49, 50. Spur gears
   Plates 51, 52. Bevel gears
N. Fasteners
   Plate 53. American Standard 60° V-thread
   Plate 54. Thread symbols
   Plate 55. Machine bolt
   Plate 56. Thread symbols

Part I - Problems (Continued)

O. Pictorial Drawings
Plates 57, 58, 59, 60, 61, 62. Isometric drawings
Plates 63, 64, 65, 66, 67, 68. Oblique drawings
Plates 69, 70, 71, 72, 73, 74. Cabinet drawings
Plates 75, 76, 77, 78, 79. Parallel perspective drawings
Plates 80, 81, 82, 83, 84. Angular perspective drawings

Part II - Instructional Material

A. Lettering
1. Form single stroke letters and numerals
2. Letter titles and notes

B. Blueprint Reading
1. Three-view drawings
a. Horizontal and vertical surfaces
b. Slanting surfaces
c. Hidden lines
d. Scales
2. Two-view drawings
a. Curved surfaces
b. Fractional tolerance
c. Decimal tolerance
d. Angular tolerance

C. Sectional Drawings
1. Special types of sections

D. Assembly Drawings
1. Detail drawings
2. Assembly drawings
3. Bills of material
4. Inking of drawings

E. Orthographic Projection
1. Auxiliary views
2. Revolutions

F. Intersections and Developments
1. Intersection of a cylinder with a flat plane
2. Angle intersection of cylinders of like diameters
3. Square and rectangular intersection
4. Intersection and development of two prisms

G. Pipe, Fittings, and Valves
1. Steel and wrought-iron pipe
2. Cast-iron pipe
3. Seamless brass and copper pipe
4. Aluminum pipe
5. Copper water tubes

G. Pipe, Fittings, and Valves
   6. Pipe joints
   7. Globe valve
   8. Check valves
   9. Gate valves
   10. Piping drawings
   11. Dimensioning
H. Pictorial Drawings
   1. Axonometric projection
      a. Isometric
      b. Dimetric
      c. Trimetric
   2. Oblique projection
      a. Oblique drawings
      b. Reduction of length of receding axis
      c. Four-center ellipse
      d. Oblique sections
   3. Perspective
      a. Simple perspective
      b. Multiview perspective
      c. Angular perspective
      d. One-point perspective
      e. Two-point perspective
      f. Three-point perspective
I. Shading
J. Graphs
   1. Rectangular
   2. Composite
   3. Bar
   4. Area
   5. Circular
   6. Polar
   7. Organization
   8. Alignment
K. Architectural Design
   1. General drawings
   2. Dimensioning
   3. Detail drawings
   4. Brick and tile construction
M. Topographic Drawings
   1. Scale
   2. Conventional symbols
   3. Profiles
   4. Contours
   5. Maps from field notes
N. Reproduction Process

O. Optional Drawings and Blueprint Reading
   1. Aeronautical drafting and blueprint reading
   2. Mechanical drafting and blueprint reading
   3. Electrical drafting and blueprint reading
   4. Welding drawings and blueprint reading
   5. To be selected by instructor

Part II - Problems

A. Lettering
   Plate 1. Inclined lettering; letter titles and notes
B. Blueprint Reading
   1. Three-view drawings
      Plate 2. Horizontal and vertical surfaces
      Plate 3. Slanting surfaces
      Plate 4. Hidden lines; scales
   2. Two-view drawings
      Plates 5, 6, 7, 8. Curved surfaces
      Fractional tolerances
      Decimal tolerances
      Angular tolerances
   3. One-view drawings
      Plates 9, 10. One-view drawings
C. Sectional Drawings
   Plate 11. Removed sections
   Plate 12. Offset sections
   Plate 13. Conventional violations
D. Assembly Drawings
   Plate 14. Detail drawing
   Plate 15, 16. Assembly drawings, bills of material, inking of drawing
E. Orthographic Projection
   Plates 17, 18. Auxiliary views
   Plates 19, 20. Revolutions
F. Intersections and Developments
   Plate 21. Intersection of cylinder with a flat plane
   Plate 22. Angle intersection of cylinders of like diameters
   Plate 23. Square and rectangular intersections
   Plate 24. Intersection and development of two prisms
G. Pipes, Fittings, and Valves
   Plate 25. Single-line drawing of piping layout and system
   Plate 26. Double-line drawing of piping layout and system
   Plate 27. Single-line isometric drawing of piping layout
H. Pictorial Drawing
   1. Axonometric projection
      Plates 28, 29. Isometric
      Plates 30, 31. Dimetric
      Plates 32, 33. Trimetric

2. Oblique projection
   Plate 34. Oblique
   Plate 35. Reduction of length of receding axis
   Plate 36. Oblique with four-center elipse
   Plate 37. Oblique sections
3. Perspective
   Plate 38. Simple perspective
   Plate 39. One-point perspective
   Plate 40. Two-point perspective
   Plate 41. Three-point perspective

I. Shading
   Plates 42, 43. Shade lines
   Plates 44. Surface shading

J. Graphs
   Plate 45. Rectangular graph
   Plate 46. Circular graph
   Plate 47. Organization chart

K. Architectural Design
   Plate 48. General plans and elevations
   Plate 49. Detail drawings

L. Structural Drawings
   Plate 50. Wood construction
   Plate 51. Steel and iron construction
   Plate 52. Reinforced concrete, brick and tile construction

M. Topographic Drawings
   Plate 53. Profiles
   Plate 54. Contours
   Plate 55. Maps from field notes

N. Reproduction Processes
   (Film and field trip)

O. Optional Drawings and Blueprint Reading
   Plates 56, 57. Select two of the following:
   1. Aeronautical drafting and blueprint reading
   2. Electrical drafting and blueprint reading
   3. Mechanical drafting and blueprint reading
   4. Welding drawing and blueprint reading
   5. To be selected by instructor

The Industrial Engines Course was published in 1957 and revised in 1963-1964. It is available in the following forms:

Related Study Assignments and Job Sheets

Book I
- Unit I - Benchwork
- Unit II - Overhaul, Cleaning and Inspection
- Unit III - Auxiliary Equipment

Book II
- Unit IV - Diesel Fuel Systems
- Unit V - Welding

Test Book
- Book I - Units I - V

Answer Book
- Book I - Units I - V

The references for the Industrial Engines Course are the following:

Title	Source
ABC'S OF HAND TOOLS	General Motors Corporation General Motors Building 3044 West Grand Blvd. Detroit 2, Michigan
GENERAL REPAIR TOOLS FOR AUTO MECHANICS	Delmar Publishers Inc. Mountainview Avenue Albany 5, New York
Ludwig METALWORK TECHNOLOGY AND PRACTICE	McKnight and McKnight 109-111 West Market Street Bloomington, Illinois
Kates DIESEL AND HIGH COMPRESSION GAS ENGINES FUNDAMENTALS	American Technical Society 848 East 58th Street Chicago 37, Illinois
SERVICE MANUAL FOR THE DOCTOR OF MOTORS	Perfect Circle Corporation Hagerstown, Indiana
DOCTOR OF MOTORS, PRESCRIPTION FOR BETTER DIESEL ENGINE OVERHAUL	Perfect Circle Corporation Hagerstown, Indiana
Maleev, V. L. DIESEL ENGINE OPERATION AND MAINTENANCE	McGraw-Hill Book Co., Inc. 330 West 42nd Street New York 36, New York

References: (Continued)

Title	Source
SERVICE MANUAL, SERIES 71	General Motors Corporation Detroit Diesel Engine Div. 13400 West Outer Drive Detroit 28, Michigan
SERVICE MANUAL, SERIES 110	General Motors Corporation Detroit Diesel Engine Div. 13400 West Outer Drive Detroit 28, Michigan
SERVICE MANUAL	Le Roi Company Milwaukee 14, Wisconsin
DR-324, Bulletin 1G-100, Bulletin 1G-125, Bulletin 1G-155	Delco-Remy Division General Motors Corporation Anderson, Indiana
AUTO-LITE ELECTRICAL EQUIPMENT MAINTENANCE AND OPERATION	The Electric Auto-Lite Co. The Parts and Service Division Toledo, Ohio
Delco-Remy Training Chart, Manual 5133H, and Manual 5133M	Delco-Remy Division General Motors Corporation Anderson, Indiana
Delco-Remy Bulletin 150 and Bulletins IC-100, ID-100 and ID-115	Delco-Remy Division General Motors Corporation Anderson, Indiana
Purvis, Jud ALL ABOUT SMALL GAS ENGINES	Goodheart-Willcox Co., Inc. 1322 South Wabash Avenue Chicago 5, Illinois
MOTOR SERVICE'S AUTOMOTIVE ENCYCLOPEDIA	Goodheart-Willcox Co., Inc. 1322 South Wabash Avenue Chicago 5, Illinois
TR-40, MAINTENANCE OF AUTOMOTIVE ENGINE COOLING SYSTEMS	Society of Automotive Engineers, Inc. 485 Lexington Avenue New York 17, New York
Frazee-Bedell TRACTORS AND CRAWLERS	American Technical Society 848 East Fifty-Eighth Street Chicago 37, Illinois

References: (Continued)

Title	Source
Elementary Principles of Diesel Engine Governing, Bulletin 01012A	Woodward Governor Co. Rockford, Illinois
American Bosch Fuel Injection Equipment Maintenance Information	American Bosch Arma Corporation Springfield 7, Massachusetts
Roosa-Master Operation and Instruction Manual	Hartford Machine Screw Co. Hartford 2, Connecticut
Roosa-Master Service Manual, Test Specifications	Hartford Machine Screw Co. Hartford 2, Connecticut
Shop Manual PT Fuel System Bulletin 983334-D	Cummins Engine Co., Inc. Columbus, Indiana
Farmall and International Tractors Fuel Systems	International Harvester Co. 10400 West North Avenue Melrose Park, Illinois
SERVICEMEN'S REFERENCE BOOK (Caterpillar Service Manual)	Louisiana Machinery Co., Inc. P. O. Box 5544 Alexandria, Louisiana
FUEL EQUIPMENT SPECIFICATION CATALOGUE	American Bosch Arma Corporation Springfield 7, Massachusetts
Colored Chart on PSB Pump	American Bosch Arma Corporation Springfield 7, Massachusetts

A detailed outline of the Industrial Engines Course follows:

Unit I - Benchwork

R.S.A.	1	Hand Tools (General)
Job	1	Hand Tools (General)
R.S.A.	2	Measuring Devices
Job	2	Measure Crankshaft and Cylinder with Micrometers
R.S.A.	3	Fastening Devices
Job	3	Identify Bolt, Nuts, and Locks
R.S.A.	4	Abrasives
Job	4	Using Abrasives (Garnet Cloth, Emery or Sandpaper)
Job	4A	Dressing Bench Grinder Wheel
Job	4B	Reshape Screw Driver, Chisel, and Center Punch, Using Bench Grinder
R.S.A.	5	Files, Hacksaws, and Bench Vise
Job	5	Using the File, Hacksaw, and Bench Vise

Course Outline (Continued)

Unit I (Continued)

R.S.A.	6	Twist Drills
Job	6	Sharpen a Twist Drill and Make An Internal Thread Block With Studs
R.S.A.	7	Threading Dies
R.S.A.	7A	Taps
R.S.A.	7B	Screw Extractors
R.S.A.	7C	"Sewing" Cracked Casting
Job	7	Threading With Dies
Job	7A	Taps and Tapping
Job	7B	Removing Broken Stud
Job	7C	"Sewing" a Cracked Casting
R.S.A.	8	Pipe Threads and Tubing
Job	8	Tubing: Cutting, Flaring, Bending and Identifying Brass Fittings
R.S.A.	9	Metal Shears
R.S.A.	9A	The Blow Torch
R.S.A.	9B	Soldering
Job	9	Metal Shear
Job	9A	Filling and Lighting the Blow Torch
Job	9B	Splice Insulated Wire and Make a Solder Joint

Unit II - Overhaul, Cleaning and Inspection

R.S.A.	1	Nomenclature and Terminology of Engine
Job	1	Identify Engine Parts, Determine the Events in a Four and Two Stroke Cycle Engine
R.S.A.	2	Piston Rings and Cylinder Honing
Job	2	Piston Rings and Cylinder Honing
R.S.A.	3	Crankshaft--Connecting Rod Main Bearings and Connecting Rod Bearings
Job	3	Crankshaft Connecting Rod
R.S.A.	4	Camshaft and Valve Train
Job	4	Check Camshaft Bearings and Train
R.S.A.	5	Part I Valve Timing - Gears and Gear Pullers
Job	5	Part I Remove and Replace Timing Gears
R.S.A.	5	Part II Valve Timing Diagrams 2 S.C. and 4 S.C.
Job	5	Part II Making Valve Timing Diagrams
R.S.A.	6	Cylinder Head Rebuilding
Job	6	Cylinder Head Rebuilding
R.S.A.	7	Flywheels
Job	7	Flywheel
R.S.A.	8	Lubricating Systems and Lube Oil Filter
Job	8	Lubricating System

Course Outline (Continued)

Unit III - Auxiliary Equipment

R.S.A.	1	Basic Principles of Electricity, Storage Battery, Battery Charger, and Volt Meter
Job	1	Servicing Battery
R.S.A.	2	D-C Generators
Job	2	Disassemble and Reassemble Generator
R.S.A.	3	Relays and Regulators for DC Generators
Job	3	Testing and Adjusting Regulators
R.S.A.	4	Alternator Generators and Regulator Control
Job	4	Repair and Test Alternator Generator and Regulator Control
R.S.A.	5	Electric Cranking Motors Magnetic and Solenoid Switches and Series Parallel Switches
Job	5	Cranking Motor Magnetic and Solenoid Switches and Series Parallel Switches
R.S.A.	6	Ignition System
Job	6	Check and Test All Points in Ignition System
R.S.A.	7	Carburetion and Fuel Pumps
Job	7	Clean and Rebuild Carburetor and Fuel Pump
R.S.A.	8	Air Cleaners
Job	8	Servicing the Air Cleaner and Distribution System--Inspect Air Ducts
R.S.A.	9	Engine Cooling Systems
Job	9	Checking and Servicing Cooling Systems
R.S.A.	10	Clutches
Job	10	Remove, Repair, Adjust, and Replace Clutch

Unit IV - Diesel Fuel Systems

R.S.A.	1	Governors
Job	1	Disassemble and Reassemble Governor
R.S.A.	2	General Motors Fuel Systems
Job	2	Tune up General Motor Engine
R.S.A.	3	American Bosch Fuel System
Job	3	Tune up Engine With Bosch Fuel System
R.S.A.	4	The Roosa-Master Fuel Pump
Job	4	Tune up Engine With Roosa-Master Fuel Pump
R.S.A.	5	Cummins (PT) Fuel System
Job	5	Tune Cummins Engine With (PT) Fuel System
R.S.A.	6	International Harvester Fuel System
Job	6	Tune International Harvester Engine
R.S.A.	7	Caterpillar Fuel System
Job	7	Check Fuel Injection System (Caterpillar, all models)
R.S.A.	8	Rebuilding the Fuel Injection System for General Motors Diesel Engine
Job	8	Rebuild and Test General Motors Fuel System
R.S.A.	9	Part I Bosch Fuel Systems

Course Outline (Continued)

Unit IV - Diesel Fuel Systems

Job	9	Part I Rebuild, Test and Calibrate an American Bosch Fuel System
R.S.A.	9	Part II Supply Pump
Job	9	Part II Rebuild, Test, and Calibrate an American Bosch Fuel System
R.S.A.	9	Part III The Bosch Fuel Nozzle
Job	9	Part III Servicing, Adjusting, and Testing the Bosch Nozzle
R.S.A.	9	Part IV Bosch, PSB Pump
Job	9	Part IV Rebuild, Test, and Calibrate American Bosch Fuel System
R.S.A.	10	Rebuilding the Roosa Master Fuel Pump
Job	10	Rebuild and Test a Roosa Master Fuel Pump
R.S.A.	11	Rebuilding the Cummins (PT) Fuel System
Job	11	Rebuild and Test a Cummins Fuel System
R.S.A.	12	Rebuilding International Harvester Fuel System
Job	12	International Harvester Fuel System
R.S.A.	13	Trouble Shooting
Job	13	Trouble Shooting and Repair of Engine

Unit V - Welding

R.S.A.	1	Functions and Operating Principles of Oxy-Acetylene, Regulators, Blowpipes, and Accessories
Job	1	To Set Up Oxy-Acetylene Cutting Equipment
R.S.A.	2	Setting Up Oxy-Acetylene Equipment
Job	2	To Cut Steel Plate With Oxy-acetylene Cutting Torch
R.S.A.	3	Oxy-Acetylene Cutting
Job	3	To Make Beads on Flat Plate Without Using Filler Rod
R.S.A.	4	Oxy-Acetylene Welding
Job	4	To Deposit Beads on Flat Plate Using Filler Rod
Job	5	To Make a Butt Weld on Mild Steel Strips in Flat Position
Job	6	To Bronze Weld Lap Joint of Mild Steel Strips
Job	7	To Silver Solder a Lap Joint of Copper
Job	8	To Strike an Arc and Deposit Beads on Flat Plate With Shielded-Arc Electrodes
R.S.A.	5	Characteristics of Arc Welding
Job	9	To Deposit Weave Bead on Flat Plate Between Stringer Bead Using Straight Polarity Electrodes
R.S.A.	6	Types of Electrodes
R.S.A.	7	Characteristics of Inert Gas Welding
Job	10	To Make a Tee Joint in Flat Position Using Straight Polarity Electrodes

Course Outline (Continued)

Unit V (Continued)

Job 11 To Start the Arc and Run Stringer Bead on Aluminum Plate

Job 12 To Deposit Stringer Beads on Flat Aluminum Plate Using Filler Metal

The Industrial Instruments Technology Course was published in 1966 and is composed of 5 books--Instructor's Guide, Student Workbook, Reference Book 1, Reference Book 2, and Reference Book 3.

A detailed outline of the Industrial Instruments Technology Course follows:

UNIT I - INDUSTRIAL INSTRUMENT TECHNOLOGY

Section 1 Pressure-Measuring and Transmitting Instruments
Section 2 Differential Pressure-Measuring
Section 3 Velocity and Volumetric Measuring
Section 4 Liquid-Level-Measuring Instruments
Section 5 Temperature-Measuring Instruments
Section 6 Viscosity and Specific-Gravity
Section 7 pH and Redox Measuring Instruments
Section 8 Gas Analyzers
Section 9 Control Valves and Valve Positioners
Section 10 Speed Measurement and Control
Section 11 Repairing and Calibrating Controllers
Section 12 Organization of Instrument Department for Processing Plants
Section 13 Industrial Psychology and Personal Adjustment

UNIT II - PROCESS CONTROL TECHNOLOGY

Section 1 Control Valves
Section 2 Piston-Operated Control Valves
Section 3 Differential Pressure Measurement
Section 4 Temperature-Measuring Instruments
Section 5 Pressure-Measuring Instruments
Section 6 Flow-Measuring Instruments
Section 7 Details of Flow-Measuring Instruments
Section 8 pH and Oxidation Reduction Potential Measurement
Section 9 Distillation and Fractionation Column Control
Section 10 Various Control Techniques
Section 11 Control of Various Processes
Section 12 Reactors

The Machine Shop Course was published in 1955 and revised in 1962. It is available in the following forms:

Book I
- Related Study Assignments Unit I
- Jobs Unit I

Book II
- Related Study Assignments Units II & III
- Jobs Units II & III

Book III
- Related Study Assignments Unit IV
- Jobs Unit IV

Book IV
- Related Study Assignments Unit V
- Jobs Unit V

Mathematics
- All Math is included in the Related Study Assignment Books I - IV

Test Books
- Book I Units I, II, & III
- Book II Units IV & V

Answer Book
- Complete for Units I - V

The following instructor's Aids are available:
- Progress Chart
- Individual folder type

The references for the Machine Shop Course are the following:

Title	Source
Giachino and Feirer BASIC BENCH-METAL PRACTICE AND PRECISION MEASURING	Chas. A. Bennett Co., Inc. 237 N. Monroe Street Peoria, Illinois
BENCH WORK Machine Shop Series	Delmar Publishers, Inc. Mountainview Avenue Albany 5, New York
MACHINE SHOP MATHEMATICS Machine Shop Series	Delmar Publishers, Inc. Mountainview Avenue Albany 5, New York

References (Continued)

Title	Source
Burghardt, Axelrod and Anderson MACHINE TOOL OPERATION, Part I	McGraw-Hill Book Co., Inc. 330 West 42nd Street New York 36, New York
Olivo, Thomas C. and Payne, Albert V. BASIC BLUEPRINT READING AND SKETCHING	Delmar Publishers, Inc. Mountainview Avenue Albany 5, New York
Axelrod, Aaron MACHINE SHOP MATHEMATICS	McGraw-Hill Book Co., Inc. 330 West 42nd Street New York 36, New York
Oberg, Erik and Jones, F. D. MACHINERY'S HANDBOOK	The Industrial Press 93 Worth Street New York 13, New York
Burghardt, Axelrod, and Anderson MACHINE TOOL OPERATION, Part II	McGraw-Hill Book Co., Inc. 330 West 42nd Street New York 36, New York
SHAPER WORK Machine Shop Series	Delmar Publishers, Inc. Mountainview Avenue Albany 5, New York
LATHE WORK Machine Shop Series	Delmar Publishers, Inc. Mountainview Avenue Albany 5, New York
MILLING MACHINE WORK Machine Shop Series	Delmar Publishers, Inc. Mountainview Avenue Albany 5, New York

A detailed outline of the Machine Shop Course follows:

Unit I - Bench and Floor

R.S.A.	1	Hand Hack Saw
Job	1	Make Two Screen Spacers
R.S.A.	2	Laying Out
Job	2	Make Lever Guides
R.S.A.	3	Files and Their Uses
Job	3	Make Two Templates
R.S.A.	4	Power Driven Saws
Job	4	Tool Post Wedge
R.S.A.	5	Abrasives
Job	5	Make a Cross Feed Pawl
R.S.A.	6	Offhand Grinding
Job	6	Make a Drill Gauge

Unit I - Bench and Floor (Continued)

R.S.A.	7	Cutting and Shearing
Job	7	Make Die Block Shims
R.S.A.	8	Drill Presses and Their Uses
Job	8	Make an Oil Hole Cover
R.S.A.	9	Cutting Internal Openings
Job	9	Transmission End Plate
R.S.A.	10	Finishing Metal Surfaces
Job	10	Make a Tool Post Wrench
R.S.A.	11	Metal Fasteners
Job	11	Make a Steel Square
R.S.A.	12	Bending and Shaping
Job	12	Make Inside Calipers
R.S.A.	13	Calipers
Job	13	Make Outside Calipers
R.S.A.	14	Taps and Tapping
Job	14	Make Tap Gauge
R.S.A.	15	Dies and Threading
Job	15	Make a Block With Studs
R.S.A.	16	How to Remove Broken Studs or Screws
Job	16	Drill Out Broken Studs
R.S.A.	17	Hand Forging
Job	17	Make an Adjustment Rod
R.S.A.	18	Soldering
Job	18	Make an Oil Pan
R.S.A.	19	Nonferrous Metals and Alloys
Job	19	Make an Oil Manifold
R.S.A.	20	Hand Reamers
Job	20	Install Bushings and Ream to Fit Shaft
R.S.A.	21	Producing and Processing Iron
Job	21	Make U Bolt and Strap
R.S.A.	22	Making Steel
Job	22	Make Motor Mount
R.S.A.	23	Rolling Mill
Job	23	Make an Eye Bolt
R.S.A.	24	Identification of Metals
Job	24	Make End Wrench
R.S.A.	25	Chisels
Job	25	Make A Cold Chisel
R.S.A.	26	Heat Treatment of Steel
Job	26	Make a Center Punch
R.S.A.	27	Screwdrivers
Job	27	Make an Offset Screw Driver
		Case Harden Wrench, Job 24
R.S.A.	28	Chipping
Job	28	Cam Lock Block
R.S.A.	29	Babbitting
Job	29	Babbitt Split Bearings

Unit II - Drill Press

R.S.A.	1	Use of the Drill Press
Job	1	Make a Spacer
R.S.A.	2	Work Holding Devices
Job	2	Guide Post Clamp
R.S.A.	3	Twist Drills and Drill Sizes
Job	3	Drill Stand, Letter Size
R.S.A.	4	Twist Drill--Terminology and Definitions
Job	4	Drill Stand Fractional Sizes
R.S.A.	5	Drill Chucks and Sleeves
Job	5	Drill and Wire Gage
Job	5B	Make a Drill Gauge
R.S.A.	6	Speeds and Feeds of a Drill Press
Job	6	Make a "C" Clamp
R.S.A.	7	Laying Out for Drilling
Job	7	Drawbar Extension
R.S.A.	8	Drill Grinding
Job	8	Machine Strap Clamp
R.S.A.	9	Other Drill Press Operations
Job	9	Spacer
R.S.A.	10	Laying Out and Drilling
Job	10	Mounting Plates
R.S.A.	11	Reamers
Job	11	Make Cross Head Pin and Lock
R.S.A.	12	Tapers
Job	12	Drill and Ream For Standard Taper Pins in Two Couplings and Shafts
R.S.A.	13	Laying Out Work
Job	13	Baffle Plate
R.S.A.	14	Boring
Job	14	Bore Large Hole
Job	15	Column Base

Unit III - Shaper

R.S.A.	1	Construction of the Shaper
Job	1	Machine a Block Square
R.S.A.	2	Operation of the Shaper
Job	2	Make an Offset Key
R.S.A.	3	Shaper Cutting Tools
Job	3	Make Two T-Slot Nuts
R.S.A.	4	Holding the Work
Job	4	Make a Chock Wedge
R.S.A.	5	Cutting Slots and Keyseats
Job	5	Cut an Open End Keyseat
Job	5A	Cut a Closed End Keyseat
Job	5B	Cut an Internal Keyseat
R.S.A.	6	Cutting Off
Job	6	Make Two Drill Press Vise Jaws

Unit III - Shaper (Continued)

R.S.A.	7	Speeds and Feeds
Job	7	Make a Spanner Wrench
R.S.A.	8	Shaping Horizontal Surfaces
Job	8	Make a Parallel Bar
R.S.A.	9	Angular Shaping
Job	9	Make a Drill Drift
R.S.A.	10	Vertical Shaping
Job	10	Make an Angle Plate
R.S.A.	11	Contour Shaping
Job	11	Make a Cam
R.S.A.	12	Shaping a Tongue and Groove
Job	12	Tongue and Groove Blocks
R.S.A.	13	Block Squaring
Job	13	"V" Blocks
R.S.A.	14	Machining Dovetails
Job	14	Dovetail Block and Slide
R.S.A.	15	Hydraulic Shapers
Job	15	T-Slot Block
R.S.A.	16	Indexing--Simple and Direct
Job	16	Make a Spline
Job	16A	Make a Spline Hub
R.S.A.	17	Gear Tooth Parts
Job	17	Make a Rack Gear
Job	17A	Make a Gear Rack (Alternate)
R.S.A.	18	Making a Gear Segment
Job	18	Make a Gear Segment
Job	18A	Make a Gear Segment (Alternate)
R.S.A.	19	Making a Drill Press Vise
Job	19	Make a Drill Press Vise
R.S.A.	20	Cutting Serrations
Job	20	Make Two Jaws For Drill Press Vise

Unit IV - Lathe

R.S.A.	1	Cutting Tools
Job	1	Grind Lathe Tool Bits
R.S.A.	2	Types of Lathes and Identification of Parts
Job	2	Make 2 Stud Blanks
R.S.A.	3	Principle of the Lathe - Care and Use of the Lathe
Job	3	Make 2 Bushing Drive Bars
R.S.A.	4	Drilling
Job	4	Caliper Parts and Six Washers
R.S.A.	5	Description of the Compound Rest
Job	5	Make a Chucking Center
R.S.A.	6	Filing and Polishing
Job	6	Make a Pump Shaft
R.S.A.	7	Drilling and Reaming
Job	7	Make a Brass Bushing and Steel Roller
R.S.A.	8	Knurling
Job	8	Knurled Shaft

Unit IV - Lathe (Continued)

R.S.A.	9	Turning Tapers - Tailstock Offset Method
Job	9	Make an Arbor
R.S.A.	10	Turning Angles With the Compound Rest
Job	10	Make a Wheel
R.S.A.	11	Cutting V-Threads
Job	11	Thread Two Studs
R.S.A.	12	Screw Threads
Job	12	Thread 2 Shafts
R.S.A.	13	Taper Turning - Taper Attachment - Compound Rest Methods
Job	13	Hoist Traverse Truck Roller Shaft
R.S.A.	14	Tapping
Job	14	Make Shift Rod Spool
R.S.A.	15	Boring
Job	15	Make Drive Shaft Bushing Housing
R.S.A.	16	Interchangeable Manufacture - Mass Production - Fits and Tolerances
Job	16	Make a Drive Shaft Bushing
R.S.A.	17	Taper Boring
Job	17	Make Hoist Traverse Truck Roller and Thrust Washer
R.S.A.	18	Internal Threading
Job	18	Pipe Puller and Nut
R.S.A.	19	Cutting a Left Hand Thread
Job	19	Pipe Puller Screw and Nut
R.S.A.	20	Counterboring--Threading to a Shoulder
Job	20	Make Piston Rod Connecting Spool
R.S.A.	21	Acme Screw Thread
Job	21	External and Internal Acme Thread
R.S.A.	22	Square Threads
Job	22	Cutting a Square Thread
R.S.A.	23	Acme Threading, Single and Multiple
Job	23	Double Lead Acme Thread Left-Hand
R.S.A.	24	Dial Indicator Method
Job	24	Live Center
R.S.A.	25	Pipe Threads
Job	25	Cut and Fit External and Internal Pipe Threads
R.S.A.	26	Social Security Act
Job	26	Tap Handle
R.S.A.	27	Radius Tools
Job	27	Machinist Hammer Kit
Job	28	Milling Machine Jack
R.S.A.	29	Sheaves
Job	29	Emery-Wheel Stand
R.S.A.	30	Faceplate Work, Angle-Plate
Job	30	Machine Cast Elbow
R.S.A.	31	Steady Rest and Follow Rest
Job	31	Turn a Long Shaft
R.S.A.	32	Turning a Crankshaft or an Eccentric

Unit IV - Lathe (Continued)

Job	32	Turn an Eccentric
Job	33	Box and Pin
Job	34	Tap Wrench
Job	35	Marine Propeller Shaft

Unit V - Milling Machine

R.S.A.	1	The Milling Machine
Job	1	To Oil the Milling Machine
R.S.A.	2	Operation of the Milling Machine
Job	2	Machine a Steel Block
R.S.A.	3	Milling Cutters
Job	3	Make 2 Mild Steel Brackets
R.S.A.	4	Mounting the Milling Cutter
Job	4	Machine a Cast Iron Bracket
R.S.A.	5	Work Holding Devices
Job	5	Machine a Spacer
R.S.A.	6	Speeds and Feeds
Job	6	Cut Keyways on a Shaft
R.S.A.	7	Slotting and Sawing
Job	7	Adjustable Parallel Bar
R.S.A.	8	End Mills and Woodruff Keyseat Cutters
Job	8	Keyslot Cut With End Mill
R.S.A.	9	Coolants and Their Uses
Job	9	Cut a Woodruff Keyseat
R.S.A.	10	Straddle Milling
Job	10	Make a Nut
R.S.A.	11	Climb Milling
Job	11	Make and Graduate a Keyseat Rule
R.S.A.	12	Special Attachments
Job	12	Gear Case Cover
R.S.A.	13	Fixtures
Job	13	Fixture For Slotting Screws
R.S.A.	14	The Index Head
Job	14	Steel Index Pin
R.S.A.	15	Using the Index Head
Job	15	Graduate a Machine Tool Feed Dial--125 Divisions
R.S.A.	16	Spur Gearing
Job	16	Machine a Pair of Spur Gears
R.S.A.	17	Spline Cutting and Fly Cutters
Job	17	Cut a Spline Shaft (A. Using 2 Cutters) (B. Using Fly Cutters)
R.S.A.	18	Clutches and Couplings
Job	18	Machine a Straight-Toothed Clutch
Job	19	Machine Saw-Toothed Clutch
R.S.A.	20	Bevel Gears
Job	20	Bevel Gears Right Angle Shafts
R.S.A.	21	Cam Milling
Job	21	Mill a Cam

Unit V - Milling Machine

R.S.A.	22	Helical or Spiral Milling
Job	22	Steel Pull Pin
R.S.A.	23	Spiral Milling
Job	23	Spiral Milling Cutter
R.S.A.	24	Spiral Gear
Job	24	Spiral Gear

Supplementary Jobs

Sup. Job 25	Make a Tap
Sup. Job 26	Machine a Reamer
Sup. Job 27	Make a Worm and Worm Gear
Sup. Job 28	Make a Step Block

The Accounting Course was written in 1955, revised in 1958 and again in 1963. It is available in book form. This material consists of 60 jobs.

The reference for this Course is listed below:

Title	Source
Sherwood, Boling, Carson, COLLEGE ACCOUNTING 7th Edition, 1962	South-Western Publishing Co., 5101 Madison Road Cincinnati 27, Ohio

A detailed outline of the Accounting Course follows:

Unit One, ELEMENTS OF ACCOUNTING
Report One, ASSETS, LIABILITIES, AND PROPRIETORSHIP

Job No. 1 - Perform Practical Problems Involving Accounting Equation

Unit One, ELEMENTS OF ACCOUNTING
Report Two, THE DOUBLE ENTRY PROCESS

Job No. 2 - Record Transactions in "T" Accounts; Take Balance of Accounts; Prepare Trial Balance.

Unit Two, ACCOUNTING PROCEDURE
Report Three, JOURNALIZING TRANSACTIONS

Job No. 3 - Analyze Transactions; Make General Journal Entries

Unit Two, ACCOUNTING PROCEDURE
Report Four, POSTING AND THE TRIAL BALANCE

Job No. 4 - Make Journal Entries; Post Entries; Take Trial Balance.

Unit Two, ACCOUNTING PROCEDURE
Report Five, THE FINANCIAL STATEMENTS

Job No. 5 - Prepare Income Statement; Prepare Balance Sheet.

Unit Three, ACCOUNTING FOR MERCHANDISE
Report Six, PURCHASES AND THE PURCHASES JOURNAL

Job No. 6 - Make Journal Entries of Transactions Stressing Purchases Journal; Posting to Ledger and Taking Trial Balance

Course Outline (Continued)

Unit Three, ACCOUNTING FOR MERCHANDISE
Report Seven, SALES AND THE SALES JOURNAL

Job No. 7 - Make Journal Entries of Transactions Stressing Sales Journal; Posting to Ledger and Taking Trial Balance

Unit Three, ACCOUNTING FOR MERCHANDISE
Report Eight, ACCOUNTING PROCEDURE

Job No. 8 - Make Journal Entries Using the General Journal, Purchases Journal, and Sales Journal, Posting to Ledger and Taking Trial Balance.

Unit Four, ACCOUNTING FOR CASH
Report Nine, RECORD OF CASH RECEIPTS AND DISBURSEMENTS: PETTY CASH

Job No. 9 - Record Transactions in the Cashbook, the Combined Cash-Journal, Petty Cash Disbursements Record, and Other Special Journals: Prove, Post, and Take a Trial Balance.

Unit Four, ACCOUNTING FOR CASH
Report Ten, BANKING PROCEDURE

Job No. 10 - Perform Operations in Transactions Affecting Banking; Reconcile Bank Balance; Record Transactions in the Combined Cash-Journal and Other Special Journals: Post and Take a Trial Balance.

Unit Five, PAYROLL ACCOUNTING
Report Eleven, EARNINGS AND DEDUCTIONS

Job No. 11 - Complete Payroll Records; Compute Employee Wages and Deductions.

Unit Five, PAYROLL ACCOUNTING
Report Twelve, PAYROLL TAXES IMPOSED ON THE EMPLOYER

Job No. 12 - Journalize Transactions Concerning the Accounting for Payrolls and Payroll Deductions; Post and Enter Account Balances.

Unit Six, ACCOUNTING FOR A RETAIL STORE
Report Thirteen, PRINCIPLES AND PROCEDURES

Job No. 13 - Classify Accounts and Analyze Procedures Relating to Retail Accounting; Journalize Transactions.

Course Outline (Continued)

Unit Six, ACCOUNTING FOR A RETAIL STORE
Report Fourteen, APPLICATION OF ACCOUNTING PRINCIPLES

Job No. 14 - Answering Questions Taken From the Books of a Retail Merchant

Unit Seven, THE PERIODIC SUMMARY
Report Fifteen, END-OF-PERIOD WORK SHEET

Job No. 15 - Complete a Work Sheet for a Mercantile Enterprise

Unit Seven, THE PERIODIC SUMMARY
Report Sixteen, THE FINANCIAL STATEMENTS

Job No. 16 - Check Work Sheet Procedures; Prepare an Income Statement and Balance Sheet; Compute Ratios

Unit Eight, ADJUSTING AND CLOSING ACCOUNTS AT END OF ACCOUNTING PERIOD
Report Seventeen, ADJUSTING ENTRIES

Job No. 17 - Made Adjusting Entries in Journal Form; Post and Prepare Cost of Goods Sold Schedule

Unit Eight, ADJUSTING AND CLOSING ACCOUNTS AT END OF ACCOUNTING PERIOD
Report Eighteen, CLOSING PROCEDURE

Job No. 18 - Draft Entries to Close Temporary Proprietorship Accounts; Post and Rule Accounts in Balance; Take Post-Closing Trial Balance; Draft Reversing Entries and Post

Unit Nine, ACCOUNTING FOR INVESTMENTS
Report Nineteen, ACCOUNTING PROCEDURE

Job No. 19 - Journalize Transactions Dealing with Investments; Post Entries; Close Temporary Accounts

Unit Ten, THE PERSONAL SERVICE ENTERPRISE
Report Twenty, ACCOUNTING METHODS

Job No. 20 - Journalizing Transactions Dealing with Personal Service Enterprises; Complete Work Sheet; Draft Adjusting and Closing Entries; Prepare Financial Statements

Course Outline (Continued)

Unit Eleven, ACCOUNTING FOR OWNERS' EQUITY
Report Twenty-One, THE SOLE PROPRIETORSHIP

Job No. 21 - Make Opening Entries, and Record Necessary Changes at End of Accounting Period

Unit Eleven, ACCOUNTING FOR OWNERS' EQUITY
Report Twenty-Three, THE CORPORATION

Job No. 23 - Answer Questions and Record Transactions Regarding Corporations

Unit Twelve, ACCOUNTING FOR NOTES AND DRAFTS
Report Twenty-Four, NOTES

Job No. 24 - Draft Entries Concerning Notes; Record Entries in Notes Receivable and Notes Payable Registers

Unit Twelve, ACCOUNTING FOR NOTES AND DRAFTS
Report Twenty-Five, DRAFTS AND TRADE ACCEPTANCES

Job No. 25 - Draft Entries Regarding Drafts and Trade Acceptances; Complete Partial Posting

Unit Thirteen, ACCOUNTING FOR PURCHASES
Report Twenty-Six, PURCHASING PROCEDURE

Job No. 26 - Complete Statements and Fill in Forms That are Used in the Purchasing Procedure

Unit Thirteen, ACCOUNTING FOR PURCHASES
Report Twenty-Seven, ACCOUNTING PRACTICE

Job No. 27 - Verify Invoices; Enter Invoices in Invoice Record; Complete Individual and Summary Posting; Prepare Schedule of Accounts Payable.

Unit Fourteen, ACCOUNTING FOR SALES
Report Twenty-Eight, CASH SALES AND CREDIT SALES

Job No. 28 - Complete Statements; Prepare Sales Invoices; Enter Sales in Sales Record; Complete Individual and Summary Posting; Prepare Schedule of Accounts Receivable

Course Outline (Continued)

Unit Fifteen, INSTALLMENT SALES AND CONSIGNMENT SALES
Report Twenty-Nine, INSTALLMENT SALES

Job No. 29 - Answer Questions and Work Problems Concerning Installment Sales

Unit Fifteen, INSTALLMENT SALES AND CONSIGNMENT SALES
Report Thirty, CONSIGNMENT SALES

Job No. 30 - Answer Questions and Draft Entries Concerning Consignment Sales

Unit Sixteen, ACCOUNTING FOR INVENTORY AND PREPAID EXPENSES
Report Thirty-One, MERCHANDISE INVENTORY

Job No. 31 - Analyze Merchandise Accounting Procedures; Complete Inventory Extensions; Prepare Revised Income Statement

Unit Sixteen, ACCOUNTING FOR INVENTORY AND PREPAID EXPENSES
Report Thirty-Two, PREPAID EXPENSES

Job No. 32 - Analyze Transactions and Work Problems Concerning Prepaid Expenses

Unit Seventeen, ACCOUNTING FOR TANGIBLE FIXED ASSETS
Report Thirty-Three, LAND, BUILDINGS, AND EQUIPMENT

Job No. 33 - Answer Questions and Work Problems Concerning Depreciation of Fixed Assets

Unit Seventeen, ACCOUNTING FOR TANGIBLE FIXED ASSETS
Report Thirty-Four, ACCOUNTING PROCEDURE

Job No. 34 - Record the Purchasing, Depreciation, and Disposition of Fixed Assets

Unit Eighteen, ACCOUNTING FOR A WHOLESALE BUSINESS
Report Thirty-Five, APPLICATION OF ACCOUNTING PRINCIPLES

Job No. 35 - Complete Analysis Test Based on Books of Account in Reference

Unit Nineteen, ACCOUNTING PROCEDURE AT END OF MONTH
Report Thirty-Six, MONTHLY ADJUSTMENT OF THE OPERATING EXPENSE ACCOUNTS

Job No. 36 - Draft Adjusting Entries; Complete Posting Procedures; Prepare Schedule of Operating Expenses

Course Outline (Continued)

Unit Nineteen, ACCOUNTING PROCEDURE AT END OF MONTH
Report Thirty-Seven, END-OF-PERIOD WORK SHEET

Job No. 37 - Prepare Work Sheets

Unit Twenty, MONTHLY FINANCIAL STATEMENTS AND PROCEDURE AT END OF YEAR
Report Thirty-Eight, THE INCOME STATEMENT

Job No. 38 - Prepare Income Statement, Schedule of Cost of Goods Sold, and Percentage Analysis

Unit Twenty, MONTHLY FINANCIAL STATEMENTS AND PROCEDURE AT END OF YEAR
Report Thirty-Nine, THE BALANCE SHEET

Job No. 39 - Prepare Balance Sheet; Compute Ratio Analysis

Unit Twenty, MONTHLY FINANCIAL STATEMENTS AND PROCEDURE AT END OF YEAR
Report Forty, PROCEDURE AT END OF YEAR

Job No. 40 - Prepare Work Sheet, Income Statement, Balance Sheet, and Schedule of Cost of Goods Sold; Draft and Post Adjusting and Closing Entries; Rule Accounts and Take Post-Closing Trial Balance

Unit Twenty-One, THE CORPORATE ORGANIZATION
Report Forty-One, ORGANIZATION AND MANAGEMENT

Job No. 41 - Analyze Statements and Answer Questions Concerning the Corporate Organization and the Certificate of Incorporation

Unit Twenty-One, THE CORPORATE ORGANIZATION
Report Forty-Two, CORPORATE RECORDS

Job No. 42 - Answer Questions and Make Entries in Stock Records

Unit Twenty-Two, ACCOUNTING FOR CAPITAL STOCK
Report Forty-Three, TYPES AND VALUES OF CAPITAL STOCK

Job No. 43 - Analyze Statements and Work Problems Concerning Capital Stock

Course Outline (Continued)

Unit Twenty-Two, ACCOUNTING FOR CAPITAL STOCK
Report Forty-Four, RECORDING CAPITAL STOCK TRANSACTIONS

Job No. 44 - Analyze Corporate Accounts and Stock Transactions; Record Capital Stock Transactions in Journal Form; Post; Take Trial Balance.

Unit Twenty-Three, ACCOUNTING FOR CORPORATION EARNINGS
Report Forty-Five, EARNINGS RETAINED IN THE BUSINESS

Job No. 45 - Analyze Statements and Journalize Transactions Concerning Corporation Earnings; Prepare Statement of Retained Earnings.

Unit Twenty-Three, ACCOUNTING FOR CORPORATION EARNINGS
Report Forty-Six, EARNINGS DISTRIBUTED TO STOCKHOLDERS

Job No. 46 - Analyze Statements and Record Transactions in Journal Form Concerning the Distribution of Corporate Earnings

Unit Twenty-Four, ACCOUNTING FOR CORPORATION BONDS
Report Forty-Seven, ACCOUNTING FOR BONDS SOLD

Job No. 47 - Answer Questions and Journalize Transactions Concerning Bond Sales and Bond Interest

Unit Twenty-Four, ACCOUNTING FOR CORPORATION BONDS
Report Forty-Eight, ACCOUNTING FOR BOND INTEREST EXPENSE AND FOR BONDS RETIRED

Job No. 48 - Answer Questions and Draft Entries Concerning Bond Interest, Amortization, and Sinking Fund

Unit Twenty-Five, ACCOUNTING FOR INTANGIBLE AND WASTING ASSETS
Report Forty-Nine, ACCOUNTING PROCEDURE

Job No. 49 - Answer Questions and Draft Adjusting Entries Concerning Intangible and Wasting Assets; Prepare Schedule of Intangible Assets

Unit Twenty-Six, THE VOUCHER SYSTEM OF ACCOUNTING
Report Fifty, PRINCIPLES OF VOUCHER ACCOUNTING

Job No. 50 - Prepare Vouchers; Record Voucher Register; Record Payment of Vouchers

Course Outline (Continued)

Unit Twenty-Seven, ACCOUNTING FOR A MANUFACTURING BUSINESS
Report Fifty-One, MANUFACTURING COST; INVENTORIES OF A MANUFACTURING BUSINESS

Job No. 51 - Answer Questions and Work Problems Concerning Manufacturing Cost

Unit Twenty-Seven, ACCOUNTING FOR A MANUFACTURING BUSINESS
Report Fifty-Two, THE CHART OF ACCOUNTS AND RECORDS OF A MANUFACTURING BUSINESS

Job No. 52 - Answer Questions and Number Accounts Based on Chart of Accounts in Reference

Unit Twenty-Eight, ACCOUNTING FOR A MANUFACTURING BUSINESS (CONCLUDED)
Report Fifty-Three, THE WORK SHEET OF A MANUFACTURING BUSINESS

Job No. 53 - Prepare a Work Sheet for a Manufacturing Enterprise

Unit Twenty-Eight, ACCOUNTING FOR A MANUFACTURING BUSINESS (CONCLUDED)
Report Fifty-Four, THE ANNUAL REPORT OF A MANUFACTURING BUSINESS

Job No. 54 - Prepare and Analyze Financial Statements

Unit Twenty-Eight, ACCOUNTING FOR A MANUFACTURING BUSINESS (CONCLUDED)
Report Fifty-Five, CLOSING THE BOOKS OF A MANUFACTURING BUSINESS

Job No. 55 - Draft and Post Adjusting, Closing, and Reversing Entries; Take Post-Closing Trial Balance

Unit Twenty-Nine, ACCOUNTING FOR BRANCH OPERATION
Report Fifty-Six, RECIPROCAL ACCOUNTS AND RECORDING PROCEDURE

Job No. 56 - Analyze Transactions; Journalize Transactions, Post, and Take Trial Balance for the Home Office and the Branch

Unit Twenty-Nine, ACCOUNTING FOR BRANCH OPERATIONS
Report Fifty-Seven, PROCEDURE AT CLOSE OF FISCAL YEAR

Job No. 57 - Analyze Statements; Complete the Work at the End of the Accounting Period for Both the Home Office and the Branch

Course Outline (Continued)

Unit Twenty-Nine, ACCOUNTING FOR BRANCH OPERATIONS
Report Fifty-Eight, COMBINED FINANCIAL STATEMENTS OF HOME OFFICE AND BRANCH

Job No. 58 - Prepare Combined Income Statement and Balance Sheet; Complete Analysis Test

Unit Thirty, ANALYSIS OF FINANCIAL STATEMENTS
Report Fifty-Nine, COMPARATIVE ANALYSIS: RATIOS

Job No. 59 - Comparative Analysis of the Financial Statements; Compute Ratios

Unit Thirty, ANALYSIS OF FINANCIAL STATEMENTS
Report Sixty, THE STATEMENT OF SOURCE AND APPLICATION OF FUNDS

Job No. 60 - Complete Work Sheet; Prepare a Statement of Source and Application of Funds, A Schedule of Current Assets and Current Liabilities

The Business English Course was written in 1961 and revised in 1964. It is available in bound form and consists of 34 jobs.

The reference for the Business English Course is listed below:

Title	Source
Aurner, Robert R. PRACTICAL BUSINESS ENGLISH FOR COLLEGES, Third Edition, 1960	South-Western Publishing Co. 221 Pacific Avenue Dallas 2, Texas

A detailed outline of the Business English Course follows:

Job No. 1: Parts of Speech

Job No. 2: Participles

Job No. 3: Infinitives

Job No. 4: Case of Nouns and Pronouns

Job No. 5: Relative and Interrogative Pronouns

Job No. 6: Forming Plurals of Nouns and Pronouns

Job No. 7: Forming the Singular Possessive and the Plural Possessive of Nouns and Pronouns

Job No. 8: Agreement of the Pronoun and Its Antecedent

Job No. 9: Agreement of the Pronoun and Its Antecedent (Cont'd)

Job No. 10: Verb Tenses

Job No. 11: Treacherous Verbs

Job No. 12: Agreement of Verb with Subject

Job No. 13: Agreement of Verb with Collective and Compound Subjects

Job No. 14: Contractions

Job No. 15: Adjectives

Job No. 16: Adverbs

Course Outline (Continued)

Job No. 17: Distinguishing Adverbs from Adjectives

Job No. 18: Prepositions

Job No. 19: Conjunctions

Job No. 20: Parallel Structure

Job No. 21: The Sentence

Job No. 22: Simple, Compound, and Complex Sentences

Job No. 23: Misused Words and Phrases

Job No. 24: The Period

Job No. 25: The Comma

Job No. 26: The Comma (Cont'd)

Job No. 27: The Semicolon

Job No. 28: The Semicolon (Cont'd)

Job No. 29: Capitalization

Job No. 30: Capitalization (Cont'd)

Job No. 31: Order of and Spacing after Punctuation Marks

Job No. 32: Expression of Numbers

Job No. 33: Expression of Numbers (Cont'd)

Job No. 34: Abbreviations

The Business Law Course was written in 1955 and revised in 1961. It is available in bound form. This material consists of 54 jobs.

The references for the Business Law Course are listed below:

Title	Source
Fisk and Snapp APPLIED BUSINESS LAW 8th Edition, 1960	South-Western Publishing Co. 5101 Madison Road Cincinnati 27, Ohio
LEGAL SECRETARY HANDBOOK (Louisiana)	Shreveport Legal Secretaries Association Shreveport, Louisiana

A detailed outline of the Business Law Course follows:

Job 1

Law and Legal Problems

Job 2

Law and Legal Problems

Job 3

Law and Legal Problems

Job 4

Contracts

Job 5

Contracts

Job 6

Contracts

Job 7

Contracts

Job 8

Review and Test

Course Outline (Continued)

Job 9

Contracts

Job 10

Contracts

Job 11

Contracts

Job 12

Contracts

Job 13

Contracts

Job 14

Contracts

Job 15

Review and Test

Job 16

Bailments

Job 17

Bailments

Job 18

Bailments

Job 19

Buyer and Seller

Job 20

Buyer and Seller

Course Outline (Continued)

Job 21

Buyer and Seller

Job 22

Contracts

Job 23

Buyer and Seller

Job 24

Buyer and Seller

Job 25

Review and Test

Job 26

Debtors and Creditors

Job 27

Debtors and Creditors

Job 28

Negotiable Instruments

Job 29

Negotiable Instruments

Job 30

Negotiable Instruments

Job 31

Negotiable Instruments

Job 32

Negotiable Instruments

Course Outline (Continued)

Job 33

Negotiable Instruments

Job 34

Review and Test

Job 35

Employer and Employee

Job 36

Employer and Employee

Job 37

Employer and Employee

Job 38

Employer and Employee

Job 39

Principal and Agent

Job 40

Principal and Agent

Job 41

Review and Test

Job 42

Insurance

Job 43

Insurance

Job 44

Insurance

Course Outline (Continued)

Job 45

Motor Vehicles

Job 46

Motor Vehicles

Job 47

Review and Test

Job 48

Property

Job 49

Property

Job 50

Property

Job 51

Property

Job 52

Business Organization

Job 53

Business Organization

Job 54

Review and Test

The Business Letter Writing Course was written in 1962 and revised in 1967. A Student Handbook and an Instructor's Guide are available in book form.

The references for the Business Letter Writing Course are the following:

Title	Source
Aurner, Robert R. EFFECTIVE COMMUNICATION IN BUSINESS, Fourth Edition	South-Western Publishing Co. 5101 Madison Road Cincinnati 27, Ohio
Gavin and Hutchinson REFERENCE MANUAL FOR STENOGRAPHERS AND TYPISTS Third Edition	Gregg Division McGraw-Hill Book Co., Inc. 330 West 42nd Street New York 36, New York
Gove, Philip B. (Editor-in-Chief) WEBSTER'S SEVENTH NEW COLLEGIATE DICTIONARY, Seventh Edition	G & C Merriam Company Springfield, Massachusetts
Larson, Lena and A. Koebele REFERENCE MANUAL FOR OFFICE EMPLOYEES, Fourth Edition	South-Western Publishing Co. 5101 Madison Road Cincinnati 27, Ohio
Payne, Lucile Vaughan THE LIVELY ART OF WRITING	Follett Publishing Company 1010 West Washington Blvd. Chicago 7, Illinois
Robertson, Mary and Charles F. Walker PRACTICAL BUSINESS CORRESPONDENCE FOR COLLEGES Third Edition	South-Western Publishing Co. 5101 Madison Road Cincinnati 27, Ohio
Wilkinson, Menning and Anderson WRITING FOR BUSINESS, Third Edition	Richard D. Irwin, Inc. Homewood, Illinois

A detailed outline of the Business Letter Writing Course follows:

UNIT 1 - Capturing Attention Through Business Letter Styling

UNIT 2 - Five Tests of an Effective Letter

Course Outline (Continued)

UNIT 3 - Human Relations in Effective Letters

UNIT 4 - Letters that Ask, Reply, Order, Acknowledge or Remit

UNIT 5 - Letters that Invite, Announce, or Express Appreciation or Sympathy

UNIT 6 - Letters that Introduce, Inquire About, or Recommend Individuals

UNIT 7 - Letters that Secure Employment

UNIT 8 - Letters that Sell

UNIT 9 - Letters that Present Claims and Handle Adjustments

UNIT 10 - Letters that Involve Credit and Collections

UNIT 11 - Letters that Build Reports

UNIT 12 - Special Forms of Communication

UNIT 13 - Dictating Business Letters

UNIT 14 - Letter-Writing Projects

The Business Mathematics Course was revised in 1961. It is available in bound form. This material consists of 32 jobs.

The reference for the Business Mathematics Course is listed below:

Title	Source
Rice, Boyd, and Mayne, BUSINESS MATHEMATICS FOR COLLEGES, Fourth Edition, 1961	South-Western Publishing Co. 5101 Madison Road Cincinnati 27, Ohio

A detailed outline of the Business Mathematics Course follows:

Job 1 - Inventory Test

Job 2 - Addition and Subtraction

Job 3 - Check Records

Job 4 - Multiplication Inventory

Job 5 - Division: Averages and Turnover

Job 6 - Weights and Measures

Job 7 - Addition and Subtraction of Decimals

Job 8 - Multiplication and Division of Decimals

Job 9 - Addition and Subtraction of Fractions

Job 10 - Multiplication and Division of Fractions

Job 11 - Aliquot Parts, Sales Tickets and Invoices, and Repair Orders

Job 12 - Percentage, Base, and Rate

Job 13 - Cash and Trade Discounts

Job 14 - Commissions, Sales, and Purchases

Job 15 - Statement of Profit and Loss: Mark-up

Job 16 - Depreciation and Overhead

Course Outline (Cont'd)

Job 17 - Simple Interest

Job 18 - Promissory Notes and Interest

Job 19 - Interest Tables: Other Interest Formulas

Job 20 - Bank Discount

Job 21 - Interest on Unpaid Balances

Job 22 - Compound Interest and Present Value

Job 23 - Annuities, Sinking Funds, and Amortization

Job 24 - Fire, Casualty, and Life Insurance

Job 25 - Payroll Sheet, Change Tally, and Change Slip

Job 26 - Payroll Deductions

Job 27 - Sales and Property Taxes

Job 28 - Federal Income Tax

Job 29 - Income Statement Analysis

Job 30 - Balance Sheet Analysis

Job 31 - Statistics and Graphs

Job 32 - Stocks and Bonds and Policies

The Business Structure, Organization and Management Course was written in 1955 and revised in 1963. It is available in bound form. This material consists of 32 jobs.

The reference for the Business Structure, Oraganization and Management Course is listed below:

Title	Source
Raymond E. Glos and Harold A. Baker INTRODUCTION TO BUSINESS 5th Edition (4th Ed. available)	South-Western Publishing Co. 5101 Madison Road Cincinnati 27, Ohio

A detailed outline of the Business Structure, Organization and Management Course follows:

Unit 1 - Business--Its Nature, Environment, and Opportunities

Job 1 The Nature of American Business
Job 2 Business and Its Environment
Job 3 Careers in Business

Unit 2 - Ownership, Management, and Organization

Job 4 Sole Proprietorships and Partnerships
Job 5 Corporations
Job 6 Management and Organization

Unit 3 - Marketing

Job 7 The Nature and Scope of Marketing
Job 8 Retailing and Retailers
Job 9 Wholesaling and Wholesalers
Job 10 Prices and Pricing
Job 11 Advertising Problems
Job 12 International Trade

Unit 4 - Physical Factors

Job 13 Location and Layout
Job 14 Purchasing and Inventory Control
Job 15 Production Problems

Unit 5 - Personnel

Job 16 Employee Selection and Training
Job 17 Employee Compensation
Job 18 Labor Problems and Legislation

Course Outline (Continued)

Unit 6 - Finance

Job 19 Long-Term Finance
Job 20 Short-Term Finance
Job 21 Financial Institutions
Job 22 Security Exchanges and Financial News
Job 23 Risks and Insurance
Job 24 Financial Problems and Policies

Unit 7 - Quantitative Controls for Decision Making

Job 25 Accounting and Financial Statements
Job 26 Business Statistics
Job 27 Budgets and Forecasting

Unit 8 - Legal and Regulatory Environment of Business

Job 28 Ethics and Business Law
Job 29 Regulation of Competitive Business
Job 30 Regulated Industries
Job 31 Taxation and Business

The Filing Course was revised in 1961 and again in 1963. It is available in bound form. This material consists of 23 Jobs.

The reference for the Filing Course is listed below:

Title	Source
Kahn, Yerian and Stewart PROGRESSIVE FILING 1961	McGraw-Hill Book Co., Inc. 330 West 42nd Street New York 36, New York

A detailed outline of the Filing Course follows:

Job 1 Indexing Rules, Alphabetic Card Filing

Job 2 Indexing Rules, Alphabetic Card Filing

Job 3 Indexing Rules, Alphabetic Card Filing

Job 4 Indexing Rules, Alphabetic Card Filing

Job 5 Indexing Rules, Alphabetic Card Filing

Job 6 Indexing Rules, Alphabetic Card Filing

Job 7 Filing Procedures and Materials

Job 8 Alphabetic Correspondence Filing

Job 9 Alphabetic Correspondence Filing

Job 10 Charge Methods, Transfer Methods

Job 11 Selection of Equipment and Supplies

Job 12 Numeric Correspondence Filing

Job 13 Numeric Correspondence Filing

Job 14 Geographic Correspondence Filing

Job 15 Geographic Correspondence Filing

Job 16 Subject Correspondence Filing

Job 17 Subject Correspondence Filing

Job 18 Card Filing--Vertical and Visible; Decimal--Subject Co-respondence Filing

Course Outline (Cont'd)

Job 19 Decimal--Subject Correspondence Filing

Job 20 Soundex Coding System, Triple-Check Automatic Index

Job 21 Cards and Visible Records

Job 22 Establishing and Maintaining Filing Systems

Job 13 Final Test

The Full-Keyboard Adding Listing Machine Course was written in 1955 and revised in 1963. It is available in bound form. The material covers 20 jobs.

The reference for the Full-Keyboard Adding-Listing Machine Course is listed below.

Title	Source
Agnew and Pasewark FULL-KEYBOARD ADDING-LISTING MACHINE COURSE, Third Edition	South-Western Publishing Co. 5101 Madison Road Cincinnati 27, Ohio

A detailed outline of the Full-Keyboard Adding-Listing Machine Course follows:

Job 1 ADDITION - Zeros; One- and Two-Digit Numbers

Job 2 ADDITION - Three-Digit Numbers

Job 3 ADDITION - Four-, Five-, and Six-Digit Numbers; Non-Add Key

Job 4 SUBTRACTION AND CORRECTION OF ERRORS

Job 5 SPEED DRILL-ADDITION

Job 6 REPEAT ADDITION

Job 7 MULTIPLICATION

Job 8 SUBTOTAL AND CROSSFOOTING

Job 9 SPEED DRILL - ADDITION

Job 10 TEST NO. 1

Job 11 PERCENTAGES, DECIMALS, AND FRACTIONS

Job 12 FIXED DECIMAL POINT

Job 13 MULTIPLICATION, Short Cut Method

Job 14 DISCOUNT AND NET AMOUNT

Job 15 SPEED DRILL - ADDITION

Job 16 DIVISION - Decimals in Dividend and Divisor

Job 17 CREDIT BALANCES

Course Outline (Continued)

Job 18 BUSINESS FORMS

Job 19 SPEED DRILL - ADDITION

Job 20 TEST NO. 2

The Key-Driven Calculator material was written in 1955 and revised in 1963. It is available in bound form. This material consists of 60 jobs.

The reference for the Key-Driven Calculator Course is listed below:

Title	Source
Agnew and Pasewark KEY-DRIVEN CALCULATOR COURSE 4th Edition	South-Western Publishing Co. 5101 Madison Road Cincinnati 27, Ohio

A detailed outline of the Key-Driven Calculator Course follows:

Part 1

Job 1 - TOUCH ADDITION - Two Digit Numbers 1-5; One-Key Ascent and Descent

Job 2 - TOUCH ADDITION - Two-Key Ascent and Descent; Decimals

Job 3 - TOUCH ADDITION - Numbers 6-9

Job 4 - TOUCH ADDITION - Three-Digit Numbers; Zeros

Job 5 - MULTIPLICATION - One- and Two-Digit Factors; Decimals

Job 6 - TOUCH ADDITION - Three-Key Ascent and Descent

Job 7 - SUBTRACTION

Job 8 - TOUCH ADDITION - Four-Key Ascent and Descent

Job 9 - DIVISION - Trial-Divisor Method

Job 10 - TEST NUMBER ONE

Part 2

Job 11 - MULTIPLICATION - Natural Fingering; Three- and Four-Digit Multiplicands

Job 12 - MULTIPLICATION - Reverse and Cross Hand Fingering

Job 13 - SPEED DRILL - Three-Column Addition

Course Outline (Continued)

Job 14 - TOUCH ADDITION - Four-Digit Numbers

Job 15 - MULTIPLICATION - Interposed Fingering; Zeros

Job 16 - SUBTRACTION - Zeros and Nines; Fewer Digits in Subtrahend

Job 17 - SPEED DRILL - Four-Column Addition

Job 18 - CROSSFOOTING

Job 19 - DIVISION - Decimals in Quotient; Decimals in Dividend and Divisor; Nines in Divisor

Job 20 - TEST NUMBER TWO

Part 3

Job 21 - MULTIPLICATION - Fractions

Job 22 - MULTIPLICATION - Accumulation of Products

Job 23 - SPEED DRILL - Multiplication of Four-Digit Multiplicands

Job 24 - MULTIPLICATION - Fixed Decimal

Job 25 - MULTIPLICATION - Left-to-Right, Using a Fixed Decimal

Job 26 - TOUCH ADDITION - Five-Digit Numbers

Job 27 - SPEED DRILL - Five-Column Addition

Job 28 - INVENTORIES - Pricing by C, M, and CWT

Job 29 - Compound Multiplication

Job 30 - Test Number Three

Part 4

Job 31 - MULTIPLICATION - Left-to-Right, Dropping off the Keyboard

Job 32 - MULTIPLICATION - Splitting the Key Factor

Job 33 - SPEED DRILL - Four-Column Addition

Course Outline (Continued)

Job 34 - PERCENTAGE

Job 35 - PERCENTAGE OF INCREASE AND DECREASE

Job 36 - TOUCH ADDITION - Six-Digit Numbers

Job 37 - SPEED DRILL - Five-Column Addition

Job 38 - DISCOUNTS

Job 39 - CHAIN DISCOUNTS

Job 40 - TEST NUMBER FOUR

Part 5

Job 41 - INVENTORIES

Job 42 - INVENTORIES - Turnover and Unit Cost

Job 43 - SPEED DRILL - Multiplication of Four-Digit Factors with Decimals

Job 44 - SALES DISTRIBUTION AND REPORTS

Job 45 - LEDGER SHEETS

Job 46 - TOUCH ADDITION - Seven-Digit Numbers

Job 47 - SPEED DRILL - Four-Column Addition Handwritten

Job 48 - CREDIT BALANCES

Job 49 - DIVISION - Reciprocal Method

Job 50 - TEST NUMBER FIVE

Part 6

Job 51 - PRORATING

Job 52 - RECONCILIATION OF BANK STATEMENTS

Job 53 - SPEED DRILL - Four-Column Addition

Job 54 - PAYROLL

Course Outline (Continued)

Job 55 - PAYROLL SUMMARY

Job 56 - TOUCH ADDITION - Eight-Digit Numbers

Job 57 - SPEED DRILL - Six-, Seven-, and Eight-Column Addition

Job 58 - DEVISING TABLES OF NUMBERS

Job 59 - COMMISSIONS

Job 60 - TEST NUMBER SIX

The Office Practice Course was revised in 1960. It is available in bound form. The material consists of 23 jobs.

The reference for the Office Practice Course is listed below:

Title	Source
Place and Hicks, COLLEGE SECRETARIAL PROCEDURES Second Edition	Gregg Publishing Division McGraw-Hill Book Co., Inc. 330 West 42nd Street New York 36, New York

A detailed outline of the Office Practice Course follows:

Job No. 1

Course Introduction
A Secretary's Role in Business

Job No. 2

Personality and Human Relations

Job No. 3

Dictation and Transcription

Job No. 4

Incoming Mail

Job No. 5

Outgoing Mail Procedures

Job No. 6

Filing and Records Organization

Job No. 7

Filing Systems and Maintenance

Job No. 8

A Secretary's Role in Public Relations

Job No. 9

Telephone Techniques and Services

Course Outline (Continued)

Job No. 10

Using Telegraph Services

Job No. 11

Communications: The Business Letter

Job No. 12

Sources of Information

Job No. 13

Travel Services

Job No. 14

Banking Procedures

Job No. 15

Financial Records

Job No. 16

Secretarial Procedures in Buying and Selling

Job No. 17

Reports, Manuscripts, and Legal Documents

Job No. 18

Meetings and Conferences

Job No. 19

Duplicating Procedures and Equipment

Job No. 20

Office Machines

Job No. 21

Launching Your Secretarial Career

Course Outline (Continued)

Job No. 22

Becoming a Member of the Team

Job No. 23

Looking Ahead to Supervision and Management

The Payroll Accounting Course was written in 1958 and revised in 1963. It is available in bound form. This material consists of 10 jobs.

The reference for this course is listed below:

Title	Source
John A. Pendery and B. Lewis Keeling PAYROLL RECORDS AND ACCOUNTING, 1963	South-Western Publishing Co. 5101 Madison Road Cincinnati 27, Ohio

A detailed outline of the Payroll Accounting Course follows:

Job 1

Need for Payroll Records

Job 2

Computing and Paying Wages and Salaries

Job 3

Old-Age, Survivors', and Disability Benefits and Taxes

Job 4

Federal Unemployment Insurance and Taxes

Job 5

State Unemployment Compensation and Taxes

Job 6

Withholding for Income Tax Purposes

Job 7

Personnel Records

Job 8

Payroll Records

Course Outline (Continued)

Job 9

Payroll Accounting

Job 10

Project

The Personal Development Course was written in 1958 and revised in 1963. It is available in bound form. The material covers 21 Lesson Plans

The references for the Personal Development Course are listed below.

Title	Source
TODAY'S SECRETARY $4.00	Gregg Publishing Division McGraw-Hill Book Co., Inc. 330 West 42nd Street New York 36, New York
P. S. FOR PRIVATE SECRETARIES $15.00	The Bureau of Business Practice 24 Rope Ferry Road Waterford, Connecticut
BETTER SECRETARIES SERIES $24.00	Prentice-Hall, Inc. Englewood Cliffs, New Jersey

A detailed outline of the Personal Development Course follows:

Lesson Plan 1 - Personalities

Lesson Plan 2 - Getting a Job

Lesson Plan 3 - First Job

Lesson Plan 4 - Secretarial Attitudes

Lesson Plan 5 - Adjusting to the Job

Lesson Plan 6 - Secretarial Cooperation

Lesson Plan 7 - Job Growth

Lesson Plan 8 - Organization and Planning

Lesson Plan 9 - Adjusting to Change

Lesson Plan 10 - Initiative vs. Aggressiveness

Lesson Plan 11 - Making Compliments Count

Lesson Plan 12 - The Extemporaneous Talk

Lesson Plan 13 - The Extemporaneous Talk Cont'd.

Course Outline (Continued)

Lesson Plan 14 - Telephone Techniques

Lesson Plan 15 - Tagline for Success

For Men

Lesson Plan 16 - Clean as a Whistle

Lesson Plan 17 - Fit as a Fiddle

Lesson Plan 18 - Time to Attire

Lesson Plan 19 - Strictly Business

For Women

Lesson Plan 16 - You and Your Grooming

Lesson Plan 17 - Your Face

Lesson Plan 18 - Your Hair

Lesson Plan 19 - Your Clothing

Lesson Plan 20 - Your Figure

Lesson Plan 21 - Your Hands and Feet

The Posting Machine Course was written in 1961. It is available in bound form. The material covers 14 jobs.

Due to the many makes of machines used for this course there can be no one text applicable. Posting data is supplied for each job and the text or reference is obtainable from the instructor.

A detailed outline of the Posting Machine Course follows:

Job 1 Opening of Accounts and Posting Old Balances

Job 2 Posting Invoices and Receipts

Job 3 Posting Invoices and Receipts

Job 4 Posting Invoices and Receipts

Job 5 Posting Invoices and Receipts

Job 6 Posting Invoices and Receipts

Job 7 Posting Invoices and Receipts

Job 8 Posting Invoices and Receipts

Job 9 Posting Invoices and Receipts

Job 10 Posting Invoices and Receipts

Job 11 Posting Invoices and Receipts

Job 12 Opening of Accounts and Posting of Old Balances

Job 13 Posting Data from Payroll Sheet

Job 14 Posting Data from Payroll Sheet

The Printing Calculator Course was recently written and is available in bound form. The material covers 12 jobs.

A detailed outline of the Printing Calculator Course follows:

Job 1 Addition and Subtraction

Job 2 Multiplication

Job 3 Cumulative Multiplication

Job 4 Percentage--Discounts

Job 5 Use of Constants--Payroll

Job 6 Division

Job 7 Averaging

Job 8 Multi-factor--Multiplication and Division--Interest

Job 9 Chain Discounts

Job 10 Proration

Job 11 Review

Job 12 Review

The Rotary Calculator Course was written in 1955 and revised in 1963. It is available in bound form. The material covers 30 jobs.

The reference for the Rotary Calculator Course is listed below:

Title	Source
Agnew and Pasewark ROTARY CALCULATOR COURSE 4th Edition	South-Western Publishing Co. 5101 Madison Road Cincinnati 27, Ohio

A detailed outline of the Rotary Calculator Course follows:

Job 1 - ADDITION - Zeros, One- and Two-Digit Numbers

Job 2 - ADDITION - Three-, Four- and More-Digit Numbers

Job 3 - SUBTRACTION

Job 4 - CONSTANTS - Addition and Subtraction

Job 5 - SPEED DRILL - Addition

Job 6 - MULTIPLICATION - Decimals

Job 7 - MULTIPLICATION - Fixed Decimal Point

Job 8 - DIVISION

Job 9 - SPEED DRILL - Subtraction

Job 10 - TEST NO. 1

Job 11 - DIVISION - Decimals

Job 12 - MULTIPLICATION - Accumulative

Job 13 - PERCENTAGE

Job 14 - MULTIPLICATION - Negative; Short-Cut Methods

Job 15 - SPEED DRILL - Multiplication

Job 16 - MULTIPLICATION - Constant Multiplication; Double Multiplication

Job 17 - DISCOUNT AND NET AMOUNT

Course Outline (Continued)

Job 18 - CHAIN DISCOUNTS

Job 19 - SPEED DRILL - Division

Job 20 - TEST NO. 2

Job 21 - PERCENTAGES OF INCREASE AND DECREASE

Job 22 - MULTIPLICATION - Compound

Job 23 - DIVISION - Reciprocal Method

Job 24 - INTEREST

Job 25 - SPEED DRILL - Multiplication with Decimals

Job 26 - ADDITION - Compound

Job 27 - DIVISION - Build-up Method
Simultaneous Division and Multiplication

Job 28 - CREDIT BALANCES

Job 29 - SPEED DRILL - Division with Decimals

Job 30 - TEST NO. 3

The Salesmanship Course was revised in 1960. It is available in bound form. This material consists of 30 assignments.

The reference for the Salesmanship Course is listed below:

Title	Source
Wingate-Nolan FUNDAMENTALS OF SELLING, 7th Edition, 1959	South-Western Publishing Co. 5101 Madison Road Cincinnati 27, Ohio

A detailed outline of the Salesmanship Course follows:

Part I
Chapter I
Assignment 1 - What is Selling?

Part I
Chapter II
Assignment 2 - Types of Selling

Part I
Chapter III
Assignment 3 - How Goods Reach the Consumer

Test No. 1--Part I

Part II
Chapter IV
Assignment 4 - Why the Consumer Buys

Part II
Chapter V
Assignment 5 - Analysis of Customer Demand

Part II
Chapter VI
Assignment 6 - Consumer Goods

Part II
Chapter VII
Assignment 7 - Market Resources for Consumer Goods

Test No. 2--Part II

Part III
Chapter VIII
Assignment 8 - The Seller's Personality--Physical Characteristics

Course Outline (Continued)

Part III
Chapter IX
Assignment 9 - The Seller's Personality--Mental Characteristics

Part III
Chapter X
Assignment 10 - The Seller's Use of English

Part III
Chapter XI
Assignment 11 - The Seller's Use of Arithmetic

Test No. 3--Part III

Part IV
Chapter XII
Assignment 12 - The Technique of Locating Customers

Part IV
Chapter XIII
Assignment 13 - Preparing to Meet Customers

Part IV
Chapter XIV
Assignment 14 - Opening the Sale

Part IV
Chapter XV
Assignment 15 - Analyzing the Customer's Wants

Part IV
Chapter XVI
Assignment 16 - Presenting a Planned Sales Story

Part IV
Chapter XVII
Assignment 17 - Handling the Customer's Objections

Part IV
Chapter XVIII
Assignment 18 - Closing the Sale

Part IV
Chapter XIX
Assignment 19 - Plus Selling

Test No. 4--Part IV

Course Outline (Continued)

Part V
Chapter XX
Assignment 20 - Advertising as a Sales Tool

Part V
Chapter XXI
Assignment 21 - Selling by Means of Letters

Part V
Chapter XXII
Assignment 22 - Selling by Means of Effective Display

Part V
Chapter XXIII
Assignment 23 - Selling by Telephone

Part V
Chapter XXIV
Assignment 24 - Selling by Means of Radio, Television, and Other Presentations

Test No. 5--Part V

Part VI
Chapter XXV
Assignment 25 - Sales Promotion Policies

Part VI
Chapter XXVI
Assignment 26 - Business Service Policies

Part VI
Chapter XXVII
Assignment 27 - Ethical Treatment of Customers

Part VI
Chapter XXVIII
Assignment 28 - Ethical Treatment of Competitors and Others

Part VI
Chapter XXIX
Assignment 29 - Meeting the Demands of Modern Consumer

Test No. 6--Part VI

Part VII
Chapter XXX
Assignment 30 - How to Secure a Job

The Shorthand Course was written in 1955 and rewritten in 1958. It is available in bound form. The material covers 70 jobs.

The reference for Shorthand Course is listed below.

Title	Source
Leslie, Zoubek, Hosler, GREGG SHORTHAND SIMPLIFIED FOR COLLEGES, Volume 1, 2nd Edition	Gregg Publishing Division McGraw-Hill Book Co., Inc. 330 West 42 nd Street New York 36, New York

The detailed outline of the Shorthand Course follows:

Job 1
  Paragraph 1 through 11
Job 2
  Paragraph 12 through 17
Job 3
  Paragraph 18 through 23
Job 4
  Paragraph 24 through 31
Job 5
  Paragraph 32 through 40
Job 6
  Paragraph 41 through 53
Job 7
  Paragraph 54 through 61
Job 8
  Paragraph 62 through 71
Job 9
  Paragraph 72 through 80
Job 10
  Paragraph 81 through 92
Job 11
  Paragraph 93 through 102
Job 12
  Paragraph 103 through 111
Job 13
  Paragraph 112 through 118
Job 14
  Paragraph 119 through 125
Job 15
  Paragraph 126 through 133
Job 16
  Paragraph 134 through 142
Job 17
  Paragraph 143 through 150
Job 18
  Paragraph 151 through 161

Course Outline (Continued)

Job 19
  Paragraph 162 through 169
Job 20
  Paragraph 170 through 179
Job 21
  Paragraph 180 through 187
Job 22
  Paragraph 188 through 196
Job 23
  Paragraph 197 through 205
Job 24
  Paragraph 206 through 210
Job 25
  Paragraph 211 through 219
Job 26
  Paragraph 220 through 231
Job 27
  Paragraph 232 through 242
Job 28
  Paragraph 243 through 252
Job 29
  Paragraph 253 through 263
Job 30
  Paragraph 264 through 269
Job 31
  Paragraph 270 through 281
Job 32
  Paragraph 282 through 289
Job 33
  Paragraph 290 through 300
Job 34
  Paragraph 301 through 307
Job 35
  Paragraph 308 through 315
Job 36
  Paragraph 316 through 320
Job 37
  Paragraph 321 through 332
Job 38
  Paragraph 333 through 345
Job 39
  Paragraph 346 through 352
Job 40
  Paragraph 353 through 359
Job 41
  Paragraph 360 through 368
Job 42
  Paragraph 369 through 375

Course Outline (Continued)

Job 43
  Paragraph 376 through 383
Job 44
  Paragraph 384 through 390
Job 45
  Paragraph 391 through 398
Job 46
  Paragraph 399 through 407
Job 47
  Paragraph 408 through 417
Job 48
  Paragraph 418 through 423
Job 49
  Paragraph 424 through 433
Job 50
  Paragraph 434 through 444
Job 51
  Paragraph 444 through 453
Job 52
  Paragraph 454 through 461
Job 53
  Paragraph 462 through 469
Job 54
  Paragraph 470 through 474
Job 55
  Paragraph 475 through 480
Job 56
  Paragraph 481 through 486
Job 57
  Paragraph 487 through 494
Job 58
  Paragraph 495 through 500
Job 59
  Paragraph 501 through 505
Job 60
  Paragraph 506 through 510
Job 61
  Paragraph 511 through 515
Job 62
  Paragraph 516 through 521
Job 63
  Paragraph 522 through 526
Job 64
  Paragraph 527 through 531
Job 65
  Paragraph 532 through 536
Job 66
  Paragraph 537 through 540

Course Outline (Continued)

Job 67
  Paragraph 541 through 546
Job 68
  Paragraph 547 through 551
Job 69
  Paragraph 552 through 555
Job 70
  Paragraph 556 through 562

The Spelling Course was written in 1955 and rewritten in 1958 and again in 1962. It is available in loose leaf form. An Instructor's Guide is available in book form. The material covers 38 jobs.

The reference for the Spelling Course is listed below:

Title	Source
Oberly-Silverthorn COLLEGE SPELLING for Businessman's Vocabulary 3rd Edition	South-Western Publishing Co. 5101 Madison Road Cincinnati 27, Ohio

The detailed outline of the Spelling Course follows:

Introduction

Job 1 - Student Study Sheet

Job 2 - Unit I - Adding a Suffix

Job 3 - Unit I - Adding a Suffix

Job 4 - Unit II - Working With Words

Job 4A - Rules of Hyphenation

Job 5 - Unit II - Working With Words

Job 6 - Unit III - Words Ending in Silent "e," "ie," & "y"

Job 7 - Unit III - Words Ending in Silent "e," "ie," & "y"

Job 8 - Unit III - Words Ending in Silent "e," "ie," 7 "y"

Job 9 - Unit IV - Words Containing "ei" & "ie" Sequences

Job 10 - Unit IV - Words Containing "ei" & "ie" Sequences

Job 11 - Unit V - Plural Form of Nouns

Job 12 - Unit V - Plural Form of Nouns

Job 13 - Unit V - Plural Form of Nouns

Job 14 - Unit VI - Possessive Forms of Nouns

Job 15 - Unit VI - Possessive Forms of Nouns

Course Outline (Continued)

Job 16 - Unit VI - Possessive Forms of Nouns

Job 17 - Unit VII - How to Build and Spell Related Words - Prefixes

Job 18 - Unit VII - How to Build and Spell Related Words - Prefixes

Job 19 - Unit VIII - Suffixes

Job 20 - Unit VIII - Suffixes

Job 21 - Unit VIII - Suffixes

Job 22 - Unit IX - Troublesome Suffixes

Job 23 - Unit IX - Troublesome Suffixes

Job 24 - Unit IX - Troublesome Suffixes

Job 25 - Unit IX - Troublesome Suffixes

Job 26 - Unit IX - Troublesome Suffixes

Job 27 - Unit IX - Troublesome Suffixes

Job 28 - Unit X - Troublesome Suffixes (Continued)

Job 29 - Unit X - Troublesome Suffixes (Continued)

Job 30 - Unit X - Troublesome Suffixes (Continued)

Job 31 - Unit XI - Troublesome Suffixes (Concluded)

Job 32 - Unit XI - Troublesome Suffixes (Concluded)

Job 33 - Unit XI - Troublesome Suffixes (Concluded)

Job 34 - Unit XII - Synonyms

Job 35 - Unit XII - Synonyms

Job 36 - Unit XIII - Miscellaneous Words

Job 37 - Unit XIV - Miscellaneous Words (Continued)

Job 38 - Unit XV - Miscellaneous Words (Concluded)

The Ten-Key Adding-Listing Machine Course was written in 1955 and revised in 1963. It is available in bound form. This material consists of 30 jobs.

The reference for this course is listed below.

Title	Source
Agnew-Pasewark TEN-KEY ADDING-LISTING AND PRINTING CALCULATOR COURSE Third Edition	South-Western Publishing Co. 5101 Madison Road Cincinnati 27, Ohio

A detailed outline of the Ten-Key Adding-Listing Machine Course follows.

Job 1 Touch Addition

Job 2 Touch Addition

Job 3 Addition of Numbers Containing Repeated Digits and Varied Number of Digits

Job 4 Subtraction and Correction of Errors

Job 5 Speed Drill--Addition

Job 6 Sub-Total Key

Job 7 Repeat Addition

Job 8 Multiplication

Job 9 Speed Drill--Addition

Job 10 Test No. 1

Job 11 Short-Cut Multiplication--Zeros in the Multiplier

Job 12 Decimals, Fractions, and Percentages

Job 13 Fixed Decimal Point

Job 14 Discount and Net Amount

Job 15 Speed Drill--Addition

Job 16 Chain Discounts

Course Outline (Continued)

Job 17 Constant Multiplication

Job 18 Division

Job 19 Speed Drill-Addition

Job 20 Test No. 2

Job 21 Division (Remainder in Quotient)
(Decimals in Quotient)
(Decimals in Dividend and Divisor)

Job 22 Credit Balances

Job 23 Interest

Job 24 Percentage of Increase and Decrease

Job 25 Speed Drill-Addition

Job 26 Prorating

Job 27 Payrolls

Job 28 Reconciliation of Bank Statements

Job 29 Speed Drill-Addition

Job 30 Test No. 3

OFFICE OCCUPATIONS
TYPEWRITING
Trade Preparatory

The Typewriting material was revised in 1966. It is available in book form. This material covers thirty five units.

The reference for this course is listed below.

Title	Source
Lloyd, Rowe, and Winger GREGG TYPEWRITING FOR COLLEGES Second Edition	Gregg Publishing Division McGraw-Hill Book Company, Inc. 330 West 42nd Street New York 36, New York

The Practical Nurse Course was published in 1954 and Book I and Book II revised in 1959, Book III revised in 1960.

Book I - Jobs (Related Study Assignments and Procedure Sheets)
Book II - Jobs (Related Study Assignments and Procedure Sheets)
Book III

The references for the Practical Nurse Education Course are the following:

Title	Source
BOOK I	
Dakin, Thompson, LeBaron, SIMPLIFIED NURSING, Sixth Ed., 1956	J. B. Lippincott Company Philadelphia, Pa.
Gill, Helen, BASIC NURSING, Fourth Ed., 1958	The Macmillan Company Sixty Fifth Avenue New York 44, New York
Rapier, PRACTICAL NURSING, 1st Ed., 1958	C. V. Mosby St. Louis, Missouri
Tabers, MEDICAL DICTIONARY	J. A. Majors Company New Orleans, Louisiana
State Department of Health, SANITARY CODE	U. S. Government Printing Office Washington 25, D. C.
Van Bearson, Carolyn, GETTING READY TO BE A MOTHER	The Macmillan Company Sixty Fifth Avenue New York 44, New York
Gorbin, Hazel, GETTING READY TO BE A FATHER	The Macmillan Company Sixty Fifth Avenue New York 44, New York
PRENATAL CARE	U. S. Government Printing Office Washington, D. C.
Federal Security Agency, PRENATAL CARE	U. S. Government Printing Office Washington 25, D. C.
Children's Bureau Publishers No. 325 PREMATURE INFANTS	U. S. Government Printing Office Washington 25, D. C.

References (Continued)

Title	Source
BOOK I (Continued)	
PREMATURE MANUAL OF MEDICAL AND NURSING PROCEDURES	Charity Hospital New Orleans, Louisiana
Wallinger, NURSING CARE OF PREMATURE INFANTS	American Journal of Nursing
Children's Bureau Publication, INFANT CARE No. 8, 1951	U. S. Government Printing Office Washington 25, D. C.
YOUR CHILD FROM ONE TO SIX YOUR CHILD FROM SIX TO TWELVE	U. S. Children's Bureau Publication 30
SOME SPECIAL PROBLEMS OF CHILDREN	National Mental Health Foundation
GUIDING THE ADOLESCENT	Children's Bureau Publication 225
Weiss, M. Olga, ATTITUDES IN PSYCHIATRIC NURSING CARE	G. P. Putnam's Sons 210 Madison Avenue New York 16, New York
Roberson, PSYCHIATRIC AIDE	The Macmillan Company Sixty Fifth Avenue New York 44, New York
BOOK II	
Wiship, TOGETHER WE WORK	American Dietetic Association
Rust, Justin, TODAYS HOME LIVING	J. B. Lippincott Co. Philadelphia, Pa.
Mitchell and Bernard, FOOD IN HEALTH AND DISEASE	F. A. Davis Company Philadelphia, Pennsylvania
Peyton, PRACTICAL NUTRITION	J. B. Lippincott Company Philadelphia, Pennsylvania
Howe, NUTRITION FOR PRACTICAL NURSES	W. B. Saunders Company Philadelphia, Pennsylvania

References (Continued)

Title	Source
BOOK II (Continued)	
Bulletins THE HEART OF THE HOME	American Heart Association
MANAGE YOUR TIME	Louisiana State University Baton Rouge, Louisiana
WAYS TO CONSERVE TIME AND ENERGY	Bureau of Educational Service Washington
HOUSE CLEANING MANAGEMENT AND METHODS	Farmers Bulletin #1834 U. S. D. A.
Hurst, THE 1-2-3 OF HOMEMAKING	Prentice Hall Englewood Cliffs, New Jersey
Moore, WHAT SHALL WE EAT AND WHY	State Department of Health
FOOD FACTS	American Dietetic Association
FAMILY FARE	United States Department of Agriculture
Harris Henderson, FOODS	D. C. Heath and Company 285 Columbus Avenue Boston 16, Massachusetts
Bulletin: L.S.U.; HARMONY IN TABLE SETTING AND SERVICE	County Home Demonstration Agent
Bulletin: MEAT FOR THRIFTY MEALS	U. S. D. A.
Darling EMOTIONAL FACTORS IN OBESITY AND WEIGHT	American Dietetic Association

A detailed outline of the Practical Nurse Education Course follows:

BOOK I

Job 1

P.S. - Pretest in Arithmetic

R.S.A. 1 - History of Practical Nursing
R.S.A. 2 - Orientation - Co-workers and Community
R.S.A. 3 - Classifications and Organization of Hospitals
R.S.A. 4 - Orientation - School and Hospital
R.S.A. 5 - Orientation - How to Study
R.S.A. 6 - Mathematics - Table of Whole Numbers

Job 2 - Set Up a Patient Unit

P.S. 1 - How to Clean and Care for Supplies and Equipment
P.S. 2 - How to Strip a Bed, Dispose of Soiled Linen and Care for Equipment
P.S. 3 - How to Care for Cleaning Equipment and Dispose of Waste
P.S. 4 - How to Arrange Equipment and Restock Patient's Unit
P.S. 5 - How to Make a Closed and Open Bed

R.S.A. 1 - Introduction to Health and the Importance of Cleanliness
R.S.A. 2 - Selection of Bedmaking Supplies
R.S.A. 3 - Principles of Heat, Light and Ventilation
R.S.A. 4 - Working Relations - The Nurse in the Home
R.S.A. 5 - Introduction to Charting - Letters and Rules of Punctuation
R.S.A. 6 - Mathematics: Addition of Whole Numbers
R.S.A. 7 - Mathematics: Subtraction of Whole Numbers
R.S.A. 8 - Mathematics: Multiplication of Whole Numbers
R.S.A. 9 - Mathematics: Division of Whole Numbers
R.S.A. 10 - How to Regulate Heat, Light and Ventilation

Job 3 - Care and Maintenance of Linen and Utility Rooms and Medicine Cabinets

P.S. 1 - How to Maintain Orderly Linen and Utility Rooms

R.S.A. 1 - Introduction to Charting Numerals

Course Outline (Continued)

BOOK I (Continued)

Job 3 (Continued)

P.S. 2 - How to Clean Linen and Utility Rooms, Check and Obtain Linen Supply
P.S. 3 - How to Clean, Arrange and Maintain Medicine Cabinet

R.S.A. 2 - Mathematics: Fractions
R.S.A. 3 - Care and Storage of Medicines in Hospital and Home
R.S.A. 4 - Mathematics: Addition of Fractions
R.S.A. 5 - Subtraction of Fractions
R.S.A. 6 - Multiplication and Division of Fractions

Job 4 - Admit the Patient

P.S. 1 - How to Assemble and fill out a clinical chart
P.S. 2 - How to Get the Patient into Bed
P.S. 3 - How to Place the Patient upon Stretcher and remove Patient From Stretcher
P.S. 4 - How to Undress the Patient
P.S. 5 - How to Put on a Gown or Pajamas
P.S. 6 - How to Care for Clothing and Valuables
P.S. 7 - How to Get Patient Out of Bed
P.S. 8 - How to Take Temperatures
P.S. 9 - How To Clean and Disinfect Clinical Thermometers
P.S. 10 - How to Take a Rectal Temperature
P.S. 11 - How to Count the Pulse
P.S. 12 - How to Count Respiration
P.S. 13 - How to Give and Remove a Bedpan

R.S.A. 1 - Introduction to Body Structure and Function
R.S.A. 2 - Working Relationships
R.S.A. 3 - Mathematics - Decimals
R.S.A. 4 - Mathematics - Addition and Subtraction of Decimals
R.S.A. 5 - Mathematics - Multiplication and Division of Decimals
R.S.A. 6 - Admission of Patient to Hospital
R.S.A. 7 - Temperature, Pulse and Respiration

Course Outline (Continued)

BOOK I (Continued)

Job 4 (Continued)

P.S. 14 - How To Give and Remove a Urinal
P.S. 15 - How to Collect a Voided Specimen of Urine From an Adult
P.S. 16 - How to Measure Fluid Intake and Output
P.S. 17 - How to Weigh and Measure an Adult Patient

Job 5 - Make a Patient Comfortable

P.S. 1 - How to Maintain Good Body Alignment
P.S. 2 - How to Give Oral Hygiene and Care of Dentures
P.S. 3 - How to Prepare a Patient for a Meal, Serve a Tray, and Feed the Patient
P.S. 4 - How to Remove Gown or Pajamas
P.S. 5 - How to Give A.M. Care
P.S. 6 - How to Give a Bed Bath
P.S. 7 - How to Give a Partial Bath
P.S. 8 - How to Give a Tub Bath
P.S. 9 - How to Give Shower Bath
P.S. 10 - How to Give Back Rub
P.S. 11 - How to Care for Fingernails and Toenails
P.S. 12 - How to Brush and Comb Hair
P.S. 13 - How to Give Treatment for Pediculi

R.S.A. 1 - The Skeletal System
R.S.A. 2 - The Muscular System
R.S.A. 3 - The Skin
R.S.A. 4 - The Digestive System
R.S.A. 5 - Personal Hygiene in Relation to Skin, Hair, Nails, Posture, Feet, Mouth and Food

Course Outline (Continued)

BOOK I (Continued)

Job 5 (Continued)

P.S. 14 - How to Make an Occupied Bed
P.S. 15 - How to Make an Occupied Bed From Head to Foot
P.S. 16 - How to Give Shampoos
P.S. 17 - How to Care for Flowers
P.S. 18 - How to Use Bedside Rails
P.S. 19 - How to Fill and Apply an Ice Cap
P.S. 20 - How to Fill Hot Water Bottle and Apply Heating Pad
P.S. 21 - How to Give Evening Care
P.S. 22 - How to Apply Supporting Measures

Job 6 - Transfer the Patient

P.S. 1 - How to Put Patient into a Wheel Chair
P.S. 2 - How to Transfer a Patient

R.S.A. 1 - Mathematics--Percentage

Job 7 - Discharge a Patient

P.S. 1 - How to Return Valuables, Dress, and Discharge a Patient

R.S.A. 1 - Discharging a Patient
R.S.A. 2 - Mathematics--The Metric System

Job 8 - Physical Examination of Adult

P.S. 1 - How to Assemble Supplies, Prepare a Patient and Assist Physician with an Examination
P.S. 2 - How to Care for the Clean Instruments
P.S. 3 - How to Handle Sterile Supplies
P.S. 4 - How to Take Blood Pressure

R.S.A. 1 - Discovering Health Assets and Liabilities
R.S.A. 2 - The Care and Cleaning of Instruments
R.S.A. 3 - Sterilization
R.S.A. 4 - Working Relationships

Course Outline (Continued)

BOOK I (Continued)

Job 9 - Care of Pre-operative and Post-operative Patients

P.S. 1 - How to "Prepare" a Patient for Surgery
P.S. 2 - How to Dress a Patient for Surgery
P.S. 3 - How to Prepare and Give a Hypodermic
P.S. 4 - How to Make a Recovery Bed
P.S. 5 - How to Set Up a Surgical Dressing Tray and Change Dressings
P.S. 6 - How to Assist with an Intravenous Infusion-Hypodermoclysis and Cut Down
P.S. 7 - How to Care for Selected Patients Reacting from an Anesthetic
P.S. 8 - How to Set Up and Care for Suction Drainage Apparatus
P.S. 9 - How to Insert a Rectal Tube
P.S. 10 - How to Give Intramuscular Injections
P.S. 11 - How to Care for a Patient in Shock
P.S. 12 - How to Use the Davis Patient Roller
P.S. 13 - How to Apply Breast, Abdominal, and T-Binders

R.S.A. 1 - Principles of Surgical Nursing
R.S.A. 2 - Regulations for the Use of Narcotics
R.S.A. 3 - Anesthetics
R.S.A. 4 - Treatment of Shock (Medical and Surgical)
R.S.A. 5 - Cancer
R.S.A. 6 - Allergy
R.S.A. 7 - Burns
R.S.A. 8 - The Use and Care of Syringes and Needles

Job 10 - Care of a Patient in an Isolated Unit

P.S. 1 - How to Set Up a Unit for Isolated Patient
P.S. 2 - How to Put on Gown and Mask
P.S. 3 - How to Care for Valuables and Clothing

R.S.A. 1 - Principles of Communicable Disease Nursing
R.S.A. 2 - Communicable Disease Control
R.S.A. 3 - Working with Patients, Families, and Community Agencies

Course Outline (Continued)

BOOK I (Continued)

Job 10 (Continued)

P.S. 4 - How to Care for Body Excreta
P.S. 5 - How to Care for Bed Linens
P.S. 6 - How to Care for Dishes
P.S. 7 - How to Care for Mattresses, Pillows, and Floors

Job 11 - Care of a Patient With Disease or Condition of the Reproductive System

P.S. 1 - How to Give a Vaginal Irrigation
P.S. 2 - How to Insert a Vaginal Suppository or Instill Vaginal Cream

R.S.A. 1 - Structure and Function of the Male and Female Reproductive System
R.S.A. 2 - Some diseases of the Reproductive System

Job 12 - Care of the Patient with Kidney and Bladder Disorder

P.S. 1 - How to Do a Catheterization
P.S. 2 - How to Do a Bladder Irrigation
P.S. 3 - How to Do a Bladder Instillation
P.S. 4 - How to Assist with a P.S.P. Test
P.S. 5 - How to Test Urine for Albumin

R.S.A. 1 - Structure and Function of the Urinary System
R.S.A. 2 - Some Disorders of the Urinary System
R.S.A. 3 - Review Metric System

Job 13 - Care of the Male Patient With Prostatic Resection

P.S. 1 - How to Care for a Patient with a Prostatic Resection

R.S.A. 1 - Structure and Function of the Male Genito-Urniary System

Course Outline (Continued)

BOOK I (Continued)

Job 14 - Care of Patient with Disease or Condition of the Digestive System

P.S. 1 - How to Give a Sitz Bath
P.S. 2 - How to Give Oral Medications
P.S. 3 - How to Collect a Specimen of Feces
P.S. 4 - a. How to Give Enemas (Cleansing)
b. How to Give Enemas (Retention)
c. How to Give Enemas (Proctocylsis)
P.S. 5 - How to Insert a Rectal Suppository
P.S. 6 - How to Remove a Fecal Impaction
P.S. 7 - How to Give a Colonic Flush
P.S. 8 - How to Collect a Specimen of Vomitus
P.S. 9 - How to Give Liquid Feedings Through Indwelling Tube
P.S. 10 - How to Assist with a Gastric Analysis
P.S. 11 - How to Assist with the Removal of Fluid from the Abdominal Cavity
P.S. 12 - How to Care for a Colostomy
P.S. 13 - How to Prepare a Patient for X-Ray and Fluoroscopic Examinations

R.S.A. 1 - Structure and Function of the Digestive System
R.S.A. 2 - Some of the Diseases and Conditions of the Digestive System
R.S.A. 3 - Collecting a Specimen of Feces for an Adult or Child
R.S.A. 4 - Administration of Drugs by Mouth
R.S.A. 5 - Preparation of a Patient For X-ray and Fluoroscopic Examination
R.S.A. 6 - Community Health in Relation of Disease of Digestive System
R.S.A. 7 - Mathematics - The Apothecary System

Job 15 - Care of the Patient with Disease or Condition of the Endocrine System

P.S. 1 - How to Prepare Patient for Basal Metabolism Rate (BMR)

R.S.A. 1 - Structure and Function of the Endocrine Glands and Their Relationship to Other Body Structures and Functions

Course Outline (Continued)

BOOK I (Continued)

Job 15 (Continued)

P.S. 2 - How to Test Urine for Sugar and Acetone
P.S. 3 - How to Measure and Give Insulin by Hypodermic
P.S. 4 - How to Collect a 24 Hour Specimen of Urine

R.S.A. 2 - Some Conditions and Diseases of the Endocrine System-medical and Surgical Aspects
R.S.A. 3 - Types of Tests

Job 16 - Care of Patient with Circulatory Condition

P.S. 1 - How to Assist in Obtaining a Blood Specimen
P.S. 2 - How to Shave a Male Patient
P.S. 3 - How to Assist in the Administration of Oxygen and Carbon Dioxide
P.S. 4 - How to Give a Temperature Bath

R.S.A. 1 - Structure and Function of the Circulatory System
R.S.A. 2 - Some of the Diseases of the Circulatory System
R.S.A. 3 - Blood Pressure
R.S.A. 4 - Temperature, Pulse and Respiration
R.S.A. 5 - Legal Responsibilities of the Practical Nurse
R.S.A. 6 - Effects of Heat and Cold on Body

Job 17 - Care of Patient with a Respiratory Disease or Condition

P.S. 1 - How to Collect Sputum Specimen
P.S. 2 - How to Assist in Obtaining a Nose and Throat Specimen
P.S. 3 - How to Administer Throat Gargle
P.S. 4 - How to Administer a Nasal or throat Spray
P.S. 5 - How to Give a Steam Inhalation
P.S. 6 - How to Assist with Aspiration of the Chest Cavity
P.S. 7 - How to Administer Medication by Nebulizer

R.S.A. 1 - Structure and Function of the Respiratory System
R.S.A. 2 - Some Diseases of the Respiratory System
R.S.A. 3 - Collecting Specimens from Respiratory Structures
R.S.A. 4 - Counterirritants
R.S.A. 5 - Community Health Problems in Relation to Respiratory Diseases
R.S.A. 6 - Mathematics--Equivalents
R.S.A. 7 - Tuberculosis

Course Outline (Continued)

BOOK I (Continued)

Job 18 - Care of Patient with Skin Disease

P.S. 1 - How to Apply Liquid or Ointment
P.S. 2 - How to Apply Hot and Cold Compresses
P.S. 3 - How to Give Foot or Arm Bath

R.S.A. 1 - Structure and Function of the Skin
R.S.A. 2 - Diseases and Conditions of the Skin
R.S.A. 3 - Individual and Community Health in Relation to Diseases of the Skin

Job 19 - Care of Patient with Diseases or Conditions of the Bones and Joints

P.S. 1 - How to Assist Patient with use of Crutches
P.S. 2 - How to Care for the Orthopedic Patient

R.S.A. 1 - Care of Patients with Diseases or Conditions of the Bones and Joints

Job 20 - Care of a Patient with Conditions and Diseases Affecting Muscles

P.S. 1 - How to Prevent and Care for Bed Sores

R.S.A. 1 - Muscular System Review
R.S.A. 2 - Diseases and Conditions Affecting Muscles

Job 21 - Care of the Maternity Patient

P.S. 1 - How to Give Perineal Care
P.S. 2 - How to Give Perineal Light Treatment
P.S. 3 - Breast Care to the Nursing and Non-nursing Mother

R.S.A. 1 - Review R.S.A. 1 -Job 11
R.S.A. 2 - The Prenatal Period
R.S.A. 3 - The Birth Process
R.S.A. 4 - The Postnatal Period

Job 22 - Care of the Newborn Infant

P.S. 1 - How to Set up a Nursery Unit
P.S. 2 - How to Care for the Eyes of the Newborn
P.S. 3 - How to Express Mucous from the Newborn

R.S.A. 1 - Care of the Newborn
R.S.A. 2 - The Premature Infant

Course Outline (Continued)

BOOK I (Continued)

Job 22 (Continued)

P.S. 4 - How to Weigh and Measure an Infant
P.S. 5 - How to Care for the Umbilical Cord
P.S. 6 - Bathe the Newborn (First Oil and Water Bath)
P.S. 7 - How to Care for and Wash Soiled Diapers
P.S. 8 - How to Restrain an Infant or Child
P.S. 9 - How to Assist with Physical Examination of an Infant
P.S. 10 - How to Assist with Breast Feeding
P.S. 11 - How to Prepare and Give Formula Feedings
P.S. 12 - How to Collect a Urine Specimen from Infants

Job 23 - Care of Children

P.S. 1 - How to Prepare and Give Foods Other Than Milk

R.S.A. 1 - The Infant - Its Growth and Development
R.S.A. 2 - How a Child Grows and Develops
R.S.A. 3 - Immunization
R.S.A. 4 - An Approach to Understanding Children
R.S.A. 5 - Childhood Diseases

Job 24 - Care of the Patient with Disease or Conditions of the Nervous System

P.S. 1 - How to Assist with a Lumbar Puncture

R.S.A. 1 - The Structure and Function of the Nervous System
R.S.A. 2 - Mental Health
R.S.A. 3 - Conditions and Diseases of the Nervous System

Course Outline (Continued)

BOOK I (Continued)

Job 24 (Continued)

R.S.A. 4 - Techniques of Caring for Patient with Mental and Emotional Conditions
R.S.A. 5 - Special Therapies

Job 25 - Care of Patient with Disease or Condition of the Eye

P.S. 1 - How to Give Eye Drops
P.S. 2 - How to Give an Eye Irrigation
P.S. 3 - How to Apply an Ointment to the Eye
P.S. 4 - How to Remove Non-embedded Foreign Body from Eye
P.S. 5 - How to Care for the Prosthetic Eye of a Patient

R.S.A. 1 - Structure and Function of the Eye
R.S.A. 2 - Some Diseases and Conditions of the Eye

Job 26 - Care of Patient with Ear, Nose, or Throat Disease or Condition

P.S. 1 - How to Administer Nose Drops
P.S. 2 - How to Administer Ear Drops
P.S. 3 - How to Assist with the Care of a Patient with a Tracheotomy Tube
P.S. 4 - How to Care for a Patient with a Hearing Aid

R.S.A. 1 - Structure and Function of the Ear, Nose, and Throat
R.S.A. 2 - Diseases of Ear, Nose, and Throat

Job 27 - Care of the aging and Old Patients

R.S.A. 1 - The Aging Process
R.S.A. 2 - Some Diseases and Conditions Common to the Later Years

Course Outline (Continued

BOOK I (Continued)

Job 28 - Care for the Dying Patient

R.S.A. 1 - Care for the Dying Patient

Job 29 - Care for the Body After Death

P.S. 1 - How to Care for the Body After Death

R.S.A. 1 - Care for the Body After Death

Job 30 - Relationships with Co-workers

R.S.A. 1 - Applying for Employment
R.S.A. 2 - Resigning and Leaves of Absence
R.S.A. 3 - Community Relationships
R.S.A. 4 - Evening and Night Nursing

BOOK II

Job 1 - Orientation

P.S. 1 - How to Get Acquainted With the Foods and Cookery Laboratory
P.S. 2 - Food Handling Techniques
P.S. 3 - How to Sterilize Dishes
P.S. 4 - How to Measure Food

R.S.A. 1 - Introduction to the Homemaking Course Designed to Meet the Needs of the Practical Nurse
R.S.A. 2 - Storage and Use of Equipment in the Foods and Cookery Laboratory
R.S.A. 3 - Introduction to Foods and Cookery Designed to Meet the Needs of the Practical Nurse
R.S.A. 4 - Food and Health
R.S.A. 5 - Adequate and Safe Storage of Food

Job 2 - Working Efficiently

P.S. 1 - How to Apply Work Simplification

R.S.A. 1 - Application to Work Simplification - Efficiency in Cleaning

Course Outline (Continued)

BOOK II (Continued)

Job 3 - Evaluate Dietary

P.S. 1 - How to Use Seven Basic Food Groups to Evaluate a Dietary Record
P.S. 2 - How to Use the Basic Four in Everyday Diet

R.S.A. 1 - Essentials of a Good Diet
R.S.A. 2 - The Nutrients - Carbohydrates, Proteins, and Fats
R.S.A. 3 - Minerals, Liquids, Vitamins, and Roughage in the Diet
R.S.A. 4 - Misinformation Concerning Food
R.S.A. 5 - The Nutrients - What foods are made of

Job 4 - Plan, Prepare and Serve a Simple Breakfast

P.S. 1 - How to Plan a Breakfast Menu
P.S. 2 - How to Buy Breakfast Foods
P.S. 3 - How to prepare Breakfast Trays
P.S. 4 - How to Prepare and Serve Fruit
P.S. 5 - How to Prepare and Serve Cereal
P.S. 6 - How to Prepare Beverages
P.S. 7 - How to Prepare and Serve Toast
P.S. 8 - How to Prepare and Serve Eggs
P.S. 9 - How to Arrange and Serve a Breakfast Tray

R.S.A. 1 - Breakfast Foods
R.S.A. 2 - Breakfast, an Important Meal

Job 5 - How to Plan, Buy and Serve

P.S. 1 - How to Plan Daily Menus
P.S. 2 - How to Buy Food
P.S. 3 - How to Make a Study of The Comparative Cost of Food - Field Trip (Optional)
P.S. 4 - How to Serve Meals - Family Style

R.S.A. 1 - Principles of Planning Menus
R.S.A. 2 - Managing the Budget
R.S.A. 3 - Principles of Good Table Service

Course Outline (Continued)

BOOK II (Continued)

Job 6 - Plan, Prepare and Serve a Lunch

P.S. 1 - How to Plan Lunch	R.S.A. 1 - Lunch Planning
P.S. 2 - How to Prepare Salads	R.S.A. 2 - Salads, Their Value and Preparation
P.S. 3 - How to Prepare and Serve Quick Breads	R.S.A. 3 - Principles of Preparing and Serving Quick Bread
P.S. 4 - How to Prepare Cheese Dishes	R.S.A. 4 - Principles of Cheese Cookery
P.S. 5 - How to Prepare Nutritious Desserts	R.S.A. 5 - Nutritious Desserts
P.S. 6 - How to Serve Lunch Family Style	R.S.A. 6 - Inexpensive Meats and Meat Substitutes

Job 7 - Plan, Prepare and Serve Dinner Dishes

P.S. 1 - How to Plan, Prepare and Serve Dinner Dishes	R.S.A. 1 - Planning and Serving Dinner Dishes
P.S. 2 - How to Broil Meat	R.S.A. 2 - Principles of Selecting and Cooking Meat, Fish, and Poultry
P.S. 3 - How to Prepare Vegetables	R.S.A. 3 - Principles of Vegetable Cookery
P.S. 4 - How to Prepare White Sauce	R.S.A. 4 - Types of Cakes
P.S. 5 - How to Prepare a Sponge Cake	

Job 8 - The Selection of Full, Light, Soft and Liquid Diets

R.S.A. 1 - The Selection in Full, Light, Soft, and Liquid Diets

Job 9 - Prepare Foods Included in Liquid Diets

P.S. 1 - How to Prepare Cream Soup--Tomato	R.S.A. 1 - Foods Included in Liquid Diet
P.S. 2 - How to Prepare Beef Tea	
P.S. 3 - How to Use Dried Milk	
P.S. 4 - How to Prepare High Protein Beverages	
P.S. 5 - How to Prepare High Caloric Beverages	

Course Outline (Continued)

BOOK II (Continued)

Job 10 - Diets in Diseases of the Digestive System

P.S. 1 - How to Plan Menus and Prepare Foods for Bland Diets
P.S. 2 - How to Plan Menus and Prepare Foods for a Low Residue Diet
P.S. 3 - How to Plan Menus and Prepare Foods for Low Fat Diets
P.S. 4 - How to Plan Menus for Different Types of Constipation - Atonic - Spastic - Obstructive
P.S. 5 - How to Plan Food For the Patient with Diarrhea or Colitis

R.S.A. 1 - Diet in the Diseases of the Digestive System

Job 11 - Diets for Metabolism Disturbances

P.S. 1 - How to Use the Food Exchange List in Preparing a Diabetic Diet
P.S. 2 - How to Make Menus From a Given Diet Pattern

R.S.A. 1 - Principles of Diabetic Treatment by Diet
R.S.A. 2 - Principles of Diet in Other Metabolic Disturbances
1. Hyperthyroidism
   (a) Hypothyroidism
2. Gout
3. Hypoglycemia
   (a) Hyperinsulinism
   (b) Fasting hypoglycemia Addisons Diseases
4. Tetany

Job 12 - Discuss the Problems of Weight

P.S. 1 - How to Plan, Prepare and Serve Menus for the Obese
P.S. 2 - How to Plan, Prepare and Serve Menu's for the Underweight

R.S.A. 1 - The Relation of Obesity to Health and Disease
R.S.A. 2 - The Relation of Underweight to Health and Disease

Course Outline (Continued)

BOOK II (Continued)

Job 13 - Diets for Circulatory Diseases

P.S. 1 - How to Select and Plan Diets Low in Sodium
P.S. 2 - Plan and Prepare Diets in Anemia
P.S. 3 - Plan and Prepare Low Cholesterol Diet

R.S.A. 1 - Low Sodium Diets
R.S.A. 2 - Diet in Anemia
R.S.A. 3 - Low Cholesterol Diets

Job 14 - Select and Plan Diets for Some Acute and Chronic Diseases

P.S. 1 - How to Plan a Day's Intake for Tuberculosis Patient
P.S. 2 - How to Plan a Days Intake for Patient With Cancer
P.S. 3 - How to Plan a Days Intake for a Patient with Febrile Diseases

R.S.A. 1 - Special Feeding Problems Due to Physiological and Psychological Changes
R.S.A. 2 - Special Dietary Needs in Cancer
R.S.A. 3 - Special Dietary Needs in Febrile Diseases
R.S.A. 4 - Special Dietary Needs in Tuberculosis

Job 15 - Meeting the Food Needs During Pregnancy and Lactation

P.S. 1 - How to Select a Day's Diet for Pregnant Woman
P.S. 2 - How to Select a Days Food for Lactating Women

R.S.A. 1 - Food Needs During Pregnancy
R.S.A. 2 - The Food Needs During Lactation

Job 16 - Meeting the Food Needs of the Infant

P.S. 1 - How to Make a Table for the Introduction of New Foods. Make a Table Showing the Increasing Quantity of Food as Baby Grows

R.S.A. 1 - Meeting the Food Needs of the Infant

Job 17 - Meeting the Food Needs of Children of Various Age Groups

P.S. 1 - How to Plan a Day's Meals for a 2 Year Old Boy, 6 year old Boy, and a 14 year old Girl (Mother and Father)

R.S.A. 1 - Food Need of Pre-School and School Age Children and Adolescents

Course Outline (Continued)

BOOK II (Continued)

Job 18 - Meeting Food Needs During the Golden Years

P.S. 1 - How to Plan Good Nutrition for the Geriatric Patient

R.S.A. 1 - The Food and Social Needs for the Golden Years

Job 19 - How to Plan Menus for A Patient with an Allergy

P.S. 1 - How to Plan Menus for a Patient with an Allergy

R.S.A. 1 - Allergies and Skin Disturbances

Job 20 - Food Habits for Various Religious and Racial Groups

R.S.A. 1 - Food Habits of Various Religious and Racial Groups

BOOK III

Suggested Content for Classes During Clinical Experience

Introduction

Suggested Outline for Planned Clinical Instruction

Medical and Surgical Nursing
- The Respiratory System
- The Endocrine System
- The Digestive System
- The Circulatory System
- The Eyes
- The Ears

Geriatric Nursing

Communicable Disease Nursing

Poliomyelitis Nursing

Orthopedic Nursing

Urological Nursing

Gynecological Nursing

Course Outline (Continued)

BOOK III (Continued)

Introduction to Psychiatric Nursing

Obstetrical Nursing and Care of the Newborn

Pediatric Nursing

Course Plan for Hospital Dietary Training for Student Practical Nurses

The Related Science of Practical Physics Course was published in 1960 and is available in bound form. It is composed of twenty-nine experiments and study units. The reference for the Related Science of Practical Physics Course is listed below.

Title	Source
Dull, Metcalfe, and Brooks MODERN PHYSICS	Holt, Rinehart and Winston, Inc. 383 Madison Ave. New York 17, New York

A detailed outline of the Related Science of Practical Physics Course follows:

EXPERIMENTS IN PHYSICS FOR INDUSTRIAL TECHNICIANS

Experiment No.

I. Weights and Measures

II. Simple Machines: Levers and Pulleys

III. Work, Power, and Friction

IV. Pressure in Liquids

V. Pressure of Air

*VI. Liquids and Gases in Motion

VII. Elasticity and Strength of Materials
Surface Tension

VIII. Forces Acting Through a Point

IX. Accelerated Motion

X. The Laws of Motion

XI. Potential and Kinetic Energy

XII. Heat and Expansion

XIII. Transmission of Heat

XIV. Steam and Gas Engines

*Denotes Study Unit.

Course Outline (Continued)

XV. Magnetism

XVI. Electricity at Rest
(Static Electricity

XVII. Electric Currents

XVIII. Electric Circuits

XIX. Magnetic and Chemical Effects of Electric Current

*XX. Electric Power, Heating and Lighting

XXI. Electric Generators and Motors

XXII. Induction Coils and Transformers

XXIII. Alternating Current

Study Unit No.

XXIV. Modern Physics

XXV. Sound Waves

XXVI. Musical Sounds

XXVII. Lenses and Optical Instruments

XXVIII. Spectra and Color

XXIX. Cathode and X-Rays, Radioactivity

*Denotes Study Unit

The Radio-Television-Electronics Course was published in 1953, revised in 1959 and 1962, and again in 1963. It is available in book form for the instructors and in loose form for distribution to students.

Related Study Assignments, Question and Answer Sheets and Jobs
- Book I - Units 1 - 10
- Book II - Units 11 - 17
- Book III - Unit 18
- Book IV - Unit 19
- Book V - Unit 19

Test Books
- Book I - Units 1 - 10
- Book II - Units 11 - 17
- Book III - Unit 18
- Book IV - Unit 19

Answer Book
- Complete for all tests

The following instructor's aids are available:
- Individual Folder Type Progress Chart

The references for the Radio-Television Course are listed below.

Title	Source
Watson, Welch, and Eby UNDERSTANDING RADIO	McGraw-Hill Book Co., Inc. 330 West 42nd Street New York 36, New York
Marcus, Abraham RADIO SERVICING	Prentice-Hall Englewood Cliffs, New Jersey
Oldfield, R. L. RADIO, TELEVISION AND BASIC ELECTRONICS	American Technical Society 848 East 58th Street Chicago 37, Illinois
Marcus and Levy ELEMENTS OF RADIO SERVICING	McGraw-Hill Book Co., Inc. 330 West 42nd Street New York 36, New York
RADIO HANDBOOK	Editors and Engineers, Ltd. Summerland, California
THE RADIO AMATEUR'S HANDBOOK BY ARRL	American Radio Relay League 225 Main Street Newington, Connecticut, 06111

References (Continued)

Title	Source
Ruiter, Jacob, Jr. MODERN OSCILLOSCOPES AND THEIR USES	Holt, Rinehart and Winston, Inc. 383 Madison Avenue New York 17, New York
Kiver TRANSISTOR IN RADIO AND TELEVISION	McGraw-Hill Book Co., Inc. 330 West 42nd Street New York 36, New York
Grob, Bernard BASIC TELEVISION	McGraw-Hill Book Co., Inc. 330 West 42nd Street New York 36, New York
Swiggett, Robert L. INTRODUCTION TO PRINTED CIRCUITS, No. 185	John F. Rider Publisher, Inc. 116 West 14th Street New York 11, New York
The A.R.R.L. ANTENNA BOOK	American Radio Relay League 38 La Salle Road West Hartford 7, Connecticut
Newitt, John H. HIGH FIDELITY TECHNIQUES	Holt, Rinehart and Winston, Inc. 383 Madison Avenue New York 17, New York
INVERSE FEEDBACK Electronic Technology Series No. 166-15	John F. Rider Publisher, Inc. 116 West 14th Street New York 11, New York
Rabinoff and Wolbrecht PRINCIPLES OF TELEVISION SERVICING	McGraw-Hill Book Co., Inc. 330 West 42nd Street New York 36, New York
Buchsbaum, W. H. COLOR TV SERVICING	Prentice-Hall Englewood Cliffs, New Jersey
Oliphant and Ray COLOR TV	Howard W. Sams & Co., Inc. 1720 East 38th Street Indianapolis 6, Indiana
RETMA FUNDAMENTALS OF COLOR TV	John F. Rider Publisher, Inc. 116 West 14th Street New York 11, New York
MANUFACTURER'S SERVICE NOTES	Howard W. Sams & Co., Inc. 1720 East 38th Street Indianapolis 6, Indiana

References (Continued)

Title	Source
TROUBLESHOOTER'S MANUALS	John F. Rider Publisher, Inc. 116 West 14th Street New York 11, New York
RCA COLOR TV PICT-O-GUIDE	RCA, Electron Tube Division Harrison, New Jersey
Darr, Jack TWO-WAY MOBILE RADIO MAINTENANCE	Howard W. Sams & Co., Inc. 1720 East 38th Street Indianapolis 6, Indiana
Noll, Edward M. MODERN COMMUNICATIONS COURSE Vols. 1, 2, and 3	Howard W. Sams & Co., Inc. 1720 East 38th Street Indianpolis 6, Indiana
Shrader, Robert L. ELECTRONIC COMMUNICATION	McGraw-Hill Book Co., Inc. 330 West 42nd Street New York 36, New York

A detailed outline of the Radio-Television-Electronics Course follows.

Unit I - Construction Fundamentals
- R.S.A. 1 - Soldering and Splicing
- Job 1A - Solder Connections and Splice Wire
- Job 1B - Disconnect Soldered Connections
- R.S.A. 2 - Learn Use and Care of Hand Tools
- Job 2A - Learn Use and Care of Hand Tools
- Job 2B - Use Tools

Unit II - Magnetism
- R.S.A. 1 - Study Permanent Magnets and Magnetic Fields
- Job 1 - Study and Plot Magnetic Lines of Force
- R.S.A. 2 - Study of Electromagnetism
- Job 2 - Produce and Study Electromagnetism
- R.S.A. 3 - Study Characteristics of an Electromagnet
- Job 3 - Make an Electromagnet and Study its Characteristics

Unit III - Principles of Electricity
- R.S.A. 1 - Learn Use of Radio Symbols
- Job 1 - Learn Use of Radio Symbols
- R.S.A. 2 - Identification of Electronic Components
- Job 2 - Identification of Electronic Components
- R.S.A. 3 - Resistor Color Code
- Job 3 - Resistor Color Code
- R.S.A. 4 - Learn How Electrical Energy is Produced
- R.S.A. 5 - Learn How Electrical Energy is Measured
- Job 5 - Learn How to Measure Electrical Energy
- R.S.A. 6 - Study the Laws of Electrical Charges
- Job 6 - Study and Prove Laws of Electrical Charges
- R.S.A. 7 - Study Electron Movement

Unit IV - Ohm's Law
- R.S.A. 1 - Use Ohm's Law in Series Circuit
- Job 1 - Use Ohm's Law in Series Circuit
- R.S.A. 2 - Use Ohm's Law in Parallel Circuit
- Job 2 - Use Ohm's Law in Parallel Circuit
- R.S.A. 3 - Use Ohm's Law in Series-Parallel Circuit
- Job 3 - Use Ohm's Law in Series-Parallel Circuit
- R.S.A. 4 - Construct a Multirange Voltmeter
- Job 4 - Construct a Multirange Voltmeter
- R.S.A. 5A - Study Milliammeters
- R.S.A. 5B - Construct an Ohmmeter
- Job 5 - Construct an Ohmmeter
- Job 5A - How to Test Resistors

Course Outline (Continued)

Unit V - Inductance

R.S.A.	1A	- Study Induced Voltages
R.S.A.	1B	- Alternating and Direct Currents
Job	1	- Produce and Study Induced Voltages
R.S.A.	2	- Phase Relationship of Voltage and Current in an Inductor or Coil
Job	2	- Show Phase Relationship of Voltage and Current in an Inductor or Coil
R.S.A.	3	- Study A. C. Measuring Instruments
Job	3	- Determine Impedance and Inductance of a Coil

Unit VI - Capacitance

R.S.A.	1	- Study Color Code as Applied to Capacitors
Job	1	- Identify Capacitors by Color Code
R.S.A.	2	- Study the Capacitance or Condenser Tester
Job	2	- Use Capacitor Tester
R.S.A.	3	- Study of Capacitance
Job	3	- Measure and Calculate Condenser Values
R.S.A.	4	- Capacitance in A. C.
Job	4	- Study Effect of A.C. and D.C. on Condensers

Unit VII - Time Constant and Resonance

R.S.A.	1	- Capacitors and Time Constants
Job	1	- Determine the Time Constant of RC Circuit
R.S.A.	2A	- Time Constants of LR Circuits
R.S.A.	2B	- Resonance
Job	2A	- Determine Resonant Frequency of RCL Series Circuit
Job	2B	- Determine Resonant Frequency of RCL Parallel Circuit

Unit VIII - Vacuum Tubes

R.S.A.	1	- Study Electron Emission in Vacuum Tubes
Job	1	- Study Electron Emission in Diode Vacuum Tube
R.S.A.	2	- Study Electrons in Cathode Ray Tube
Job	2	- Study Electrons in Cathode Ray Tube
R.S.A.	3A	- Study Electron Action in Diode Tube
R.S.A.	3B	- Study Diode Tube Rectifier
Job	3	- Build and Study a Vacuum Tube Rectifier
R.S.A.	4	- Study Rectifier Filters
Job	4	- Construct Filter for Rectifier
R.S.A.	5	- A.C. Power Supply for AC-DC Portable
Job	5	- Build an A.C. Power Supply for a 3-Way Portable Radio
R.S.A.	6	- Study the Diode Tube as a Detector
Job	6	- Diode Detector
R.S.A.	7	- Study the Triode Tube
Job	7	- Induced Voltage by the Current Change in a Vacuum Tube

Course Outline (Continued)

Unit VIII -Vacuum Tubes (Cont'd)

R.S.A.	8	- Study A.C. Triode Tube
Job	8	- Study Characteristics of Triode Tube
R.S.A.	9	- Methods of Obtaining Grid Bias
R.S.A.	10	- Study the Tetrode and Pentode Tubes
Job	10	- Determine Characteristics of Pentode Tube
R.S.A.	11	- Study the Vacuum Tube Voltmeter
Job	11	- Compare Voltmeter and Vacuum Tube Voltmeter
R.S.A.	12	- Tube Testers
Job	12	- Test Tubes

Unit IX - Amplification

R.S.A.	1	- Class A Amplifier
Job	1	- Build and Study a Triode Amplifier
R.S.A.	2	- Class B Amplifier
Job	2	- Build or Study a Class B Amplifier
R.S.A.	3	- Class C Amplifier
Job	3	- Class C Amplifier
R.S.A.	4	- Coupling to the Push-Pull Amplifier Grids
Job	4	- Coupling to Push-Pull Amplifier Grids
R.S.A.	5	- Direct Coupled Amplifiers
Job	5	- Direct Coupled Amplifiers

Unit X - Transistor

R.S.A.	1	- Semiconductor Theory
Job	1	- Testing Diodes in Transistors
R.S.A.	2	- Junction Transistors NPN
Job	2	- Test for Reverse Current in Collector to Base Circuit
R.S.A.	3	- Junction Transistors PNP
Job	3	- Transistor Dynamic Gain
R.S.A.	4	- Point Contact Transistor
Job	4	- Voltage Relationship Between Elements
R.S.A.	5	- Types of Transistors
Job	5	- Voltage Distribution With Open Base Circuit
R.S.A.	6	- Transistor Amplifiers
Job	6	- Transistor Static Gain
R.S.A.	7	- Servicing Transistor Circuits
Job	7	- Transistor Amplifier
R.S.A.	8	- Test Equipment for Transistor Circuits
Job	8	- Test Equipment
Job	8A	- How to Test Transistors

Unit XI - Oscillation

R.S.A.	1	- Study Oscillation
Job	1	- Build a Hartley Oscillator
R.S.A.	2	- Study Vacuum Tube Oscillators
Job	2A	- Build a Crystal Oscillator

Course Outline (Continued

Unit XI - Oscillation (Cont'd)

Job	2B	- Study and Build a Modified Colpitts (Clapp) Oscillator Circuit
R.S.A.	3	- Study UHF Oscillators
Job	3	- Build a UHF Oscillator With Linear Tank
R.S.A.	4	- Study Multivibrators
Job	4	- Build and Study Multivibrator Circuit
R.S.A.	5	- Transistor Oscillators
Job	5	- Transistor Oscillator

Unit XII - Radio Receivers

R.S.A.	1	- Study R. F. Detectors
Job	1	- Build and Study R.F. Detector Circuits
R.S.A.	2	- Study R.F. Amplifiers
Job	2	- Build and Operate a R.F. Amplifier
R.S.A.	3	- Study the Superheterodyne Receiver
Job	3	- Build and Study a 5 Tube Superheterodyne Receiver
R.S.A.	4	- Study Automatic Volume Control
Job	4	- Determine Values and Use of A.V.C. Voltage
R.S.A.	5A	- Study Frequency Modulation
R.S.A.	5B	- Study Receiver Alignment
Job	5A	- Align a Superheterodyne Receiver
Job	5B	- Align a Superheterodyne Receiver Using an Output Meter
Job	5C	- Align a Superheterodyne Receiver Using a V.T.V.M. as an Output Indicator
R.S.A.	6	- Study a Three-Way Portable Radio Receiver
Job	6	- Install a Replacement Oscillator Coil and Align Receiver
R.S.A.	7	- Transistor Circuits in Radio
Job	7	- Signal Tracing and Gain Measurement
R.S.A.	8	- Troubleshooting Transistor Radios
Job	8	- Troubleshooting in Transistor Receivers
R.S.A.	9	- Servicing Transistor Radios
Job	9	- Signal Tracing Using Tuned Probe
R.S.A.	10	- Alignment of Transistor Radios
Job	10	- Alignment of Transistor Radio

Unit XIII - Radio Troubleshooting

R.S.A.	1	- Study Methods of Signal Tracing
Job	1	- Use Signal Generator, Signal Tracer and the Oscilloscope in Signal Tracing
R.S.A.	2	- Printed Circuits and Etched Wiring
Job	2	- Power Supply
Job	3	- The I. F. Stage
Job	4	- The Local Oscillator
Job	5	- The Radio Frequency Amplifier Stage
Job	6	- How to Replace an Oscillator Coil in a Receiver With a General Replacement Type

Course Outline (Continued)

Unit XIV - Radio Transmitters and Transmission

R.S.A.	1	- Study R. F. Power Amplifier
Job	1	- Build Oscillator and R. F. Amplifier
R.S.A.	2A	- Study Neutralization of Triode R. F. Amplifier
R.S.A.	2B	- Study the Frequency Doubler
Job	2	- Operate a Frequency Doubler
R.S.A.	3A	- Study Push-Pull R. F. Amplifiers
R.S.A.	3B	- Study Modulation Methods
Job	3	- Build and Operate a Plate Modulator
R.S.A.	4A	- Study F. M. Transmission
R.S.A.	4B	- Study Antennas
R.S.A.	4C	- Theory of Wave Propagation
Job	4	- Parasitic Elements
R.S.A.	5	- Antennas for UHF and VHF
Job	5	- Demonstrate Standing Waves on Transmission Lines
Job	6	- Line of Sight Theory Demonstration
Job	7	- Plot Field Strength of a Vertical Antenna

Unit XV - Hi-Fidelity

R.S.A.	1	- High Fidelity Systems
Job	1	- Impedance Matching
R.S.A.	2A	- Loud Speakers
R.S.A.	2B	- High Fidelity Speaker Enclosures
R.S.A.	2C	- Electrical Cross-over Net Works
Job	2	- Calculation and Design of Negative Feedback Network
R.S.A.	3A	- Records and Record Players
R.S.A.	3B	- Tape Recording and Playback
Job	3	- Tape Recording
R.S.A.	4A	- The Photo Electric Cell
R.S.A.	4B	- Sound Information on Film
R.S.A.	4C	- Methods of Obtaining Power of the Exciter Lamp in Sound-on-film Reproduction
Job	4	- Motion Picture Sound

Unit XVI - Advanced Test Equipment

R.S.A.	1	- Study the Oscilloscope
Job	1	- Learn Use of the Oscilloscope
R.S.A.	2	- Study Sweep and Marker Generators
Job	2	- Learn Use of Sweep and Marker Generators
R.S.A.	3	- Study the Cross Hatch Generator
Job	3	- Learn Use of the Cross Hatch Generator
R.S.A.	4	- Study Voltage Calibrator
Job	4	- Learn Use of Voltage Calibrator
R.S.A.	5	- Frequency Standards and Sub-Standards
Job	5	- Learn Use of Frequency Standard
R.S.A.	6	- General Application of Test Equipment
Job	6	- Test Probes

Course Outline (Continued)

Unit XVII - Black and White Television

R.S.A. 1 - Study the Television System
Job 1 - Receiver Familiarization
R.S.A. 2 - Study Picture Tubes
Job 2 - Observe the Television Signal
R.S.A. 3 - Study TV Receiver Block Diagrams
Job 3 - Receiver Block Diagrams
R.S.A. 4 - Study Sound I.F. Stages and Detector Types
Job 4A - Align TV Sound I.F. Stages
Job 4B - Troubleshooting Sound Section Circuits
R.S.A. 5 - Study Video I.F. Amplifiers
Job 5 - Build and Align a Video I.F. Strip
R.S.A. 6 - Study Video I.F. Alignment
Job 6 - Troubleshooting Video Section Circuits
R.S.A. 7 - Study TV RF Tuners
Job 7A - Check Front End Response of TV Set
Job 7B - Front End Familiarization
R.S.A. 8 - Study TV Tuner Alignment
Job 8 - Align a TV Tuner
R.S.A. 9 - Study Second Detectors and Video Amplifiers
Job 9 - Build and Test a Video Amplifier
R.S.A. 10 - Study TV Synchronizing Circuits
Job 10 - Build and Test a TV Sync Circuit
R.S.A. 11A - Study a Noise Immune Sync Separator
R.S.A. 11B - Study TV Sweep Circuits
Job 11A - Build and Test a TV Blocking Oscillator
Job 11B - Troubleshooting Horizontal Sweep Circuits
Job 11C - Troubleshooting Vertical Sweep Circuits
R.S.A. 12 - Study TV Power Supplies
Job 12 - Horizontal Deflection Circuit
R.S.A. 13 - Study AFC-Sync Circuits
Job 13A - Observe AFC Sync Circuit Characteristics
Job 13B - Troubleshooting Sync Circuits
R.S.A. 14 - Study AGC Circuits
Job 14 - Troubleshooting AGC Circuits
R.S.A. 15 - How to Install a Replacement Flyback Transformer
Job 15 - Install and Test a Flyback Transformer
R.S.A. 16 - Study TV Troubleshooting
Job 16 - Troubleshoot a TV Receiver
R.S.A. 17 - Transistor Circuits in Television
Job 17 - Checking Video Amplifier
R.S.A. 18 - Servicing Transistor Television
Job 18 - Troubleshooting Transistor Television
Job 19 - Trouble Shoot a TV Receiver
Job 20 - Trouble Shoot a TV Receiver
Job 21 - Trouble Shoot a TV Receiver
Job 22 - Trouble Shoot a TV Receiver
Job 23 - Trouble Shoot a TV Receiver
Job 24 - Trouble Shoot a TV Receiver
Job 25 - Trouble Shoot a TV Receiver

Course Outline (Continued)

Unit XVIII - Color Television

Part I

R.S.A. 1 - Compatible Color TV System
R.S.A. 2 - An Introduction to the Basic Color TV System
R.S.A. 3 - Color Standards
R.S.A. 4 - The Color Spectrum
R.S.A. 5 - Wave Lengths of Different Hues
R.S.A. 6 - Color Mixing to Produce a Desired Hue
R.S.A. 7 - Some Characteristics of Vision
R.S.A. 8 - The Standard Color Chart

Part II

R.S.A. 1 - A General Discussion of the Color Standards
R.S.A. 2 - Vectors Applied to Analysis of Two-Phase Modulation
R.S.A. 3 - The Color Sub-Carrier
R.S.A. 4 - Spectrum Analysis of a Conventional Television Signal
R.S.A. 5 - Frequency Interleaving
R.S.A. 6 - I and Q Signals
R.S.A. 7 - Circuitry Added to a Television Receiver to Produce Color
R.S.A. 8 - Block Diagrams of a Color Receiver

Part III

R.S.A. 1 - The Tuner of Front-End Circuits
R.S.A. 2 - The Video Intermediate Frequency Stages
R.S.A. 3 - The Video Amplifier
Job 1 - Video 4.5 mc. Trap Adjustment
R.S.A. 4 - The Audio System
R.S.A. 5 - The Chroma Amplifier or Band-Pass Amplifier
R.S.A. 6 - Phase Detectors
R.S.A. 7 - Color Killer Circuits
R.S.A. 8 - I and Q Demodulators or Synchronous Detectors
R.S.A. 9 - The 3.58 mc. Reference Oscillator
R.S.A. 10 - Color Synchronization
R.S.A. 11 - Sound Intermediate Frequency and Quadrature Detector
Job 2 - Sound I. F. Alignment
R.S.A. 12 - Color Matrixing
R.S.A. 13 - Reproduction of Color

Part IV

R.S.A. 1 - Principles
R.S.A. 2 - Adjustments
R.S.A. 3 - Handling
R.S.A. 4 - Purity
R.S.A. 5 - Static Convergence
R.S.A. 6 - Dynamic Convergence
R.S.A. 7 - Convergence Circuitry
Job 1 - Dynamic Convergence Adjustments Horizontal Convergence

Course Outline (Continued)

Unit XVIII - Color Television
Part IV (Cont'd)

Job	2 -	Dynamic Convergence Adjustments Vertical Convergence
R.S.A.	8 -	Receiver Adjustments
Job	3 -	Shop Project
Job	4 -	AGC Control and Noise Threshhold Adjustment

Part V

R.S.A.	1 -	Burst Amplifier and Crystal Oscillator Alignment
R.S.A.	2 -	Quadrature and Demodulator Alignment
R.S.A.	3 -	Chroma Channel Alignment
Job	1 -	First Video Amplifier and Band Pass Amplifier Alignment
R.S.A.	4 -	Video Intermediate Frequency Alignment
Job	2 -	Picture I.F. Transformer Adjustments
Job	3 -	Sweep Alignment of Picture I.F.
R.S.A.	5 -	Sound Intermediate Frequency Alignment
R.S.A.	6 -	Tuner Alignment
Job	4 -	Antenna Matching Unit Alignment
Job	5 -	Tuner Alignment
Job	6 -	UHF Alignment
R.S.A.	7 -	Test Equipment

Part VI

R.S.A.	1 -	Voltage Regulation
Job	1 -	Horizontal Oscillator Alignment
Job	2 -	High Voltage Adjustment
R.S.A.	2 -	Obtaining the Voltage for the Convergence Section
R.S.A.	3 -	The Deflection Yoke
R.S.A.	4 -	The Convergence Yoke
Job	3 -	Preliminary Convergence and Color Purity Adjustments

Part VII

R.S.A.	1 -	Color Control
R.S.A.	2 -	Hue Control
Job	1 -	Color AFC Alignment
R.S.A.	3 -	The Contrast Control--The Brightness Control
R.S.A.	4 -	The Fine Tuning Control

Part VIII

R.S.A.	1 -	Phase and Matrix
R.S.A.	2 -	Purity
R.S.A.	3 -	Convergence
Job	1 -	Convergence Coils
R.S.A.	4 -	Black and White Adjustments
Job	2 -	Black and White Adjustments

Course Outline (Continued)

Unit XVIII - Color Television
Part IX
R.S.A. 1 - Checking Tuner, Video IF and Video Amplifier
R.S.A. 2 - Signal Tracing in the Chroma Section
Job 1 - Oscilloscope Waveforms

Part X
R.S.A. 1 - Dot-Bar Generator
R.S.A. 2 - Color Bar Generator
R.S.A. 3 - The Color Stripe Signals for Testing Receivers
R.S.A. 4 - R.F. - I.F. Alignment Equipment
R.S.A. 5 - Video Alignment Equipment
R.S.A. 6 - R.F., Demodulator, Low Capacity and High Voltage Probes
R.S.A. 7 - Oscilloscopes

Part XI
R.S.A. 1 - Antennas
R.S.A. 2 - Transmission Lines
R.S.A. 3 - Receiver Installation
R.S.A. 4 - Antenna System Installation

Part XII
R.S.A. 1 - Servicing Hints
Job 1 - Field Adjustment of Demodulator Phasing
R.S.A. 2 - Signal Tracing

Unit XIX - Communications
R.S.A. 1 Modulation Systems
Question and Answer Sheet No. 1
Question and Answer Sheet No. 2
Question and Answer Sheet No. 3
Job 1 Receiver Familiarization
R.S.A. 2 Frequency Modulation
Question and Answer Sheet No. 4
Question and Answer Sheet No. 5
Question and Answer Sheet No. 6
Question and Answer Sheet No. 7
Job 2 Receiver Voltage and Resistance
R.S.A. 3 FM Receiver
Question and Answer Sheet No. 8
Question and Answer Sheet No. 9
Question and Answer Sheet No. 10
Question and Answer Sheet No. 11
Job 3 FM Reciever
R.S.A. 4 R-F Amplifier

Course Outline (Continued)

Unit XIX - Communications

		Question and Answer Sheet No. 12
		Question and Answer Sheet No. 13
		Question and Answer Sheet No. 14
		Question and Answer Sheet No. 15
Job	4	R-F Amplifier
R.S.A.	5	High Frequency Oscillator-Mixer
		Question and Answer Sheet No. 16
		Question and Answer Sheet No. 17
		Question and Answer Sheet No. 18
		Question and Answer Sheet No. 19
Job	5	High Frequency Oscillator-Mixer
R.S.A.	6	First I-F Amplifiers
		Question and Answer Sheet No. 20
		Question and Answer Sheet No. 21
		Question and Answer Sheet No. 22
		Question and Answer Sheet No. 23
Job	6	First I-F Amplifiers
R.S.A.	7	Second Mixer, Oscillator, and Second I-F Stages
		Question and Answer Sheet No. 24
		Question and Answer Sheet No. 25
		Question and Answer Sheet No. 26
		Question and Answer Sheet No. 27
Job	7	Second Mixer, Oscillator, and I-F Stages
R.S.A.	8	Limiter
		Question and Answer Sheet No. 28
		Question and Answer Sheet No. 29
		Question and Answer Sheet No. 30
		Question and Answer Sheet No. 31
Job	8	Limiters
R.S.A.	9	Discriminator
		Question and Answer Sheet No. 32
		Question and Answer Sheet No. 33
		Question and Answer Sheet No. 34
		Question and Answer Sheet No. 35
Job	9	Discriminator
R.S.A.	10	Audio Circuits and Squelch
		Question and Answer Sheet No. 36
		Question and Answer Sheet No. 37
		Question and Answer Sheet No. 38
		Question and Answer Sheet No. 39
Job	10	Audio and Squelch Circuits
R.S.A.	11	Receiver Specifications
		Question and Answer Sheet No. 40
		Question and Answer Sheet No. 41
		Question and Answer Sheet No. 42
		Question and Answer Sheet No. 43
Job	11	20 DB Quieting Test

Course Outline (Continued)

Unit XIX - Communications

R.S.A.	12	Receiver Servicing
		Question and Answer Sheet No. 44
		Question and Answer Sheet No. 45
		Question and Answer Sheet No. 46
		Question and Answer Sheet No. 47
Job	12	Receiver Gain Checks
Job	12A	"Motrac" Receiver Stage Gain Checks
R.S.A.	13	Modulation Methods
		Question and Answer Sheet No. 48
		Question and Answer Sheet No. 49
		Question and Answer Sheet No. 50
		Question and Answer Sheet No. 51
Job	13	Transmitter Familiarization
Job	13A	Citizens Band Transceiver
R.S.A.	14	Transmitter Block Diagram
		Transmitter Block Diagram
		Question and Answer Sheet No. 52
		Question and Answer Sheet No. 53
		Question and Answer Sheet No. 54
		Question and Answer Sheet No. 55
Job	14	Transmitter Voltage and Resistance
R.S.A.	15	Oscillator
		Question and Answer Sheet No. 56
		Question and Answer Sheet No. 57
		Question and Answer Sheet No. 58
		Question and Answer Sheet No. 59
		Question and Answer Sheet No. 60
Job	15	Oscillator
R.S.A.	16	Phase Modulator
		Question and Answer Sheet No. 61
		Question and Answer Sheet No. 62
		Question and Answer Sheet No. 63
		Question and Answer Sheet No. 64
		Question and Answer Sheet No. 65
Job	16	Phase Modulator
R.S.A.	17	Audio Circuits
		Question and Answer Sheet No. 66
		Question and Answer Sheet No. 67
		Question and Answer Sheet No. 68
		Question and Answer Sheet No. 69
		Question and Answer Sheet No. 70
Job	17	Audio Circuits
R.S.A.	18	Frequency Multipliers
Job	18	Frequency Multipliers
R.S.A.	19	Power Amplifiers
Job	19	Power Amplifiers

Course Outline (Continued)

Unit XIX - Communications

R.S.A.	20	Transmitter Servicing
Job	20	Transmitter Servicing
R.S.A.	21	Power Supplies - General
Job	21	Dynamotor Power Supply
R.S.A.	22	Power Supplies - Vibrator and Dynamotor
Job	22	Vibrator Power Supply
R.S.A.	23	Power Supplies - Transistor
Job	23	Transistor Power Supply
R.S.A.	24	Power Supplies - A. C.
Job	24	A. C. Power Supply
R.S.A.	25	Antennas
Job	25	Antennas
R.S.A.	26	Towers and Transmission Lines
Job	26	Tower Installation
R.S.A.	27	Mobile Installation
Job	27	Mobile Installation
R.S.A.	28	Base Station Installation
Job	28	Base Station - Remote Control
Job	28A	Extender Circuit Servicing
R.S.A.	29	Test Equipment
Job	29	F. M. Station Monitor
R.S.A.	30	F. C. C. Tests and Measurements
Job	30	F. C. C. Tests and Measurements
R.S.A.	31	Selective Calling
Job	31	Tone-Coded Systems
R.S.A.	32	Preventive Maintenance
Job	32	Preventive Maintenance
R.S.A.	33	Microwave
Job	33	"Handie-Talkie" FM Radio
R.S.A.	34	Radio Relay Systems
Job	34	Stage Gain Measurement
R.S.A.	35	Trouble Shooting
Job	35	Trouble Shooting
Job	36	Trouble Shooting
Job	37	Trouble Shooting
Job	38	Trouble Shooting
Job	39	Trouble Shooting
Job	40	Trouble Shooting
R.S.A.	36	International Morse Code

The Refrigeration and Air Conditioning Course was published in 1951-52 and revised in 1962. It is available in the following forms:

Book I

Related Study Assignments	Unit I
Jobs	Unit I
Mathematics	Unit I

Book II

Related Study Assignments	Units II & III
Jobs	Units II & III
Mathematics	Units II & III

Book III

Related Study Assignments	Unit IV
Jobs	Unit IV
Mathematics	Unit IV

Book IV

Related Study Assignments	Unit V
Jobs	Unit V
Mathematics	Unit V

Test Book

Book I	Units I, II, & III
Book II	Units IV & V

Answer Book
Complete for tests and math

The following instructor's aids are available:
Class Progress Chart (Pad)
Individual Folder Type

The references for the Refrigeration & Air Conditioning Course are the following:

Title	Source
ABC'S OF HAND TOOLS	General Motors Corporation General Motors Technical Center Warren, Michigan
IMPERIAL TUBE WORKING HANDBOOK No. 369-B	Imperial Eastman Corporation Imperial Brass Division 6300 West Howard Street Chicago 48, Illinois

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Althouse and Turnquist MODERN REFRIGERATION AND AIR CONDITIONING	The Goodheart-Willcox Co., Inc., 1322 South Wabash Avenue Chicago 5, Illinois
Anderson, Edwin P. AUDEL'S REFRIGERATION AND AIR CONDITIONING GUIDE	Theo. Audel and Co. 49 West 23rd Street New York 10, New York
IMPERIAL CATALOG No. 80-A	Imperial Eastman Corporation Imperial Brass Division 6300 West Howard Street Chicago 48, Illinois
A TO ZERO OF REFRIGERATION	General Motors Corporation General Motors Technical Center Warren, Michigan
NEW MASTER SERVICE MANUAL No. N-1	Business News Publishing Co. 450 West Fort Street Detroit 26, Michigan
BASIC REFRIGERATION-PRINCIPLES-PRACTICE-OPERATION	Nickerson and Collins Co. 433 Waller Ave. Chicago 44, Illinois
Magnus-Marlott HANDBOOK OF REFRIGERATION AND AIR CONDITIONING	Follett Publishing Co. 1010 W. Washington Blvd. Chicago 7, Illinois
BASIC BENCH-METAL PRACTICE AND PRECISION MEASURING	The Manual Arts Press Peoria, Illinois
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COPELAMETIC CONDENSING UNIT AND MOTOR-COMPRESSOR SERVICE MANUAL	Copeland Refrigeration Corp. Sidney, Ohio
NORGE ROLLATOR REFRIGERATION SERVICE OPEN TYPE SYSTEM	Norge Appliance Service Dept. Borg-Warner Corp. Sherman Blvd. Plant Mushegon Heights, Michigan
HANDBOOK OF AUTOMATIC REFRIGERANT CONTROLS	Alco Valve Company 865 Kingland Avenue St. Louis 5, Missouri
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McDougal, Wynne L., SERIES AND PARALLEL CIRCUITS	American Technical Society 848 East 58th Street Chicago 37, Illinois
Richter, H. P. PRACTICAL ELECTRICAL WIRING	McGraw-Hill Book Co., Inc. 330 West 42nd Street New York 36, New York
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M-H AIR CONDITIONING CONTROLS (Electric) REFERENCE MANUAL	Minneapolis-Honeywell Regulator Company 2747 Fourth Avenue South Minneapolis 8, Minnesota
THE NATIONAL ELECTRICAL CODE	National Board of Fire Underwriters 85 John Street New York 38, New York

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CUTLER-HAMMER REFRIGERATION CONTROL CATALOG	Cutler-Hammer, Inc. Milwaukee 1, Wisconsin
RANCO MANUAL No. 1058 and No. 1244	Ranco, Inc. 601 W. Fifth Avenue Columbus 1, Ohio
Rolf, Oliver K. REBUILDING HERMETIC UNITS	Nickerson and Collins 433-435 North Waller Ave. Chicago 44, Illinois
Lasher and Richards HOW YOU CAN GET A BETTER JOB	American Technical Society 848 East 58th Street Chicago 37, Illinois
PENN INSTALLATION AND SERVICE MANUAL	Penn Controls, Inc. Goshen, Indiana
MASTER SERVICE MANUAL, COMMERCIAL REFRIGERATION, C-1	Business News Publishing Co., 450 W. Fort Street Detroit 26, Michigan
SPORLAN VALVE CO. CATALOG No. 55	Sporlan Valve Company 7525 Sussex Avenue St. Louis 17, Missouri
SAFETY CODE FOR MECHANICAL REFRIGERATION	The American Society of Refrigerating Engineers 234 Fifth Avenue New York 1, New York
Anderson, Edwin P. AUDEL'S PLUMBERS AND STEAM FITTERS GUIDE	Theo. Audel and Company 49 West 23rd Street New York 10, New York
TRANE AIR CONDITIONING MANUAL	The Trane Company, Educational Division LaCrosse, Wisconsin

References (Continued)

Title	Source
AIR CONDITIONING AND REFRIGERATING DATA BOOK, Application Volume	The American Society of Refrigerating Engineers 234 Fifth Avenue New York 1, New York
TRANE REFRIGERATION MANUAL	The Trane Company, Educational Division LaCrosse, Wisconsin
AIR CONDITIONING AND REFRIGERATING DATA BOOK, Design Volume	The American Society of Refrigerating Engineers 234 Fifth Avenue New York 1, New York
AUTOMATIC CONTROL OF HEATING AND AIR CONDITIONING	McGraw-Hill Book Co., Inc. 330 West 42nd Street New York 36, New York
STANDARD REFRIGERATION AND AIR CONDITIONING, QUESTIONS & ANSWERS	McGraw-Hill Book Co., Inc. 330 West 42nd Street New York 36, New York
Marsh, R. Warren and Olivo, C. Thomas PRINCIPLES OF REFRIGERATION with INSTRUCTOR'S GUIDE	Delmar Publishers, Inc. Mountainview Ave. Albany 5, New York
COMMERCIAL AND INDUSTRIAL REFRIGERATION	McGraw-Hill Book Co., Inc. 330 West 42nd Street New York 36, New York
LaSalvia, James L. KEY TO AIR CONDITIONING Manuals K-1, K-2, & K-3	Business News Publishing Co. 450 W. Fort Street Detroit 26, Michigan

A detailed outline of the Refrigeration and Air Conditioning Course follows.

Unit I

Math 1 - Linear Measurement
R.S.A. 1 - Hand Tools and How to Use
Job 1 - Identify Assigned Tools
Math 2 - Rule Practice
R.S.A. 2 - Working Copper Tubing
Job 2 - Cut and Bend Copper Tubing
Math 3 - Addition of Rule Measurements
R.S.A. 3 - Fittings
Job 3 - Check Sizes of Flare, Sweat, and Pipe Fittings
R.S.A. 4 - Simplified Principles of Refrigeration
Job 4 - Flare and Connect Copper Tubing
R.S.A. 5 - How to Solder Connections and Use Halide Leak Detector
Job 5 - Swedge and Solder Copper Tubing
Math 4 - Subtraction of Rule Measurements
Math 5 - Addition of Whole Numbers
Math 6 - Subtraction of Whole Numbers
R.S.A. 6 - Service Valves
Job 6 - Disassemble and Reassemble Service Valves
R.S.A. 7 - Refrigeration Gauges
Job 7 - Install and Remove High and Low Pressure Gauges
R.S.A. 8 - Principles of Refrigeration
Job 8 - Identify Screws, Bolts, and Nuts
Math 7 - Reducing Fractions to Lowest Terms
R.S.A. 9 - Screw, Bolt, and Nut Sizes
Math 8 - Changing Improper Fractions to Mixed Numbers
Math 9 - The Micrometer
R.S.A. 10 - The Lathe
R.S.A. 11 - Compressors and Compressor Parts
Job 9 - Disassemble, Clean and Check Compressor
R.S.A. 12 - Compressor Repairing Precision Work
Job 10 - Repair Compressor Parts
Job 11 - Reassemble Compressor
R.S.A. 13 - Refrigerant Oils
Job 12 - Service and Test Compressor
Math 10 - Changing Mixed Numbers to Improper Fractions
Math 11 - Changing Fractions to Higher Terms
R.S.A. 14 - Serviceable Hermetic Compressor Part
Job 13 - Disassemble, Repair and Reassemble A Serviceable Hermetic Compressor
Math 12 - Least Common Denominators
Job 14 - Service A Rotary Compressor
Math 13 - Addition of Fractions
R.S.A. 15 - Shop Sketching

Course Outline (Continued)

Unit I (Continued)

R.S.A. 16 - Condensers and Receivers
Job 15 - Clean A Condenser and A Receiver
R.S.A. 17 - Shop Sketching, Forming Figures
Job 16 - Check a Low Side and A High Side Float
Math 14 - Subtraction of Fractions
R.S.A. 18 - Expansion Valve Refrigerator System
Job 17 - Check and Adjust Automatic Expansion Valve
Math 15 - Multiplication of Fractions
Job 18 - Check and Adjust Thermostatic Expansion Valve
R.S.A. 19 - Capillary Tube
Math 16 - Division of Fractions
Job 19 - Check Capillary Tube System
R.S.A. 20 - Evaporators
Job 20 - Test and Repair Evaporators
Math 17 - The Decimal System

Unit II

R.S.A. 1 - Magnetism
Job 1 - Determine the Polarity of Magnets and the Existence of Magnetic Fields
R.S.A. 2 - Current Electricity and Electro-Magnetism
Job 2 - Make an Electromagnet and Study its Characteristics
R.S.A. 3 - Electric Circuits, Series and Parallel
Job 3 - Series and Parallel Circuits
R.S.A. 4 - Operation and Care of Volt, Ampere, Ohm, and Watt Meters
Job 4 - Taking Meter Readings
R.S.A. 5 - Ohm's Law
Job 5 - Ohm's Law
R.S.A. 6 - Types of Refrigeration and Air Conditioning Controls
Job 6A - Connect a Combination High Pressure and Low Pressure Control
Job 6B - Connect a Temperature Control
Job 6C - Connect 3-Phase Motor Controlled by a Remote Start-Stop Pushbutton
R.S.A. 7 - Types of Relays
Job 7 - Connecting Relays
R.S.A. 8 - Insulation and Current Capacity of Conductors
Job 8 - Measure Sizes of Wire
R.S.A. 9 - Electric Motors
Job 9A - Disassemble, Check, and Reassemble A Split-Phase Motor and A Capacitor Start Motor
Job 9B - Disassemble, Check, and Reassemble a Three Phase Motor
Job 9C - Disassemble, Check, and Reassemble R. I. Motor

Course Outline (Continued)

Unit II (Continued)

R.S.A. 10 - Universal Motors
Job 10 - Disassemble, Check and Reassemble Universal Motor
R.S.A. 11 - Construction, Operation and Connections of Capacitors
Job 11 - Testing Capacitors
R.S.A. 12 - Capacitor Motors
Job 12 - Disassemble, Repair and Reassemble A Capacitor-Start Motor

Unit III

Math 1 - Square and Cubic Measurements and Multiplication of Whole Numbers
R.S.A. 1 - Practical Theory of Refrigeration
Math 2 - Division of Whole Numbers
R.S.A. 2 - Moisture, Air and Foreign Matter
Job 1 - Refill Small Refrigerant Cylinder
R.S.A. 3 - Refrigerants
Job 2 - Check Refrigerant Cylinder Pressure
R.S.A. 4 - Sealed Unit Refrigerators
Job 3 - Check Electrical System on Sealed Units
Job 4 - Make Trouble Shooter Chart Using Manufacturer's Manual
Job 5 - Check Sealed Unit, Using Chart, and Determine Trouble in A Written Diagnosis
Job 6 - Check A Sealed Unit System
Job 7 - Check And Replace Thermostatic Motor Control in Electrical System. Explain Functions and Give Reason For Replacing
Job 8 - Replace a Defective Cabinet Light Switch in Electrical Circuit and Make Free Hand Sketch of Entire Electrical System
Job 9 - Check a Sealed Unit For a "Grounded Unit" - "To Housing" - "Between Windings"
Job 10 - Identify Motor Terminals and Run Sealed Unit With A Starting Cord
R.S.A. 5 - Absorption Type Refrigerator
Job 11 - Reverse Rotation on A Sealed Unit
Job 12 - Open A Sealed Unit and Check Whether or Not It Is Repairable
Job 13 - Repair A Leaking Motor Terminal On A Sealed Unit
Job 14 - Check Sealed Unit For Refrigerant Leak, Repair and Recharge Unit - Make Written Diagnosis of Leak and Method of Repair

Course Outline (Continued)

Unit III (Continued)

Job 15 - Replace A Major Component of a Sealed Unit - Give Type Solder and Flux Used
Job 16 - Dehydrate, Charge and Operate Unit Repaired In Job 15
R.S.A. 6 - Expansion Valve
Job 17 - Rewire Sealed Unit System
Math 3 - Making and Reading Line Graphs
Job 18 - Assemble Unit With A.E.V., Using Reciprocating Compressor
Job 19 - Assemble Unit With A Thermostatic Expansion Valve
R.S.A. 7 - Capillary Tube Refrigerator Systems
Job 20 - Assemble Unit With Capillary Tube
R.S.A. 8 - Domestic Refrigeration Servicing
R.S.A. 9 - Dual Temperature Refrigerator
Job 21 - Check and Repair A Combination Home Freezer-Refrigerator
R.S.A. 10 - Personal and Social Problems - Getting and Holding a Job
Job 22 - Check and Repair A Capillary Tube, Open Type Refrigerator
R.S.A. 11 - Home Freezer
Job 23 - Check and Repair A Home Freezer With Capillary Tube Control
R.S.A. 12 - Cabinets, Cabinet Repairing and Refinishing
Job 24 - Replace Door Gasket
Job 25 - Repair or Replace Cabinet Hardware
Job 26 - Refinish Refrigerator Cabinet

Unit IV

R.S.A. 1 - Motor Controls
Job 1 - Adjust Low Pressure Motor Control
Math 1 -Simple Percentage
Job 2 - Check and Adjust Thermostatic Motor Control
Job 3 - Adjust High Pressure Control and A Combination Control
Math 2 - Discount
R.S.A. 2 - Advanced Refrigeration Fundamentals and Commercial Evaporators
Job 4 - Install Gravity Coil In Reach-In Box Using Air-Cooled Condensing Unit
Job 5 - Replace The Gravity Coil With a Blower-Coil on Job No. 4
Math 3 - Evaporator Capacity
R.S.A. 3 - Commercial Refrigeration Valves and Controls
Job 6 - Service Water Regulating Valves

Course Outline (Continued)

Unit IV (Continued)

R.S.A. 4 - American Standard Safety Code for Mechanical Refrigeration
Job 7 - Clean (Small)Water Cooled Condenser
R.S.A. 5 - Pipe Sizes
Job 8 - Thread and Connect Pipe
R.S.A. 6 - Condensing Units and Refrigerant Pipes
Job 9 - Install Gravity Coil in Walk-In Box Using Water-Cooled Condensing Unit
Math 4 - Compressor Capacity
Job 10 - Replace the Gravity Coil With a Blower Coil on Job No. 9
R.S.A. 7 - Multiple Systems
Job 11 - Install A Complete Multiple Unit (Same temperature)
Job 12 - Install A Solenoid Valve and Thermostatic Control on Job No. 10.
R.S.A. 8 - Commercial Refrigeration Systems
Job 13 - Install A Two-Temperature Valve Job
Job 14 - Install and/or Operate Hot Gas Defrost on Job
R.S.A. 9 - Commercial Refrigeration Installation
Job 15 - Install and Operate Water Defrost
R.S.A. 9A - Wet and Dry Type Beverage Coolers
Job 16 - Install or Service a Wet Beverage Cooler
Job 17 - Install or Service a Dry Beverage Cooler
Math 5 - Refrigerant Pipe Capacity
Job 18 - Service a Water Cooler
Job 19 - Construct and/or Install or Service Small Ice Maker
R.S.A. 10 - Miscellaneous Refrigeration Equipment
Job 20 - Construct and/or Install Counter-Flow Condenser
Job 21 - Install Oil Separator on Unit
Math 6 - Service Orders
Job 22 - Construct and/or Install Heat Interchanger
R.S.A. 11 - Cooling Water
Job 23 - Construct and/or Install Evaporative Condensers
Job 24 - Check a Forced Draft Water Tower
R.S.A. 12 - Evaporative Condensers
R.S.A. 13 - Commercial Refrigeration - Electrical
Job 25 - Install and/or Connect Single Phase Motor Using Magnetic Switch
Job 26 - Install and/or Connect Three Phase Motor Using Magnetic Switch
Job 27 - Install and/or Connect Three Phase Motor Using Magnetic Switch and Pilot Relay
R.S.A. 14 - Low Temperature and R-22
Job 28 - Check Operation of Ice Cream Cabinet
Job 29 - Construct and/or Check Low Temperature Unit
Math 7 - Parts and Supply Orders

Course Outline (Continued)

Unit IV (Continued)

Job 30 - Install and Check a Plate Coil
R.S.A. 15 - Heat Pumps
Job 31 - Construct and Operate a Heat Pump
R.S.A. 16 - Ammonia System
Job 32 - Design and Sketch An Ammonia System
R.S.A. 17 - Factors That Affect Commercial Refrigeration
R.S.A. 18 - Commercial Refrigeration Calculations and Heat Load
Job 33 - Survey and Calculate a Heat Load
Math 8 - Job Costs
R.S.A. 19 - Safety and First Aid for the Refrigeration Service Engineer

Unit V

R.S.A. 1 - Air Conditioning Equipment
Job 1 - Install and/or Check Portable Air Conditioning Unit
R.S.A. 2 - Heat Temperature and Comfort
Job 2 - Check Installation of Window Unit
Job 3 - Remove Cabinet From Window Unit Identifying Component Parts and Make a Trouble Shooters Chart on a Room Unit Using Mfgs. Service Manual
Job 4 - Check and Repair Electrical System on a Room Unit--Make Repairs if Necessary
Job 5 - Check Sealed Unit For "Grounded Out" Motor-to-Housing--Between Windings and Identify Motor Terminals as Running, Starting, Common--Give Method Used
Job 6 - Open a Defective Sealed Unit to Find Cause of Failure--Give Method Used for Repair
Job 7 - Check and Clean Filter--Replace if Necessary
Job 8 - Check Condensate and Explain What Use is Made of it By the Condenser and Condenser Fan
Job 9 - Replace a Major Component Part of a Room A/C Unit--Make Complete Service Report
Job 10 - Check Air Flow With Anemometer or Velometer
Job 11 - Install and/or Check Self-Contained Unit
R.S.A. 3 - Heat Gains, Part I and Part II
Job 12 - Check Relative Humidity
R.S.A. 4 - Residential Winter Air Conditioning
Job 13 - Install or Check Residential Forced Air Heating System
R.S.A. 5 - Properties of Air
Job 14 - Install a Complete Remote Air Conditioning Unit
R.S.A. 6 - The Psychrometric Chart
Job 15 - Check and Oil Motors on Air Conditioning System

Course Outline (Continued)

Unit V (Continued)

R.S.A. 7 - Air Conditioning Calculations, Part I
Math 1 - Measurement of Angles
Job 16 - Check or Install and Operate Duct-type Heater Coil in Air Conditioning System. Install Necessary Controls
R.S.A. 8 - Ducts and Fans
Job 17 - Install Modulating Motor System
Job 18 - Check the Efficiency of Atmospheric Tower as Compared to Forced Draft Tower
Job 19 - Balance a Duct System
R.S.A. 9 - Air Conditioning Calculations, Part II
Job 20 - Survey and Calculate a Cooling Load
R.S.A. 10 - Automotive Air Conditioning and Controls
Job 21 - Servicing Automotive Air Conditioning Unit

The Sheet Metal Course was written in 1958. It is available in the following form.

Related Study Assignment
Book 1

Test
Available in loose form

Others
Blueprint Reading and Sketching - Petroleum Industry Workers

Successful Soldering by Louie S. Taylor

Student Study Guide in Sheet Metal Work - for apprentices on-the-job Trainers and other Learners

A detailed outline of the Related Study Assignments follows:

R.S.A. 1 - Machine Processes - Bar Folder

R.S.A. 2 - Machine Processes - Hand Brake

R.S.A. 3 - Machine Processes - Forming Rolls

R.S.A. 4 - Machine Processes - Squaring Shears

R.S.A. 5 - Machine Processes - Beading Machine

R.S.A. 6 - Machine Processes - Crimping Machine

R.S.A. 7 - Machine Processes - Turning Machine

R.S.A. 8 - Machine Processes - Burring Machine

R.S.A. 9 - Machine Processes - Drill Presses

R.S.A. 10 - Machine Processes - Grinding Wheels

R.S.A. 11 - Hand Processes - Bench Tools

R.S.A. 12 - Hand Processes - Patterns

R.S.A. 13 - Hand Processes - Hand Snips

R.S.A. 14 - Hand Processes - Forming Stakes

R.S.A. 15 - Hand Processes - Bending Metal

R.S.A. 16 - Hand Processes - Files

Course Outline (Continued)

R.S.A. 16 - Hand Processes - Files

R.S.A. 17 - Hand Processes - Soldering Coppers

R.S.A. 18 - Hand Processes - Solders and Fluxes

R.S.A. 19 - Hand Processes - Grooved Seams

R.S.A. 20 - Hand Processes - Chisels

R.S.A. 21 - Hand Processes - Stretching and Shrinking

R.S.A. 22 - Hand Processes - Solid & Hollow Punches

R.S.A. 23 - Hand Processes - Hand Punches

R.S.A. 24 - Hand Processes - Drills

R.S.A. 25 - Hand Processes - Rivets & Riveting

R.S A. 26 - Hand Processes - The Hack Saw

R.S.A. 27 - Hand Processes - Wired Edges

R.S.A. 28 - Hand Processes - Single and Double Seams

R.S.A. 29 - Hand Processes - Pittsburgh Lock

R.S.A. 30 - Test - Gable Molding With Raked Profile

R.S.A. 31 - Test - Miter - Different Profiles

R.S.A. 32 - See Instructor

R.S.A. 33 - Test - Cone & Frustum

R.S.A. 34 - See Instructor

R.S.A. 35 - Test - Irregular Frustum of Cone

R.S.A. 36 - Test - Conical Gutter Outlet

R.S.A. 37 - Test - Collar for Double Pitch Roof

R.S.A. 38 - Test - Elliptical Flaring Pan

R.S.A. 39 - Test - Tapered Square Pipe on Sq. Pipe

R.S.A. 40 - Test - Cylinder on Cone Vertically

Course Outline (Continued)

R.S.A. 41 - Test - No. 8-Cylinder on Cone Horizontally

R.S.A. 42 - Test - No. 9--Cone on Cylinder

R.S.A. 43 - Test - No. 10--Cone on Cone

R.S.A. 44 - Test - No. 1-Square to Round on Center

R.S.A. 45 - Test - No. 2-Rect., To Round off Center

R.S.A. 46 - Test - No. 3-Rect., To Round off Center- 2 Ways

R.S.A. 47 - Test - No. 4-Taper Joint off Center

R.S.A. 48 - Test - No. 5-Rectangle to Triangle

R.S.A. 49 - Test - No. 6-Irregular-Round to Oblong

R.S.A. 50 - Test - No. 7-Irregular T-Joint

R.S.A. 51 - Test - No. 8-Roof Collar Square to Round

R.S A. 52 - Test - No. 9-Scalene Cone

R.S.A. 53 - Test Noil, Flaring Roof Collar

R.S.A. 54 - Test - No. 2, Roof Collar, Square to Round

R.S.A. 55 - Test - No. 3, 3-piece Tapered Offset

R.S.A. 56 - Test - No. 4, 3-piece Reducing Elbow

R.S.A. 57 - Test - No. 5, 3-piece Transition-Square to Round

R.S.A. 58 - Test - No. 6, Furnace Boot

R.S.A. 59 - Test - No. 7, Tapering-y-Joint

R.S.A. 60 - Test - Math-Area and Volumes

R.S.A. 61 - See Instructor

R.S.A. 62 - See Instructor

R.S.A. 63 - See Instructor

R.S.A. 64 - See Instructor

The Small Craft Operation and Navigation Course was published in 1960. It is available in book form.

A detailed outline of the Small Craft Operation and Navigation Course follows:

Introduction

Part I - Rules and Regulations

- Lesson 1 - Equipment Required by Regulations
- Lesson 2 - Classes of Vessels
- Lessons 3 & 4 - Rules of the Road
- Lesson 5 - Recommended Equipment to be Carried on Small Craft

Part II - Aids to Navigation

- Lesson 6 - Buoys and Markers
- Lesson 7 - Lights
- Lesson 8 - Charts
- Lesson 9 - The Use of Charts in Piloting
- Lesson 10 - Navigation in Fog and Other Conditions or Reduced Visibility

Part III - The Marine Compass and Piloting

- Lesson 11 - Historical Background and Construction
- Lesson 12 - Magnetism
- Lesson 13 - Compass Error

Appendix A - Common Nautical Terms

Appendix B - Equipment Required on Motor Boats

Appendix C - How Safe a Skipper are You?

Appendix D - Introduction to First Aid - For Lessons 1, 2, and 3

The Small Engines Mechanics Course was recently revised and is available in the following book form for instructors. It is available in loose form for the students.

Book I	
Related Study Assignments	Units I-VI
Jobs	Units I-VI
Mathematics	Units I-VI
Book II	
Related Study Assignments	Units VII-XIII
Jobs	Units VII-XIII
Test Book	
Book I	Units I-XIII
Answer Book	
For Tests and Math	Units I-XIII

The references for the Small Engines Mechanics Course are listed below:

Title	Source
A.B.C.'S OF HAND TOOLS	General Motors Corporation General Motors Technical Center Warren, Michigan
GENERAL REPAIR TOOLS FOR AUTO MECHANICS	Delmar Publishers Inc. Mountainview Avenue Albany 5, New York
WALDES TRUARC RETAINING RING TECHNICAL MANUAL	Waldes Kohinoor, Inc. Long Island City, N. Y.
Catalog of Tubing Fittings	Imperial Eastman Corporation Imperial Brass Division 6300 West Howard Street Chicago 48, Illinois
SOLDERING SIMPLIFIED	Kester Solder Co. 4201 Wrightwood Avenue Chicago 48, Illinois
Atteberry, P. H. POWER MECHANICS	Goodheart-Willcox Co., Inc. 1322 S. Wabash Chicago 5, Illinois

References (Continued)

Title	Source
SMALL ENGINES SERVICE MANUAL	Technical Publications, Inc. 1014 Wyandotte Street Kansas City 5, Missouri
Purvis, Jud ALL ABOUT SMALL GAS ENGINES	Goodheart-Willcox Co., Inc. 1322 S. Wabash Chicago 5, Illinois
GENERAL THEORIES OF OPERATION	Briggs and Stratton Corporation 2711 North Street Milwaukee 1, Wisconsin
Venk, Ernest THE COMPLETE OUTBOARD BOATING MANUAL	American Technical Society 848 East 58th Street Chicago 37, Illinois
REPAIRMAN'S HANDBOOK	Briggs and Stratton Corporation 2711 North Street Milwaukee 1, Wisconsin
SMALL ENGINES SERVICE MANUAL	Implement and Tractor Pub., Inc. 1014 Wyandotte Kansas City 5, Missouri
CLINTON ENGINES SALES AND SERVICE MANUAL	Clinton Engine Corporation Maquoketa, Iowa
MASTER PARTS AND SERVICE MANUAL	Tillotson Mfg. Co. Toledo 12, Ohio
TECUMSEH ENGINES MASTER PARTS AND SERVICE MANUAL	Tecumseh Products Parts Department Grafton, Wisconsin
CARTER CARBURETOR MASTER PARTS AND SERVICE MANUAL	Carter Carburetor Co. Division of ACF Industries St. Louis 7, Missouri
CLINTON CHAINSAW SALES AND SERVICE MANUAL	Clinton Engine Corporation Maquoketa, Iowa
LAWN BOY SERVICE MANUAL	Lawn Boy Division of Outboard Marine Corp. Galesburg, Illinois

References (Continued)

BRIGGS AND STRATTON REPAIR INSTRUCTIONS, Form MS-3854	Briggs and Stratton Corporation 2711 North Street Milwaukee 1, Wisconsin
TECUMSEH ENGINES MECHANIC'S HANDBOOK	Tecumseh Products Parts Department Grafton, Wisconsin
MAGNETO IGNITION	Fairbanks, Morse and Co. 600 S. Michigan Ave. Chicago 5, Illinois
WHAT MAKES THE SPARK	R. E. Phelon Co. East Longmeadow, Mass.
WISCONSIN ENGINES INSTRUCTIONS BOOK AND PARTS LIST	Wisconsin Motor Corp. Milwaukee 46, Wisconsin
WICO ELECTRIC CO. SERVICE AND PARTS LIST	Wico West Springfield, Mass.
AUTO-LITE SPARK PLUG SERVICE MANUAL	The Leech-Neville Co. 1347 East 51st Street Cleveland 13, Ohio
A. C. SPARK PLUG SHOP MANUAL	Delco-Remy Division General Motors Corporation Anderson, Indiana
AUDEL'S GAS ENGINE MANUAL	Theo. Audel and Co. 49 West 23rd Street New York 10, New York
BENCHWORK, DRILLS, AND DRILLING (FILM NO. 3)	Jam Handy Organization 2821 E. Grand Blvd. Detroit, Michigan
BENCHWORK, REAMING, TAPPING, AND THREADING (FILM NO. 4) TAPPING AND THREADING, FRAMES 46 through 86	Jam Handy Organization 2821 E. Grand Blvd. Detroit, Michigan
CUSHMAN SERVICE MANUAL	Cushman Motor Works, Inc. Lincoln, Nebraska
Stephenson, George E. POWER MECHANICS	Delmar Publishers Inc. Mountainview Avenue Albany 5, New York

References (Continued)

THE LAWN MOWER SERVICE MANUAL	Yard-Man Inc. Jackson, Michigan
WESTERN TOOL AND STAMPING CO. PARTS AND PRICE CATALOG	Western Tool and Stamping Co. Des Moines, Iowa
OPERATING INSTRUCTIONS FOR THE MODEL 900 LAWN MOWER SHARPENER	Fate-Root-Heath Company Plymouth, Ohio
CHAIN SAW SERVICE MANUAL	Technical Publications, Inc. 1014 Wyandotte Street Kansas City 5, Missouri
CHAIN SAW SERVICE MANUAL	Implement and Tractor Pub., Inc. 1014 Wyandotte St. Kansas City 5, Missouri
JOHNSON SERVICE MANUAL	Johnson Motors Waukegan, Illinois
MASTER SERVICE MANUAL	Mercury Outboard Motors Kiekhaefer Corporation Beaver Dam, Wisconsin
OUTBOARD MOTOR AND BOATING GUIDE	Theo. Audel and Co. 49 West 23rd Street New York 10, New York

A detailed outline of the Small Engines Mechanics Course follows:

Introduction

Unit I - Basic Repair Skills

R.S.A.	1	Hand Tools and How to Use
Math	1	Linear Measurement
Math	2	Rule Practice
Job	1	Disassemble and Reassemble Used Engine
Job	2	Identify Hand Tools
Math	3	Addition of Rule Measurements
Job	3	Reshape screwdriver, Chisel, and Center Punch, Using Bench Grinder
Math	4	Subtraction of Rule Measurements
R.S.A.	2	Measuring Devices
R.S.A.	2A	The Micrometer
Job	4	Measure Crankshaft and Cylinder With Micrometers

Course Outline (Continued)

R.S.A.	3	Fastening Devices and Related Items (Part I)
Job	5	Identify Bolts and Nuts
R.S.A.	3	Fastening Devices and Related Items (Part II)
Job	6	Identify Retaining Rings
R.S.A.	4	Drills, Taps, and Dies
R.S.A.	4A	Tools
Job	7	Make a Drill Gauge
Job	8	Make Internal Thread Block and Studs
R.S.A.	5	Installing Studs and Removing Broken Studs
Job	9	Remove a Broken Stud
R.S.A.	5A	Internal Thread Repairs
Job	10	Repair Internal Threads with Inserts
R.S.A.	6	Tubing and Fittings
Job	11	Make Up Replacement Fuel Line, Using Assorted Fittings
Job	12	Repair Internal Pipe Threads With Repair Insert
R.S.A.	7	Soldering
Job	13	Splice Insulated Wire
Job	14	Make a Solder Joint
Job	15	Sweat a Tank Fitting
R.S.A.	8	Bushings and Reamers
Job	16	Remove, Replace, and Ream a Bushing

Unit II- Engine Fundamentals

Introduction

R.S.A.	1	Theory of Operation - 2-Stroke Cycle Engines
Job	1	Disassemble and Reassemble 2-Cycle Engine
Math	5	The Decimal System
Math	6	Addition and Subtraction of Decimals
Job	2	Identify Engine Parts By Proper Name, Using Manufacturer's Parts Catalog (2-Cycle Engine)
R.S.A.	2	Theory of Operation - 4-Stroke Cycle Engines
Job	3	Disassemble and Reassemble Engine, 4-Stroke Cycle
Math	7	Multiplication and Division of Decimals
Job	4	Identify Parts by Name, 4-Cycle Engine, Using Manufacturer's Parts Catalog
Job	5	Start, Stop, and Store 2-Cycle Engine
Job	6	Start, Stop, and Store 4-Cycle Engine
R.S.A.	3	Principles and Operations of Small Gasoline Engines

Unit III - Fuel Systems

R.S.A.	1	Fuel Supply Systems
Job	1	Remove, Repair, and Replace Carburetor, Briggs and Stratton (Updraft)

Course Outline (Continued)

R.S.A.	2	Float Carburetors
Job	2	Remove, Repair, and Replace Carburetor (Briggs and Stratton Float Type, Sidedraft)
R.S.A.	3	Governors
Job	3	Repair and Adjust Carburetor and Governor, Clinton Vertical Shaft Engine (Carter Carburetor)
R.S.A.	4	Diaphragm Carburetors
Job	4	Repair and Adjust Carburetor and Governor, Clinton Vertical Shaft Engine (Clinton or Walbro Carburetor)
Job	5	Repair and Adjust Carburetor and Governor, Lauson Series, Walbro Carburetor
Job	6	Repair and Adjust Carburetor and Governor, Power Products, (Tillotson Carburetor) AV Series
Job	7	Repair Carburetor, Double Diaphragm, Carter Model "ND"
Job	8	Repair Single Diaphragm Carburetor, (Lauson V Series Lightweight Engine) or Power Products Engine (Tecumseh Carburetor)
R.S.A.	5	Air Cleaners
Job	9	Repair and Adjust Carburetor and Governor Lawn Boy "C" Series Engine
R.S.A.	6	Remote Control System
Job	10	Repair and Adjust Remote Control System (Craftsman Lawn Mower With Handle Mounted Dial Control)
Job	11	Install a Bowden Wire Remote Control System

Unit IV - Magneto Ignition

R.S.A.	1	Magnetism and Electricity
Job	1	Repair Ignition System, Briggs & Stratton Aluminum Horizontal Series Engine
R.S.A.	2	Flywheel Magnetos
Job	2	Repair Ignition System, Briggs and Stratton Small Cast Iron Series
Job	3	Repair Ignition System, Briggs & Stratton "Magnematic Ignition System"
R.S.A.	3	Trouble Shooting Information
Job	4	Repair Ignition System, Clinton Vertical Shaft Aluminum Engine Series
Job	5	Repair Ignition System Clinton Vertical Shaft, Two Cycle
Job	6	Repair Ignition System, Lauson V-Series, Wico Magneto
R.S.A.	4	High Tension Magnetos
Job	7	Repair High Tension Magneto (Wico Model XH-1) (as used on Wisconsin AE, AEH, AEN Series)

Course Outline (Continued)

Job	8	Repair High Tension Magneto (Multi-Cylinder Model as used on Wisconsin 4-Cylinder Engine) (Fairbanks Morse Type FM-X4A7B)
R.S.A.	5	Spark Plugs

Unit V - Starting Systems

R.S.A.	1	Manual Starters
Job	1	Repair Rewind Starter, Briggs and Stratton
Job	2	Disassemble and Repair Rewind, Clinton Engine (Fairbanks Morse Starter)
Job	3	Repair Recoil Starter (Clinton Starter)
Job	4	Repair Rewind Starter, Clinton Engine (Schnake Starter)
Job	5	Repair Rewind Starter, Lawn Boy C Series Engine
Job	6	Repair Rewind Starter, Tecumseh Engine (Eaton Starter)
Job	7	Repair Wind-Up Starter, Briggs and Stratton, Vertical Shaft Engine
Job	8	Repair Wind-Up Starter, Tecumseh Engine, "Self Starter"
R.S.A.	2	Wind-Up Starters
Job	9	Repair Wind-Up Starter, Clinton "Impulse Starter"

Unit VI - Engine Overhaul

Introduction:

R.S.A.	1	Cooling
Job	1	Clean and Inspect Air-Cooling System (Any Make)
R.S.A.	2	Valve Systems
Job	2	Reface Valves
Job	3	Remove, Replace, and Reseat Valve Seats
Job	4	Perform Valve and Seat Reconditioning Job (Briggs and Stratton Engine, Small Series, Lightweight)
Job	5	Perform Valve and Seat Reconditioning Job (Clinton Engine, Lightweight Series)
Job	6	Recondition Valve System, Tecumseh Engine (4-Cycle)
Job	7	Recondition Valve System, Wisconsin 2 or 4-Cylinder Engine
R.S.A.	3	Cylinders
Job	8	Hone Aluminum Cylinder for Oversize Piston
Job	9	Hone Cylinder For Oversize Piston (Cast Iron)
R.S.A.	4	Pistons, Rings, Pins, and Connecting Rods
Job	10	Bore Cylinder For Oversize Piston
Job	11	Remove and Replace Connecting Rod, Piston, and Piston Rings. (Briggs & Stratton Lightweight Series, Vertical Shaft Engine)

Course Outline (Continued)

Job	12	Remove and Replace Connecting Rod and Piston Assembly, Clinton Lightweight VS Series
Job	13	Remove and Replace Connecting Rod and Piston Assembly, Tecumseh 2-Cycle, Vertical-Shaft Engine
R.S.A.	5	Camshafts, Crankshafts, Bearings and Seals
Job	14	Remove and Replace Crankshaft and Main Bearings, Tecumseh "V" Series, 4 Cycles
Job	15	Remove and Replace Crankshaft and Main Bearings, Tecumseh 2-Cycle Engine
R.S.A.	6	Oil Pumps
Job	16	Complete Engine Overhaul, Briggs and Stratton Model 8 Engine
Job	17	Complete Engine Overhaul, Clinton "V" Series Lightweight 4 Cycle
Job	18	Complete Engine Overhaul, Lawn Boy C Series
Job	19	Complete Engine Overhaul, Briggs and Stratton (Cast Iron Series, 3 HP or above)
Job	20	Complete Engine Overhaul (Wisconsin 2 or 4 Cylinder Engine)

Unit VII - Clutches and Drive Mechanisms

R.S.A.	1	Centrifugal Clutches
Job	1	Repair Centrifugal Clutch, Drum Type
Job	2	Repair Centrifugal Clutch, Disc Type (Cushman Scooter)
R.S.A.	2	Manual Clutches
R.S.A.	3	Belt and Chain Drives
Job	3	Repair and Adjust Belt Drive Assembly
Job	4	Repair and Adjust Chain Drive Assembly
R.S.A.	4	Transmissions
Job	5	Repair Transmission
R.S.A.	5	Differentials
Job	6	Repair Differential

Unit VIII - Grass Cutting Equipment

Introduction:

R.S.A.	1	Rotary Lawn Mowers
Job	1	Remove, Repair, and Replace Rotary Mower Blade
Job	2	Overhaul Self-Propelled Rotary Mower, Complete
R.S.A.	2	Reel Type Lawn Mowers
Job	3	Adjust Bed-Knife Clearance and Lubricate Mower
Job	4	Grind a Bed Knife and Reel
Job	5	Complete Overhaul, Reel Type Power Mower

Course Outline (Continued)

Unit IX - Refinishing

R.S.A.	1	Painting, Refinishing, and Preparations
Job	1	Prepare a Lawn Mower for Refinishing
R.S.A.	2	Paints, Lacquers, and Thinners
Job	2	Paint a Lawn Mower with Spray Gun

Unit X - Chain Saws

R.S.A.	1	Chain Saw Operation
Job	1	File and Adjust Chain, Any Make
Job	2	Repair Chain Saw Oiling System
Job	3	Repair Clutch
Job	4	Repair Chain Saw Transmission
Job	5	Overhaul Chain Saw, Complete

Unit XI - Pumps

R.S.A.	1	Centrifugal and Diaphragm Pumps
Job	1	Overhaul a Centrifugal Pump
Job	2	Overhaul a Diaphragm Pump

Unit XII - Outboard Engine Fuel Systems

R.S.A.	1	Remote Fuel-Supply Systems
Job	1	Repair Outboard Remote Fuel System
R.S.A.	2	Outboard Engine Carburetion
Job	2	Repair Carburetor, Johnson or Evinrude, 2 Cylinder (with electric choke)
Job	3	Repair and Adjust Dual Carburetors, Mercury 4 Cylinder
Job	4	Repair Two-Barrel Carburetor, Johnson or Evinrude 4 Cylinder (with automatic choke)

Unit XIII - Outboard Engine Ignition

R.S.A.	1	Outboard Magnetos
Job	1	Repair and Synchronize Outboard Magneto, 2 Cylinder Engine
Job	2	Repair and Synchronize Outboard Magneto 4 Cylinder Engine
R.S.A.	2	Battery Ignition
Job	3	Repair Outboard Engine Battery Ignition System

Units I - VII of the Tractor Maintenance and Repair Course was published in 1953-1954, Units VIII - XIV in 1958. It is available in the following forms:

Math, Related Study Assignments, Jobs and Job Information Sheets are all in Packages for students. Book forms are available for the Instructors.
Book I - Units I and II
Book II - Units III and IV
Book III - Units V, VI and VII
Book IV - Units VIII through XIV

Test Book
Includes all test for Units I - XIV
Answer Book
Complete for Units I - XIV

The following instructor's aids are available:
Permanent Record Folders
Wall Progress Charts

The references for the Tractor Maintenance and Repair Course are the following:

Title	Source
Jones, Fred, FARM GAS ENGINE AND TRACTORS	McGraw-Hill Book Co., Inc. 330 West 42nd Street New York 36, New York
Johnson, SERVICING AND MAINTAINING FARM TRACTORS	McGraw-Hill Book Co., Inc. 330 West 42nd Street New York 36, New York
I AND T SHOP SERVICE BOOK	Implement and Tractor Pub., Inc. Graphic Arts Building Kansas City 5, Missouri
OPERATORS MANUAL	
SPARK PLUG CLEANER MANUFACTURER'S SERVICE MANUAL	
MOTOR'S TRUCK AND TRACTOR REPAIR MANUAL	Motor 250 West 55th Street New York
Delco-Remy ELECTRICAL EQUIPMENT OPERATION AND MAINTENANCE HANDBOOK	Delco-Remy Division General Motors Anderson, Indiana

References (Continued)

Title	Source
MOTOR'S AUTO REPAIR MANUAL	Motor 250 West 55th Street New York 19, New York
Crouse, AUTOMOTIVE MECHANICS, Second Edition	McGraw-Hill Book Co., Inc. 330 West 42nd Street New York 36, New York
BORING BAR MANUFACTURERS MANUAL	
Kuns, AUTO MECHANICS Book One	American Technical Society 848 East 58th Street Chicago 37, Illinois
A.B.C.'S OF HAND TOOLS	General Motors Corporation General Motors Building 3044 West Grand Boulevard Detroit 2, Michigan
Morrison, Ivan, Gregg, FARM TRACTOR MAINTENANCE, 1946	The Interstate Printers and Publishers, Inc. Jackson at Van Buren Danville, Illinois

A detailed outline of the Tractor Maintenance and Repair Course follows:

UNIT I: PREVENTIVE MAINTENANCE FUNDAMENTALS

PACKAGE #1

Math	1	The Steel Rule
R.S.A.	1	Fastening Devices, Calipers, and Thread Gages
Job	1	Identify Bolts and Nuts

PACKAGE #2

R.S.A.	2	Drills, Taps, and Dies
Job	2	Make Internal Thread Block and Studs
J.I.S.	1	Tools (For use with Job 2)

PACKAGE #3

R.S.A.	3	Installing Studs and Removing Broken Studs
Job	3	Remove a Broken Stud
Math	2	Addition and Subtraction of Scale Measurements

Course Outline (Continued)

UNIT I (Continued)

PACKAGE #4

R.S.A.	4	Soldering
Job	4	Make a Solder Joint

PACKAGE #5

Job	5	Start, Operate and Stop Tractor

PACKAGE #6

R.S.A.	5	Hand Tools and How to Use
Job	6	Identify Hand Tools

PACKAGE #7

R.S.A.	6	Tire Service
Job	7	Remove, Repair, and Replace Tire and Tube

PACKAGE #8

Math	3	Addition and Subtraction of Whole Numbers
R.S.A.	7	Lubrication
Job	8	Lubricate Tractor

PACKAGE #9

R.S.A.	8	Lubricating Oils and Oil Filters
Job	9	Drain, Flush, Refill Crankcase and Service Oil Filter

PACKAGE #10

R.S.A.	9	Battery Service
Job	10	Service a Battery

PACKAGE #11

R.S.A.	10	Cooling Systems
Job	11	Flush Cooling System

UNIT II: FRONT AXLE AND STEERING GEAR

PACKAGE #12

R.S.A.	11	Front Wheel Service
Job	12	Remove, Repack, and Adjust Front Wheel Bearings
Math	4	Multiplication of Whole Numbers

Course Outline (Continued)

UNIT II (Continued)

PACKAGE #13

R.S.A.	12	Front Axles
Job	13-B	Set Toe-In (Ford, 8N)
Job	13-C & E	Set Toe-In (Farmall, Super-A and Case, LA)
Math	5	Division of Whole Numbers

PACKAGE #14

R.S.A.	13	Reamers and Reaming
Job	14-B	Renew Spindle Bushings (Ford, 8N)
Job	14-C	Rebush Steering Knuckles (Farmall, Super-A)
Job	14-E	Renew Kingpin Bushings (Case, LA)
Job	15-B	Renew Axle Pin Bushing (Ford, 8N)
Job	15-C	Renew Axle Pivot Shaft Bushings (Farmall Super-A)
Job	15-E	Renew Axle Pivot Shaft Bushing (Case L.A.)
Math	6	Changing Fractions

PACKAGE #15

Job	16-A	Renew Vertical Spindle Bushing (John Deere-B)
Job	17-A	Repair Roll-O-Matic (John Deere-B)
Job	18-D	Renew Front Wheel Felt Washers (Allis-Chalmer, W.C.)
R.S.A.	14	Steering Gears and Adjustment
Job	19-A	Adjust Steering Gear (John Deere-B)

PACKAGE #16

Job	19-B	Adjust Steering Gear (Ford, 8N)
Job	19-D	Adjust Steering Gear (Allis-Chalmers, W.C.)
Job	19-E	Adjust Steering Gear (Case, LA)
R.S.A.	15	Tie Rod Ends and Universal Joints
Job	20-B	Overhaul Steering Gear (Ford, 8N)
Job	20-C	Overhaul Steering Gear (Farmall, Super-A)
Job	20-E	Overhaul Steering Gear (Case, LA)

Unit III: Cooling System

PACKAGE #17

R.S.A.	16	Radiators and Radiator Service
Math	7	Addition and Subtraction of Fractions
Job	21	Remove and Repair Radiator

PACKAGE #18

R.S.A.	17	Fans and Fan Drives
Math	8	Multiplication of Fractions
Job	22-A	Repair Fan Assembly (John Deere-B) (Hood and Radiator Removed)

Course Outline (Continued)

UNIT III (Continued)

PACKAGE #18 (Continued)

Job	22-C	Repair Fan Assembly (Farmall Super-A)
Job	23-A	Check and Repair Ventilator Pump (John Deere-B) (Fan Assembly Removed)

PACKAGE #19

Math	9	Division of Fractions
R.S.A.	18	Water Pumps
Job	24-B	Remove, Repair, and Replace Water Pump(Ford 8N)
Job	24-D	Remove, Repair, and Replace Water Pump (Allis-Chalmer WC)
Job	24-E	Remove, Repair, and Replace Water Pump (Case LA)

PACKAGE #20

R.S.A.	19	Thermostats, Shutters, and Temperature Gages
Job	25	Remove, Check, and Replace Thermostat (Radiator Drained)

UNIT IV: ATTACHMENTS

PACKAGE #21

R.S.A.	20	Power Take-offs and Drawbars
Job	26-C	Remove, Repair, and Replace Power Take-Off (Farmall, Super-A) (To be performed with Job No. 27-C)
Job	26-D	Remove, Repair, and Replace Power Take-Off (Allis-Chalmers W.C.)
Job	26-E	Remove, Repair, and Replace Power Take-Off (Case LA)

PACKAGE #22

Math	10	Pulley Speeds and Sizes
R.S.A.	21	Belt Pulleys and Pulley Speeds
Job	27-B	Remove, Repair, and Replace Belt Pulley (Ford 8N)
Job	27-C	Remove, Repair, and Replace Belt Pulley (Farmall, Super-A) (To be performed with Job No. 26-C)
Job	27-D	Remove, Repair, and Replace Belt Pulley (Allis-Chalmers W.C.)

Course Outline (Continued)

UNIT IV: (Continued)

PACKAGE #23

Math	11	The Decimal System
R.S.A.	22	Lighting Systems, Lights and Light Switches
Job	28-A	Install Lighting Attachment (John Deere-B)
Job	28-B	Install Lighting System (Ford 8N)
Job	28-C	Install Lighting System (Farmall, Super-A)
Job	28-D	Install Lighting System (Allis-Chalmers, W.C.)
Job	28-E	Install Lighting System (Case, LA)

PACKAGE #24

Math	12	Addition and Subtraction of Decimal Fractions
R.S.A.	23	Basic Hydraulic Principles and General Power Lift Operation
R.S.A.	23-A	Powr-Trol and Power Lift (John Deere, B)*
R.S.A.	23-B	Hydraulic Control (Ford 8N)
R.S.A.	23-C	Touch-Control (Ford 8N)
R.S.A.	23-E	Hydraulic Control Unit (Case L.A.)
Job	26-B	Remove and Repair Power Take-Off Shaft (Ford 8N)
Job	29-A	Repair Powr-Trol (John Deere-B)
Job	29-B	Remove, Repair, and Replace Hydraulic Control (Ford, 8N)
Job	29-C	Remove, Repair, and Replace Touch Control (Farmall, Super-A)
Job	29-D	Remove, Repair, and Replace Mechanical Lift (Allis-Chalmers, W.C.)
Job	29-E	Remove, Repair, and Replace Hydraulic Control Unit (Case, LA)

UNIT V: REAR AXLE, FINAL DRIVE, AND BRAKES

PACKAGE #25

Math	13	Multiplication of Decimal Fractions
R.S.A.	24	Bearings, Seals and Closures
Job	30-C	Remove, Repair and Reassemble Final Drive (Farmall, Super-A)
Job	30-D	Disassemble, Repair, and Reassemble Final Drive (Allis-Chalmers, WC)
R.S.A.	25	Tractor Final Drives
Job	33-D	Remove, Repair, and Replace Brakes (Allis Chalmers W.C.) (Final Drive Disassembled)

PACKAGE #26

R.S.A.	26	Types of Rear Axles and Their Adjustments
Job	31-A	Remove and Renew Rear Axle Bearings or Seals (John Deere-B)

Course Outline (Continued)

UNIT V (Continued)

PACKAGE #26 (Continued)

Job	31-B	Remove and Renew Rear Axle Bearings or Seals (Ford 8N)
Job	31-E	Remove and Renew Rear Axle Bearings or Seals (Case, LA)

PACKAGE #27

Math	14	Division of Decimals
R.S.A.	27	Brakes
Job	32-A	Adjust Brakes (John Deere-B)
Job	32-B	Adjust Brakes (Ford 8N)
Job	32-C	Adjust Brakes (Farmall, Super-A)
Job	32-D	Adjust Brakes (Allis Chalmers, WC)
Job	32-E	Adjust Brakes (Case, LA) (Mechanical-Internal Expanding)
Job	32-E	Adjust Hydraulic Brakes (Case, LA) (Minor Adjustment)
Job	32-E	Adjust Hydraulic Brakes (Case, LA) (Major Adjustment)
Job	32-X	Adjust Disc Type Brakes (All Models)
Job	33-A	Remove, Repair, and Replace Brakes (John Deere-B)
Job	33-B	Disassemble, Repair and Reassemble Brakes (Ford 8N) (Wheel and Brake Drum Removed)
Job	33-E	Remove, Repair, and Replace Brakes (Case, LA)
Job	33-E	Disassemble, Repair, and Reassemble Brakes (Case,LA) (Hydraulic Brakes)
Job	33-X	Remove, Repair, and Replace Disc Brakes (All Models)

UNIT VI: DIFFERENTIAL

PACKAGE #28

Math	15	Changing Common Fractions to Decimals
Math	16	The Micrometer
R.S.A.	28	Ring Gear and Pinion Adjustments
Job	34-C	Adjust Ring Gear and Pinion (Farmall, Super-A) (Final Drive Removed)
Job	34-D	Adjust Ring Gear Backlash (Allis-Chalmers, WC)
R.S.A.	29	Differential Construction and Operation
Job	35-A	Remove, Repair, and Reassemble Differential (John Deere-B)
Job	35-B	Remove, Repair, and Reassemble Differential (Ford, 8-N)
Job	35-C	Remove, Repair, and Reassemble Differential (Farmall, Super-A)
Job	35-D	Remove, Repair and Reassemble Differential (Allis Chalmers, WC.)
Job	35-E	Remove, Repair, and Reassemble Differential (Case, LA.) (To be performed with Jobs 37-E and 38-E)

Course Outline (Continued)

UNIT VI (Continued)

PACKAGE #28 (Continued)

Job 36-D	Disassemble, Repair, and Reassemble Torque Tube (Allis-Chalmers, WC.)
R.S.A. 30	Getting and Holding a Job

UNIT VII: TRANSMISSIONS

PACKAGE #29

R.S.A. 31	Transmission Shifter Mechanism
Job 37-A1	Disassemble, Repair, and Reassemble Shifter Mechanism (John Deere-B) (Differential Removed) (Serial No. B-9600 to B-201000)
Job 37-A2	Disassemble, Repair, and Reassemble Shifter Mechanism (John Deere-B) (Differential Removed) (Serial No. B-201000 and Up)
Job 37-B	Disassemble, Repair, and Reassemble Shifter Mechanism (Ford, 8-N) (Differential Removed)
Job 37-C	Remove, Repair, and Replace Shifter Mechanism (Farmall, Super-A)
Job 37-D	Remove, Repair, and Replace Shifter Mechanism (Allis-Chalmers, WC.)
Job 37-E	Repair and Replace Shifter Mechanism (Case, LA.) (Differential Removed)

PACKAGE #30

Math 17	Gear Ratios
R.S.A. 32	Transmissions
R.S.A. 32-A1	Transmission Construction and Operation (John Deere-B, Serial No. B-96000 to B-201000)
Job 38-A1	Disassemble, Repair, and Reassemble Transmission (John Deere-B) (Differential and Shifter Mechanism Removed) (Serial No. B-96000 to B-201000)
R.S.A. 32-A2	Transmission Construction and Operation (John Deere-B, Serial No. B-201000 and up)
Job 38-A2	Disassemble, Repair, and Reassemble Transmission (John Deere-B Serial No. B-201000 and up) (Differential and Shifter Mechanism)
R.S.A. 32-B	Transmission Construction and Operation (Ford, 8-N)
Job 38-B	Disassemble, Repair, and Reassemble Transmission (Ford, 8-N) (To be Performed with Job No. 37-B)
Job 38-C	Disassemble, Repair, and Reassemble Transmission (Farmall, Super A.) (Differential Removed)
Job 38-D	Remove, Repair, and Replace Transmission (Allis-Chalmers, W.C.) (Differential and Torque Tube Removed)
Job 38-E	Disassemble, Repair, and Reassemble Transmission (Case, LA) (Differential and Shifter Mechanism Removed)

Course Outline (Continued)

UNIT VIII: CLUTCHES

PACKAGE #31

R.S.A. 33	Types of Clutches; Care and Operation
Math 18	Simple Percentage
Job 39-A	Repair and Adjust Clutch, Farmall A, B, or C
Job 39-B	Repair and Adjust Clutch, Allis-Chalmers WD
Job 39-C	Repair and Adjust Clutch, Ford 8N
Job 39-D	Repair and Adjust Clutch, John Deere B

UNIT IX: FUEL SYSTEMS

PACKAGE #32

R.S.A. 34	Fuel Supply and Carburetion Systems
Job 40-A	Remove, Repair, and Replace Carburetor, Farmall A, B, or C
Job 40-B	Remove, Repair, and Replace Carburetor, Allis-Chalmers WD.
Job 40-C	Remove, Repair, and Replace Carburetor, Ford 8N
Job 40-D	Remove, Repair, and Replace Carburetor, John Deere B

PACKAGE #33

R.S.A. 35	Governors, Types and Operation
Math 19	Discount
Job 41-A	Remove, Repair, and Replace Governor, Farmall A, B, or C
Job 41-B	Remove, Repair, and Replace Governor, Allis-Chalmers WD
Job 41-C	Remove, Repair, and Replace Governor, Ford 8N
Job 41-D	Remove, Repair, and Replace Governor, John Deere B

UNIT X: MAGNETO IGNITION

PACKAGE #34

R.S.A. 36	Magnetism and Electricity
R.S.A. 37	Magneto Construction and Operation
Job 42-A	Disassemble, Repair and Reassemble Magneto, Farmall A, B, or C

PACKAGE #35

R.S.A. 38	Impulse-Starter Couplings; Timing and Care of the High-Tension Magneto
Math 20	Personal Checks and Drafts
Job 42-B	Disassemble, Repair and Reassemble Magneto, Allis-Chalmers WD
Job 42-C	Disassemble, Repair and Reassemble Magneto, (John Deere B)

Course Outline (Continued)

UNIT XI: BATTERY IGNITION

PACKAGE #36

R.S.A.	39	Types and Requirements of Battery Ignition Systems
Job	43-A	Disassemble, Repair, and Reassemble Distributor, Farmall A, B, or C.
Job	43-B	Disassemble, Repair, and Reassemble Distributor, Allis-Chalmers WD

PACKAGE #37

R.S.A.	40	Coils, Condensers, Contact Points, Distributor, and Spark Plugs
Job	43-C	Disassemble, Repair and Reassemble Face Mounted Distributor, Ford 8N
Job	43-D	Disassemble, Repair, and Reassemble Angle Mounted Distributor, Ford 8N
Job	43-E	Remove, Clean, Adjust and Replace Spark Plugs

UNIT XII: CRANKING MOTORS

PACKAGE #38

R.S.A.	41	Operating Principles of Cranking Motors and Drivers
Math	21	Work Orders and Bills
Job	44	Remove, Overhaul, and Replace Cranking Motor

UNIT XIII:

PACKAGE #39

R.S.A.	42	Generator Construction and Operation
Job	45	Remove, Disassemble, Repair and Replace a Generator

PACKAGE #40

R.S.A.	43	Cutout Relays and Step-voltage Controls
Math	22	Keeping Accounts
Job	46	Remove, Check, and Adjust Step-voltage Control

UNIT XIV: ENGINES

PACKAGE #41

R.S A.	44	Engine Fundamentals
Job	47	Clean Engine With Cold or Hot Degreasing Solution
Job	48	Remove and Replace Expansion Plug

Course Outline (Continued)

PACKAGE #42

R.S.A.	45	Valve Types and Construction
R.S.A.	46	Valve Mechanisms
Job	49	Reface Rocker Arms

PACKAGE #43

R.S.A.	47	Valve Service
Job	50	Remove, Clean, and Replace Rocker Arms
Job	51	Grind Valves on I-Head Engine
Job	52	Grind Valves on L-Head Engine

PACKAGE #44

R.S.A.	48	Pistons, Piston Rings, Cylinders and Sleeves
Job	58	Remove Old and Install New Piston Rings
Job	59	Remove Old and Install New Cylinder Sleeves, Dry Type
Job	60	Remove and Install Cylinder Sleeve, Wet Type
Job	61	Rebore Cylinder
Job	62	Hone Cylinder and Fit Piston

PACKAGE #45

R.S.A.	49	Piston Pins and Bushings, Connecting Rods, Crankshaft and Main Bearings
Job	53	Remove Old and Fit New Piston Pins and Bushings
Job	54	Install New Ring Gear on Flywheel
Job	55	Adjust Connecting Rod Bearings with Engine in Tractor, John Deere (Shim Type)
Job	56	Install New Connecting Rod Bearings With Engine in Tractor (Insert Type)
Job	57	Adjust Main Bearings, John Deere B

PACKAGE #46

R.S.A.	50	Engine Lubrication Systems
Job	63	Remove, Inspect, and Replace Oil Pump

PACKAGE #47

Job	64	Overhaul Engine Completely (Except John Deere)

PACKAGE #48

Job	65	Overhaul Engine Completely, John Deere B

The Vocational-Technical Drawing Course was written in 1964-65. It is available in book form for the instructors and in loose form for distribution to students. There are twenty-two units of Related Study Assignments and Jobs with accompanying tests and answers.

Unit I Introduction and Orientation
- RSA 1 History of the Occupation
- RSA 2 The Draftsman and Specialization
- RSA 3 Drafting Instruments and Materials
- RSA 4 Nature of the Work and Employment Outlook
- RSA 5 How to Use Instructional Material

Unit II Lettering
- RSA 1 Sheet Layout
- Math 1 Common Fractions
- Job 1 Draw Horizontal and Vertical Lines
- RSA 2 Lettering - Vertical Caps - The Straight Line Group
- Math 2 Partitive Fractions
- Job 2 Practice Free-Hand Lettering - The Straight Line Group
- RSA 3 The Circle Group
- Math 3 Equivalent Fractions and the Golden Rule
- Job 3 Practice Free-Hand Lettering, The Circle Group
- RSA 4 Lettering - Numerals and Fractions
- Math 4 Reduction of Common Fractions
- Job 4 Practice Lettering Numerals and Fractions
- RSA 5 Lower Case Letters
- Math 5 Reduction of Improper Fractions
- Job 5 Practice Lower Case Letters
- RSA 6 Inclined Lettering
- Math 6 Writing a Mixed Number as a Fraction
- Job 6 Practice Inclined Lettering
- RSA 7 Lettering - Proportion, Stability, Size and Spacing
- Math 7 Like and Unlike Fractions
- Job 7 Lettering - Practice Proportion, Size and Spacing
- RSA 8 Compression and Extension
- Math 8 Addition of Fractions
- Job 8 Practice Compression and Extension
- RSA 9 Lettering - Notes and Titles
- Math 9 Substraction of Fractions
- Job 9 Letter Notes and Titles
- RSA 10 Lettering Styles for Architectural Draftsmen
- Math 10 Multiplication of Fractions
- Job 10 Practice Letter Styles
- RSA 11 Review of Unit II
- Math 11 Division of Fractions
- Job 11 Review Lettering

Course Outline (Continued)

Unit III Geometric Construction

RSA	1	Geometric Construction - Straight Lines
Math	1	Circle Circumference
Job	1	Geometric Construction
RSA	2	The Circle
Math	2	Circle Diameters and Radii
Job	2	Construct Circles and Center Lines
RSA	3	Geometric Construction - Circles
Math	3	Area of Circles, Sectors and Segments
Job	3	Geometric Construction - Circles
RSA	4	Geometric Construction - Arcs
Math	4	Square Areas
Job	4	Geometric Construction - Fillets and Rounds
RSA	5	Geometric Construction - Arcs Tangent to Arcs and Circles
Math	5	Areas
Job	5	Geometric Construction - An exterior Arc Tangent to a Circle and a Straight Line
RSA	6	Geometric Construction - The Reverse or Ogee Curve
Math	6	Areas - Area of Transportation
Job	6	Geometric Construction - Construct a Reverse or Ogee Curve
RSA	7	Geometric Construction - Plane Figures
Math	7	Area of Triangles
Job	7	Geometric Construction - Plane Figures
RSA	8	Geometric Construction - Plane Figures, the Hexagon and Octagon
Math	8	Area of Polygons
Job	8	Geometric Construction - Hexagons
RSA	9	Geometric Construction - The Ellipse and its Straight Line Tangents
Math	9	Areas - Area of Ellipses
Job	9	Geometric Construction - Construct a Parabola
RSA	10	Geometric Construction - Parabolas
Math	10	Areas - Area of a Parabola
Job	10	Geometric Construction - Construct a Parabola

Unit IV Dimensioning

RSA	1	Dimensioning - Line Conventions
Math	1	Decimal Fractions - Using Conversion Table
Job	1	Dimensioning - Line Conventions
RSA	2	Dimensioning - Rectangles
Math	2	Decimal Fractions - Meaning of Decimal Fractions
Job	2	Dimensioning - Rectangles
RSA	3	Dimensioning - Size and Location
Math	3	Decimals - Reduction to Lower Terms
RSA	4	Dimensioning - Circles, Arcs and Curves - Size and Location Dimensions

Unit IV Dimensioning
(Continued)

Math	4	Decimal Fractions - Addition
Job	4	Dimensioning - Circles, Arcs and Curves
RSA	5	Dimensioning - Angles
Math	5	Decimal Fractions - Subtraction
Job	5	Dimensioning - Angles
RSA	6	Dimensioning - Counterbored and Countersunk Holes, Chamfers and Keyways
Math	6	Decimal Fractions - Multiplication
Job	6	Dimensioning - Holes, Chamfers and Keyways
RSA	7	Dimensioning - Conical Tapers, Flat Tapers and Machine Tapers
Math	7	Decimal Fractions - Division of Decimals by Whole Numbers
Job	7	Dimensioning Tapers
RSA	8	Dimensioning - Tolerances
Math	8	Decimal Fractions - Division by a Decimal
Job	8	Dimensioning - Tolerances

Unit V Single View Drawings

RSA	1	Single View Drawings
Job	1	Single View Drawing - Rectangular Combinations
RSA	2	Single View Drawings - Laying out the Drawing
Job	2	Single View Drawings - Angular Surfaces
RSA	3	Single View Drawings - Order of Pencilling
Job	3	Single View Drawings - Circles and Arcs
RSA	4	Single View Drawings - Finished Drawings
Job	4	Single View Drawings - Construct a Finished Drawing
Job	5	Single View Drawings - Reverse Curves and Circles Tangent
Job	6	Single View Drawings - Elliptical Shapes
Job	7	Single View Drawings - Parabolic Curves

Unit VI Multi-View Drawings

RSA	1	Theory of Visualization of the Three Principal Views
Job	1-15	Multi-View Drawings - Surface Identification
RSA	2	Multi-View Drawings - Laying Out the Front and Top Views
Job	16	Multi-View Drawings - Lay Out and Draw Front and Top Views
RSA	3	Multi-View Drawings - Laying Out The Right-Side View
Job	17	Multi-View Drawings - Laying Out the Right-Side View Using 45° Miter Method
Job	18	Multi-View Drawings - Laying Out the Right-Side View, Using Radial Point Method
RSA	4	Multi-View Drawings - Invisible Surfaces - Technique of Hidden Lines

Unit VI Multi-View Drawings
(Continued)

Job	19	Multi-View Drawings - Hidden-Line Technique
RSA	5	Multi-View Drawings - Tangent Surfaces
Job	20	Multi-View Drawings - Tangent Surfaces
RSA	6	Multi-View Drawings - Fillets, Rounds and Runouts
Job	21	Multi-View Drawings - Fillets, Rounds and Runouts
RSA	7	Multi-View Drawings - Projection of Inclined Surfaces and Oblique Surfaces
Job	22-30	Multi-View Drawing - Projection of Inclined Surfaces and Oblique Surfaces
RSA	8	Multi-View Drawing - Left Side, Back and Bottom Views
Job	31	Multi-View Drawings - Projecting the Left-Side View
Job	32-35	Orthographic Views From Pictorials

Unit VII Auxiliary Views

RSA	1	Auxiliary Views - Use of Arcs for Projecting Auxiliaries
Job	1	Construct Auxiliary by Using Arcs
RSA	2	Auxiliary Views - The Reference Plane Against the Front Surface
Job	2	Construct an Auxiliary by Use of a Reference Line
RSA	3	Auxiliary Views - The Reference Plane Against an Inner Surface
Job	3	Reference Line on Inner Surface
RSA	4	Auxiliary Views - The Reference Plane as a Center Line
Job	4	The Reference Plane and the Center Line
RSA	5	Auxiliary Views - Circular and Curved Inclined Surfaces
Job	5	Auxiliary Views - Completion of Principal Views by Auxiliary--Circles and Curves
RSA	6	Auxiliary Views - Oblique Surfaces
Job	6	Auxiliary Views - Completion of Principal Views by Auxiliary--Circles and Curves
Job	7-8	Auxiliary Views - Oblique Surfaces
Job	9-12	Auxiliary Views - Additional Problems

Unit VIII Sectional Views

RSA	1	Sectional Views - Usage and Symbols
Job	1	Sectional Views - Usage and Symbols
RSA	2	The Cutting Plane and Full Sections
Job	2	Sectional Views - The Cutting Plane
RSA	3	Sectional Views - Half Sections
Job	3	Sectional Views - Half Sections

Unit VIII Sectional Views
(Continued)

RSA	4	Sectional Views - Offset Sections, Location and Lines Behind the Cutting Plane
Job	4	Sectional Views - Offset
RSA	5	Sectional Views - Broken-Out and Revolved Sections
Job	5	Sectional Views - Broken-Out Sections
Job	6	Sectional Views - Revolved Sections
RSA	6	Removed, Auxiliary and Thin Sections
Job	7	Sectional Views - Removed Sections
Job	8	Sectional Views - Auxiliary Sections
Job	9	Sectional Drawings - Thin Sections
RSA	7	Miscellaneous Section Rules
Job	10	Sectional Views - Web or Rib Sections
Job	11	Sectional Views - Sections Through Shafts, Bolts, Bearings, etc.
Job	12-14	Sectional Views - Additional Jobs

Unit IX Precision Dimensioning and Tolerancing

RSA	1	Precision Dimensioning and Tolerancing - Decimal Dimensioning System
Job	1	Precision Dimensioning and Tolerancing - Decimal Dimensioning
Job	2	Precision Dimensioning and Tolerancing - Conversion Tables
RSA	2	Precision Dimensioning and Tolerancing - Basic Rules Governing Decimal Dimensioning
Job	3	Precision Dimensioning and Tolerancing - Basic Rules Governing Decimal Dimensioning
RSA	3	Precision Dimensioning and Tolerancing - Limits
Job	4	Precision Dimensioning and Tolerances
RSA	4	Precision Dimensioning and Tolerancing - Form Tolerances
Job	5	Precision Dimensioning and Tolerancing - Form Tolerances
RSA	5	Precision Dimensioning and Tolerancing - Position Tolerancing
Job	6	Precision and Limit Dimensioning - Position Tolerancing
RSA	6	Precision Dimensioning and Tolerancing - Surface Finishes

Unit X Screw Threads and Fasteners

RSA	1	Terminology
Job	1	Screw Threads and Fasteners - Terminology
RSA	2	Detailed Representation of American Standard V-Thread
Job	2	Screw Threads and Fasteners - Detailed Representation, American Standard V-Thread

Unit X Screw Threads and Fasteners
(Continued)

RSA	3	Detailed Representation of Miscellaneous Threads Square and Acme Threads
Job	3	Screw Threads and Fasteners - Square Threads
Job	4	Screw Threads and Fasteners - The Acme Thread
RSA	4	Thread Symbols - Schematic and Simplified
Job	5	Screw Threads and Fasteners - Schematic and Simplified Representation
RSA	5	Thread Series and Classes
Job	6	Screw Threads and Fasteners - Use Screw Thread Tables
RSA	6	Specifying and Dimensioning
Job	7-8	Screw Threads and Fasteners - Specifying and Dimensioning
RSA	7	Bolts, Screws, Rivets and Miscellaneous

Unit XI Gears and Cams

RSA	1	Gears and Cams - Machines Force and Motion
Math	1	Ratio
RSA	2	Gears and Cams - Gear Terminology
Math	2	Proportion
Job	1	Gears and Cams - Gear Terminology
Job	2	Gears and Cams - Construct a Spur Gear by Circular Arc Methods
RSA	3	Gears and Cams - Spur Gears
Math	3	Calculating Gear Dimensions
Job	3	Gears and Cams - Construct a Spur Gear by Circular Arc Methods
RSA	4	Gears and Cams - Rack Gear
Math	4	Calculating Gear Dimensions
Job	4	Gears and Cams - Construct a Rack Gear
RSA	5	Gears and Cams - Internal, Bevel, Worm and Helical Gears
RSA	6	Gears and Cams - Cam Layout
Job	5	Gears and Cams - Lay Out A Cam

Unit XII Pictorial Drawings

RSA	1	Pictorial Drawings - Types and Usage
RSA	2	Pictorial Drawings - Isometric Projection
Job	1-10	Pictorial Drawing - Construct an Isometric Drawing
RSA	3	Pictorial Drawing - Dimetric Drawing
Job	11-15	Pictorial Drawing - Construct A Dimetric Drawing
RSA	4	Pictorial Drawing - Cavalier Drawings
Job	16	Pictorial Drawings - Construct a Cavalier Drawing
RSA	5	Pictorial Drawings - Cabinet Drawings

Unit XII Pictorial Drawings
(Continued)

Job	17	Pictorial Drawing - Construct a Cabinet Drawing
Job	18	Pictorial Drawings - Construct a General Oblique Drawing
RSA	6	Pictorial Drawings - General Oblique
RSA	7	Pictorial Drawing - Perspective Drawing
Job	19	Pictorial Drawing - Construct a One-Point Perspective
Job	20	Pictorial Drawing - Construct a Two-Point Perspective

Unit XIII Technical Sketching

RSA	1	Technical Sketching - Application and Technique
Job	1-4	Technical Sketching - Sketch Straight Lines
RSA	2	Technical Sketching - Circles and Arcs
Job	5-6	Technical Sketching - Sketching Circles and Arcs
Job	7	Technical Sketching - Sketch Elliptical Shapes
Job	8	Technical Sketching - Sketch an Irregular Curve
RSA	3	Technical Sketching - Pictorial Sketching
Job	9-11	Technical Sketching - Isometric Sketching
Job	12	Technical Sketching - Oblique Sketching
Job	13	Technical Sketching - Cabinet Sketching
Job	14	Technical Sketching - Sketch a One-Point Perspective
Job	15	Technical Sketching - Sketch a Two Point Perspective

Unit XIV Welding Drawings

RSA	1	Welding Drawings - Welding Processes - Arc Welding
Job	1	Welding Drawings
RSA	2	Welding Drawings - Resistance Welding
Job	2	Welding Drawings - Resistance Projection Weld Symbols
Job	3-4	Welding Drawings - Resistance Projection Weld Symbols
Job	5	Welding Drawings - Resistance - Seam Welding Symbols
Job	6	Welding Drawings - Flash and Upset Welding Symbols
RSA	3	Welding Drawings - Welding Applications
Job	7	Welding Drawings - Symbols for Built up Surfaces
Job	8	Welding Drawings - Fillet Welding Symbols
Job	9	Welding Drawings - Intermittent Welding Symbols
Job	10	Welding Drawings - Location and Extent of Fillet Welds
Job	11	Welding Drawings - Groove Welds
Job	12	Welding Drawings - Size and Root Penetration of Welds

Unit XV Architectural Drawings

RSA	1	Architectural Drawings - Reading Architectural Drawings
RSA	2	Architectural Drawings - Elements of Construction Drawings - Preliminary Planning
Job	1	Architectural Drawing - Preliminary Planning
RSA	3	Architectural Drawing - Wood Frame Floor Plans and Symbols
Job	2	Architectural Drawing - Wood Frame Floor Plans and Symbols
RSA	4	Architectural Drawing - Foundation Plans
Job	3	Architectural Drawing - Foundation Plans
RSA	5	Architectural Drawing - Brick Veneer Floor Plans and Architectural Symbols
Job	4	Architectural Drawing - Brick Veneer Floor Plans
RSA	6	Architectural Drawing - Wall and Roof Sections
Job	5	Architectural Drawing - Wall and Roof Sections
RSA	7	Architectural Drawing - Window and Door Details and Schedules
Job	6	Architectural Drawing - Detail a Double Hung Window in Wood Frame
Job	7	Architectural Drawing - Detail a D. H. Window in Brick Veneer
Job	8	Architectural Drawing - Detail a Door in a Wood Frame
Job	9	Architectural Drawing - Detail a Door in Brick Veneer
RSA	8	Architectural Drawing - Elevations
Job	10	Architectural Drawing - Elevations
RSA	9	Architectural Drawing - Roof and Cornice Details
Job	11	Architectural Drawing - Gable Roof
Job	12	Architectural Drawing - Cornice Details
Job	13	Architectural Drawing - Hip Roof
Job	14	Architectural Drawing - Cornice Details
RSA	10	Architectural Drawing - Stair Details
Job	15	Architectural Drawing - Stair Section
Job	16	Architectural Drawing - Plan View of Stairs

Unit XVI Plumbing and Piping Drawings

RSA	1	Plumbing and Piping Drawings - Drainage and Waste Systems and Pipe Symbols
Job	1	Plumbing and Piping Drawings - Use Piping Symbols
RSA	2	Plumbing and Piping Drawings - Preparing the Drawings
Job	2	Plumbing and Piping Drawings - Construct an Isometric Piping Diagram

Unit XVII Heating, Ventilating and Air Conditioning

RSA	1	Heating, Ventilating and Air Conditioning - Heating Systems

Unit XVII Heating, Ventilating and Air Conditioning (Continued)

Job	1	Heating, Ventilating and Air Conditioning - Prepare a Ductwork Layout
RSA	2	Heating, Ventilating and Air Conditioning - Ventilating and Air Conditioning Systems
Job	2	Heating, Ventilating and Air Conditioning

Unit XVIII Topographical Drawing

RSA	1	Topographical Drawing - Maps
RSA	2	Topographical Drawing - Surveying
Job	1	Topographical Drawing
RSA	3	Topographical Drawing - Use and Interpretation of Title Certificates
Job	2	Topographical Drawing - Plotting from Title Certificate
RSA	4	Topographical Drawing - Interpretation of Field Notes
Job	3-8	Topographical Drawing - Plotting from Field Notes
RSA	5	Topographical Drawing - Profiles and Cross Sections
Job	9	Topographical Drawing - Plotting a Profile from Field Notes
RSA	6	Topographical Drawing - Contour Lines
Math	1	Using Decimal Equivalents of One Foot
Job	10	Topographical Drawing - Prepare a Contour Map from Field Notes
RSA	7	Topographical Drawing - Interpretation of Aerial Photographs
RSA	8	Topographical Drawing - Property Plats, Coordinates and Acreage Calculations
RSA	9	Topographical Drawing - Permit Drawings
Math	2A	Trigonometry - Right-Angled Triangles
Math	2B	Trigonometry
Math	2C	Trigonometry
Math	2D	Trigonometry
Math	2E	Trigonometry
Math	2F	Trigonometry - Oblique Triangles
Math	2G	Trigonometry - Oblique Triangles
Math	2H	Trigonometry - Oblique Triangles
Math	2I	Trigonometry - Oblique Triangles
Math	2J	Trigonometry - Oblique Triangles
RSA	10	Topographical Drawing - Land Survey Drawings

Unit XIX Structural Steel (Tentative)

RSA	1	The Structural Steel Frame - Present and illustrate the steel framing system, structural steel shapes, and the relationship between design drawings and shop fabrication details
Math	1	Calculate weights of steel shapes given

Unit XIX Structural Steel (Tentative)
(Continued)

Job	1	Indicate all dimensions of sectional structural steel shapes presented; given - pictorial sections with size and detailed dimensions in table form
RSA	2	Erection and Shipping Marks - Present and illustrate
Math	2	Calculate weights of steel shapes given
Job	2	Provide shipping and erection marks for the steel members shown; given - plan and elevation of design and drawings for a multi-story building
RSA	3	Dimensioning Structural Steel Details - Present and illustrate how these dimensions vary from architectural practice
Math	3	Practice common scales used; calculate dimensions; calculate total tonnage
Job	3	Provide the missing dimensions on the shop details provided; given - shop details; structural steel tables
RSA	4	Beam Connections - Present and illustrate the types of connections and the standardization into six series
Math	4	Prepare an itemized bill of material for Job 3 this unit
Job	4	Detail 18 beams for the second floor; given - set of design drawings; structural steel tables
RSA	5	Column Detailing - Present and illustrate the components necessary for complete column detailing
Math	5	Calculate the individual weights of the beams detailed in Job 5
Job	5	Detail 36 columns for two tiers given - set of design drawings used for previous jobs; structural steel tables
RSA	6	Detailing Members of the Bracing Unit - Present and illustrate
Math	6	Calculate angles and legs of triangles; review of basic trigonometry; use of tables; calculate weights of columns in Job 5
Job	6	Detail all bracing; given - set of design drawings used in previous jobs; structural steel tables
RSA	7	Detailing Trusses - Present and illustrate the various types of trusses and relationship between design and shop details
Math	7	Calculate weights of the structural steel used in Job 6; review trigonometry
Job	7	Detail all trusses; given - set of design drawings used in previous jobs; structural steel tables
RSA	8	Miscellaneous Iron Details - Present and illustrate the difference between structural steel frames and miscellaneous iron

Unit XIX Structural Steel (Tentative)
(Continued)

Math	8	Calculate weights of trusses in Job 7
Job	8	Detail all miscellaneous iron indicated given - design drawings used in previous jobs; structural steel tables; architectural details required

Unit XX Intersections and Developments

RSA	1	Intersections and Developments - Truncated Prisms
Job	1	Intersections and Developments - Develop a Truncated Prism
RSA	2	Intersections and Developments - Right Cylinders
Job	2	Intersections and Developments - Develop a Right Cylinder
RSA	3	Intersections and Developments - Right Pyramids
Job	3	Intersections and Developments - Develop a Right Pyramid
RSA	4	Intersections and Developments - True-Length Diagrams
Job	4	Intersections and Developments - Develop an Oblique Cone
RSA	5	Intersections and Developments - Truncated Cones
Job	5	Intersections and Developments - Truncated Cone
RSA	6	Intersections and Developments - Transition Pieces
Job	6	Intersections and Developments - Develop a Transition Piece
RSA	7	Intersections and Developments - Surfaces of Spheres
Job	7	Intersections and Developments - Develop the Surface of a Sphere
RSA	8	Intersections and Developments - Elbow on Development
Job	8	Intersections and Development - Develop a Three-Piece Elbow
RSA	9	Intersections and Developments - Intersection of Prisms
Job	9	Intersections and Developments - Develop Intersecting Prisms
RSA	10	Intersections and Developments - Cylindrical Intersection
Job	10	Intersections and Developments - Develop Intersecting Cylinders
RSA	11	Intersections and Developments
Job	11	Intersections and Developments - Develop an Intersecting Prism and Cylinder
RSA	12	Intersections and Developments - Intersection of a Cylinder and a Cone

Unit XX Structural Steel (Tentative)
(Continued)

Job 12 Intersections and Developments - Develop an Intersecting Cylinder and Cone

Unit XXI Engineering Charts and Graphs

RSA 1 Engineering Charts and Graphs - Rectangular Grid Systems
Job 1 Engineering Charts and Graphs
Job 2 Engineering Charts and Graphs - Construct a Profile Graph
Job 3 Engineering Charts and Graphs - Construct a Multiple-Curve Graph
RSA 2 Engineering Charts and Graphs - Rectilinear and Logarithmic Charts
Job 4 Engineering Charts and Graphs - Construct a Rectilinear Chart - Time Series
RSA 3 Engineering Charts and Graphs - Display Charts - Bar Charts
Job 5 Engineering Charts and Graphs - Construct a Bar Chart
Job 6 Engineering Charts and Graphs - Construct a Bar Chart
Job 7 Engineering Charts and Graphs - Construct a Bar Chart
RSA 4 Engineering Charts and Graphs - Circle Graphs
Job 8 Engineering Charts and Graphs - Construct a Pie Chart
Job 9 Engineering Charts and Graphs - Construct a Pie Chart
RSA 5 Engineering Charts and Graphs - Pictorial Charts
Job 10 Engineering Charts and Graphs - Construct a Pictorial Chart
RSA 6 Engineering Charts and Graphs - Organization and Flow Charts
Job 11 Engineering Charts and Graphs - Construct an Organization Chart
Job 12 Engineering Charts and Graphs - Construct a Flow Chart
RSA 7 Engineering Charts and Graphs
Job 13 Engineering Charts and Graphs - Use a Graph to Change Feet Per Second To Miles Per Hour
Job 14 Engineering Charts and Graphs - Use Graphs to Determine Horsepower
Job 15 Engineering Charts and Graphs - Use Graphs to Determine Time Elements and Contour Lines

Unit XXII Reproduction Processes

RSA 1 Reproduction Processes

The Watchmaking Technology Course was published in 1964-65 and is available in book form for the instructors and in loose form for students. It is composed of thirty-three units.

The references for the Watchmaking Technology Course are listed below.

Title	Source
Fried, Henry B. THE WATCH REPAIRER'S MANUAL 2nd Edition	D. Van Nostrand Co., Inc. 120 Alexander Street Princeton, New Jersey
ABC'S OF HAND TOOLS	General Motors Corporation Detroit, Michigan
BULOVA WATCH REPAIR MANUAL 3rd Edition	Bulova School of Watchmaking Bulova Park Flushing 70, New York
Olivo, Thomas C. and Payne, Albert V. BASIC BLUEPRINT AND SKETCHING	Delmar Publishers Inc. Mountainview Avenue Albany 5, New York
Hood, Grant MODERN METHODS IN HOROLOGY	Bradley Polytechnic Institute Peoria, Illinois
DeCarle, Donald WITH THE WATCHMAKER AT THE BENCH	Sir Isaac Pitman & Sons, Ltd. London
Goodrich, Ward THE WATCHMAKER'S LATHE	North American Watch Tool and Supply Co. Chicago, Illinois
Levin, Louis, and Levin, Samuel PRACTICAL BENCHWORK FOR HOROLOGISTS 6th Edition	Louis Levin & Son Los Angeles, California
Milham, Willis TIME AND TIMEKEEPERS	The Macmillan Company Sixty Fifth Avenue New York 44, New York

A detailed outline of the Watchmaking Technology Course follows.

Unit I Rules and Regulations (Tentative)

Course Outline (Continued)

Unit II Prepare Hand Tools
- RSA 1
- Job 1 Make a Regular 3/16 Graver
- Job 2 Make a Lorenge 3/16 Graver
- Job 3 Make a Regular 1/8 Graver
- Job 4 Make a Lorenze 1/8 Graver
- Job 5 Make a Round-End Graver (Small rounding)
- Job 6 Make a Squaring Graver
- Job 7 Make a Parting Tool
- Job 8 Make a Round-End Graver (Large rounding)
- Job 9 Make a Pivot Burnisher
- Job 10 Make a General Purpose Burnisher

Unit III Heat Treatment of Steel (Hardening and Tempering)
- RSA 1
- Job 1 Harden Six Pieces of Steel Rod, Different Sizes
- Job 2 Harden Gravers
- Job 3 Harden Burnishers
- RSA 2
- Job 4 Temper the Six Pieces of Drill Rod, Hardened in Job 1
- Job 5 Temper Gravers

Unit IV Finish Hand Tools
- RSA 1
- Job 1 Make Handles for Tools Made in Unit II
- Job 2 Sharpen and Polish Hand Tools Made in Unit II

Unit V Sawing and Filing
- RSA 1
- Job 1 File a Tapered Pin
- Job 2 Make a Spatula
- Job 3 Make a Pallet Warmer
- Job 4 Make Two Beat Tools
- Job 5 Make Two Beat Tools
- Job 6 Make a Polishing Shovel

Unit VI Lathe Turning
- RSA 1
- Job 1 Disassemble, Clean, and Reassemble Lathe
- Job 2 Make a Stepped Section
- Job 3 Make Two Single Tapers
- Job 4 Make Connecting Tapers
- Job 5 Make Divided Sections
- Job 6 Make Three Connected Balls

Unit VII Lathe Turning and Drilling
- RSA 1
- Job 1 Make a Flat-Nose Punch

Unit VII Lathe Turning and Drilling (Continued)

Job	2	Make a Round-Nosed Punch
Job	3	Make a Centering Punch
Job	4	Make a Center Punch
Job	5	Make a Screw Extracting Punch
Job	6	Make a Taper Mouth Punch
Job	7	Cut Eight Perfect Centers
Job	8	Make Two Double-End Jewel Pushers
Job	9	Make a Conical Pivot
Job	10	Make a Large Balance Staff (Brass)
Job	11	Make a Large Balance Staff (Steel)
Job	12	Make a Large Stem
Job	13	Make a Small Stem
Job	14	Make a Bushing
Job	15	Make a Case Screw
Job	16	Make a Balance-Cock Screw
Job	17	Make a Small Plate Screw
Job	18	Make a 16 Size Balance Staff
Job	19	Make a 12 Size Balance Staff
Job	20	Make a Screw Plate
Job	21	Make Four Screws for the Screw Plate
Job	22	Make a Balance Tack

Unit VIII Drills and Taps

RSA	1	
Job	1	Make a Flat Drill 1.80mm
Job	1	Make a Flat Drill 1.60mm
Job	3	Make a Flat Drill 1.50mm
Job	4	Make a Flat Drill 1.30mm
Job	5	Make a Flat Drill 1.10mm
Job	6	Make a Flat Drill 1.00mm
RSA	2	
Job	7	Make a Tap 3.00mm
Job	8	Make a Tap 1.60mm
Job	9	Make a Tap 2.30mm
Job	10	Make a Tap 2.00mm
Job	11	Make a Tap 1.70mm

Unit IX Alarm Clocks (Tentative)

RSA	1	
Job	1	Remove Clock Movements From Cases
Job	2	Remove and Replace Clock Hands
Job	3	Remove and Replace Balance Assembly
Job	4	Center and Level Hairspring
Job	5	Adjust Alarm Mechanism
Job	6	Remove and Replace Main Spring
Job	7	Disassemble and Reassemble Clock
Job	8	Clean a Clock
Job	9	Polish Clock Pivots
Job	10	Make and Replace Balance Bushing

Unit IX Alarm Clocks (Tentative)
(Continued)

Job 11 Make and Replace Balance Staff
Job 12 Close Pivot Holes
Job 13 Rebush Pivot Holes
Job 14 Replace Pallet Pins
Job 15 Replace Cannon Pinion
Job 16 Check Depthing of Wheels
Job 17 Straighten and Level Bent Wheels
Job 18 Adjust and Rate Three Clocks

Unit X Pendulum Clocks
RSA 1
Job 1 Adjust Striking Mechanism
Job 2 Replace Pendulum Spring
Job 3 Adjust Lock and Slide
Job 4 Disassemble and Assemble Pendulum Clock
Job 5 Replace Mainspring
Job 6 Adjust and Rate a Pendulum Clock

Unit XI Preparation for Pivoting
RSA 1
Job 1 Make Ten Pivot Drills
Job 2 Harden and Temper Pivot Drills
Job 3 Sharpen Pivot Drills

Unit XII Pivoting
RSA 1
Job 1 Make a Square-Shouldered Pivot
Job 2 Pivot Steel Stock
Job 3 Repivot Two Clock Wheels
Job 4 Repivot 16 Size Center Wheel
Job 5 Repivot 16 Size Third Wheel
Job 6 Repivot 16 Size Fourth Wheel

Unit XIII Hairsprings
RSA 1
Job 1 Pin Ten Hairsprings into Studs
Job 2 Pin Ten Hairsprings into Collets
Job 3 True Hairsprings in Round
Job 4 True Hairsprings in Flat
Job 5 Vibrate Hairspring to Wheel

Unit XIV Jeweling Tools and Jewel Setting
RSA 1
Job 1 Make a Jewel Graver
Job 2 Make a Jewel Burnisher
Job 3 Make a Jewel Stripper
Job 4 Set Five Burnished in Cap Jewels
Job 5 Set Five Burnished in Balance Hole Jewels
Job 6 Set Six Burnished in Jewels into Brass Plate

Unit XIV Jeweling Tools and Jewel Setting
(Continued)

Job	7	Set Three Friction Cap Jewels into Bushings
Job	8	Set Three Friction Balance Hole Jewels into Bushings
Job	9	Set Six Friction Jewels into Brass Plate
Job	10	Remove and Replace Jewels in Watch Plates

Unit XV Staffing

RSA	1	
Job	1	Staff Six Balance Wheels, With Rivet Type Staff
Job	2	Staff Two Balance Wheels, Friction Type Staff
Job	3	Remove Two Standard Riveted Staffs From Wheels
Job	4	Remove Friction Staffs From Wheels
Job	5	Remove Side and Top Groove Staffs

Unit XVI Truing and Poising

RSA	1	
Job	1	True Six Balance Wheels
Job	2	Poise Six Balance Wheels
Job	3	Make a Staff for 16 Size Balance Wheel, True and Poise

Unit XVII Pocket Watches

RSA	1	
Job	1	Remove and Replace Hands
Job	2	Remove and Replace Dial
Job	3	Remove and Replace Elgin Balance Assembly
Job	4	Remove and Replace Hamilton Balance Assembly
Job	5	Remove and Replace Waltham Balance Assembly
Job	6	Disassemble and Reassemble 16 Size Watch Movements
Job	7	Make a Hairspring-Collet Removing Tool
Job	8	Remove and Replace Hamilton, Elgin, and Waltham Hairsprings.
Job	9	Remove and Replace all Types of Roller Tables
Job	10	Replace Roller Jewels
RSA	2	
Job	11	Replace Balance Cock Jewels
Job	12	Measuring, Selecting, and Fitting Balance Staff
Job	13	Restaff Hamilton Balance Wheel
Job	14	Restaff Elgin Balance Wheel
Job	15	Restaff Waltham Balance Wheel
Job	16	Replace Elgin Mainspring
Job	17	Replace Hamilton Mainspring
Job	18	Replace Waltham Mainspring
Job	19	Check and Adjust End and Side Shake in Time Train
Job	20	Straighten bent Wheels
Job	21	Install Two Jewels on Escape Wheel

Unit XVII Pocket Watches
(Continued)

Job 22 Replace Center Hole Jewel
Job 23 Check Depthing
Job 24 Close Holes on Time Train
Job 25 Replace Minute Wheel Post
Job 26 Tighten Elgin Cannon Pinion
Job 27 True Bent Center Posts
Job 28 Replace Wheel in Hamilton Dial Train
Job 29 Alter Screws from an Assortment, to Fit into Watch
Job 30 Make and Replace Three Click Springs
Job 31 Make and Replace Winding Arbor (using sample)
Job 32 Make and Replace Winding Arbor (without sample)
Job 33 Replace Broken Regulator Pins
Job 34 Remove Rusty Screws
Job 35 Remove Broken Screws
Job 36 Straighten Bent Pivots
Job 37 Make and Replace Broken Detent Screw
Job 38 Make Hamilton Pallet Arbor
Job 39 Replace Broken Pallet Arbors
Job 40 Fit New Pair or Hands to Watch
Job 41 Convert Seven Jewel Watch to Fifteen Jewel Watch
Job 42 Disassemble, Clean, Oil and Reassemble Pocket Watch
Job 43 Repair Test Watch and Enter into Log
Job 44 Estimate Work on Test Watches

Unit XVIII Escapement
RSA 1
Job 1 Manipulate Model Escapement
Job 2 Remove and Replace Pallet Stones
Job 3 Make Escapement Checks on 16 Size Hamilton
Job 4 Match Escapement on 16 Size Hamilton
Job 5 Match Escapement on 16 Size Elgin

Unit XIX Electric Clocks
RSA 1
Job 1 Adjust Alarm Mechanism
Job 2 Disassemble and Reassemble Clock
Job 3 Replace Motor
Job 4 Check and Replace Coil
Job 5 Clean and Oil Electric Clock

Unit XX Crystal Fitting
RSA 1
Job 1 Fit Crystal to 16 Size Watch
Job 2 Fit Crystal to 12 Size Watch
Job 3 Fit Crystal to 6/0 Size Watch

Unit XX Crystal Fitting
(Continued)

Job 4 Fit Crystal to 10/0 Size Watch
Job 5 Fit Crystal to 10 1/2 Ligne Watch
Job 6 Fit Fancy Crystal to 10 1/2 Ligne Watch
Job 7 Fit Fancy Crystal to 8 3/4 Ligne Watch
Job 8 Fit Fancy Crystal to 6 3/4 Ligne Watch
Job 9 Fit Fancy Crystal to 5 Ligne Watch
Job 10 Replace Round, Waterproof Crystals, With Crystal Inserter
Job 11 Replace Crystals in Elgin, Wyler, Gruin With the Use of the Number System
Job 12 Grind "Near Fit" Crystals to Fit Bezels

Unit XXI Shaping Overcoils
RSA 1
Job 1 Form Four Overcoils, Using Gradual Bend Method
Job 2 Form Four Overcoils, Using Knee Bend Method
Job 3 Vibrate Hairspring and Form Overcoils for Two Pocket Watches

Unit XXII Polishing Machine
RSA 1
Job 1 Polish 16 Size Silver Case
Job 2 Polish 16 Size White Gold Case
Job 3 Polish 16 Size Yellow Gold Case
Job 4 Polish 16 Size Yellow Gold Filled Case
Job 5 Polish 10 Ligne Stainless Steel Case
Job 6 Polish 6 3/4 Ligne Gold Filled Case
Job 7 Polish Plastic Watch Crystals
Job 8 Polish Pocket Watch Chain

Unit XXIII Chronometer Watches and Marine Chronometers
RSA 1
Job 1 Disassemble, Clean, Oil, and Reassemble 22 Size Hamilton Chronometer Watch
Job 2 Disassemble, Clean, Oil and Reassemble 36 Size Waltham Chronometer Watch
Job 3 Disassemble, Clean, Oil, and Reassemble 18 Size Elgin Chronometer Watch
Job 4 Adjust and Rate Elgin, Hamilton, and Waltham Chronometer Watches
RSA 2
Job 5 Disassemble, Clean, Oil, and Reassemble a Marine Chronometer
Job 6 Adjust and Rate a Marine Chronometer

Unit XXIV Material Cabinets and Systems
RSA 1
Job 1 Fingerprint a Swiss Watch
Job 2 Identify and Obtain Replacement Parts for Practice Movements

Unit XXV Wrist Watches

Job	1	Disassemble, Clean, Oil and Reassemble 10 1/2 Ligne Wrist Watch
Job	2	Replace Mainspring in Wrist Watch
Job	3	Tighten Cannon Pinion
Job	4	Replace Stem
Job	5	Make and Install Click and Clutch Spring
Job	6	Replace Balance Hole Jewels
Job	7	Replace Pallet Bridge Jewel
Job	8	Make and Install Pallet Arbor
Job	9	Replace Six Pallet Arbors in Swiss and American Watch Movements
Job	10	Replace Pallet Stones and Adjust Lock
Job	11	Install Four Roller Jewels
Job	12	Staff 10 1/2 Ligne Watch
Job	13	Staff 8 3/4 Ligne Watch
Job	14	Staff 6 3/4 Ligne Watch
Job	15	Staff 5 Ligne Watch
Job	16	Make a Stem to Fit a 10 1/2 Ligne Watch Without the Use of a Sample
Job	17	Replace Banking Pins
Job	18	Overhaul Rusty Movement
Job	19	Polish Pivots in 6 3/4 Ligne Watch
Job	20	Replace Regulator Pins and Boots
Job	21	Replace Broken Guard Finger
Job	22	Repair Test Watch and Enter into Log Book

Unit XXVI Self-Winding Watches

RSA	1	
Job	1	Dismantle and Reassemble a Self-Winding Watch
Job	2	Replace Broken Oscillating Weight Axle
Job	3	Replace Driving Gear Arbor
Job	4	Replace Oscillating Weight Bushings and Jewels
Job	5	Make and Replace Stop Click Spring
Job	6	Replace Broken Mainspring
Job	7	Replace Broken Slip Spring
Job	8	Adjust Side Shake in Oscillating Weight Bushing
Job	9	Clean, Oil, and Adjust Four Self-Winding Watches

Unit XXVII Complicated Watches

RSA	1	
Job	1	Disassemble and Reassemble Two Calendar Watches
Job	2	Disassemble, Clean, Oil, and Adjust Calendar Wrist Watch
RSA	2	
Job	3	Disassemble and Reassemble a Wrist Alarm Watch
Job	4	Disassemble, Clean, Oil, and Adjust Wrist Alarm
RSA	3	
Job	5	Disassemble and Reassemble, in Stages, a Chronograph Wrist Watch
Job	6	Adjust Meshing of Gears for the Sweep Second Hand

Unit XXVII Complicated Watches
(Continued)

Job 7 Adjust Minute Counter
Job 8 Adjust Rate With Timer Mechanism Engaged and Timer Mechanism Disengaged
Job 9 Adjust Fly-Back Mechanism

Unit XXVIII Waterproofing Watches
RSA 1
Job 1 Test Four Watches Using Air Pressure Principle
Job 2 Replace Leaky Crystal and Secure it Airtight
Job 3 Replace Four Case Pipes and Test for Waterproofness
Job 4 Replace Leaky Crowns on Practice Watches
Job 5 Replace Case Back, Gaskets and Test
Job 6 Waterproof Watch With One Piece Case

Unit XXIX Adjusting to Positions
RSA 1
Job 1 Adjust 16 Size Elgin to 3 Positions
Job 2 Adjust 16 Size Hamilton to 3 Positions
Job 3 Adjust American Wrist Watch to 3 Positions
Job 4 Adjust Swiss Wrist Watch to 3 Positions
Job 5 Adjust 16 Size Elgin (R.R.) to 5 Positions
Job 6 Adjust 16 Size Hamilton R.R.) to 5 Positions

Unit XXX Electric Wrist Watches
RSA 1
Job 1 Disassemble and Reassemble Electric Watches (three)
Job 2 Clean 3 Electric Watches
Job 3 Replace Energy Cells in Electric Watches
Job 4 Check the Coil in a Electric Watch
Job 5 Adjust Contact Points
Job 6 Adjust Trip Spring
Job 7 Adjust and Rate Three Electric Watches
Job 8 Adjust Shake in Electric Watches

Unit XXXII. Electronic Wrist Watches

Unit XXXIII. General Watch Repair

FINAL TEST
Written Test (Theory)
Practical Test (Bench Work)

The Welding Jobs, Instructor's Guides and Tests were published in 1958 and revised in 1963. Each Job contains Related Study Assignments and when necessary, math and technical information. The Welding Course Mathematics was published in 1952. The Welding Course is available in the following forms:

Jobs and Tests are available in loose form for the students. Job and Test Books are available for the instructors.

Book I - Units I and II
Book II - Units III and IV
Mathematics (Welding Course Math)
Blueprint Reading and Sketching (From Oklahoma A and M College reprinted by the Lab.)

Test Book I - Units I, II, III and IV
Answer Book - Units I, II, III and IV

The following instructor's aids are available:
Permanent Record Folder
Wall Progress Chart

The References for the Welding Course are the following:

Title	Source
Potter OXYACETYLENE WELDING	American Technical Society 848 East 58th Street Chicago 37, Illinois
Bennett and Siy BLUEPRINT READING FOR WELDERS	Delmar Publishers, Inc. Mountainview Avenue Albany 5, New York
WELDING COURSE MATHEMATICS	Louisiana State Voc.-Tech. Curriculum Laboratory P. O. Box 657 Natchitoches, Louisiana
Althouse-Turnquist MODERN WELDING PRACTICE	The Goodheart-Willcox Co., Inc. 1322 South Wabash Avenue Chicago 5, Illinois
THE OXYACETYLENE HANDBOOK	The Linde Company 270 Park Avenue New York 17, New York

References (Continued)

Title	Source
OXYACETYLENE WELDING AND CUTTING	Air Reduction Sales Co., Inc. Div. of Air Reduction Co., Inc. 2507 Larkspur Street Baton Rouge, Louisiana
	Air Reduction Sales Co., Inc. Div. of Air Reduction Co., Inc. 6031 St. Vincent Avenue Shreveport, Louisiana
	Air Reduction Salse Co., Inc. Div. of Air Reduction Co., Inc. 1406 S. Rendon New Orleans 75, Louisiana
Sacks THEORY AND PRACTICE OF ARC WELDING	D. Van Nostrand Co., Inc. 120 Alexander Street Princeton, New Jersey
NEW LESSONS IN ARC WELDING	Lincoln Electric Co. 22801 St. Clair Avenue Cleveland 17, Ohio
Roden and Griffin BASIC ARC WELDING	Delmar Publishers Inc. Mountainview Avenue Albany 5, New York
Blodgett-Scalzi DESIGN OF WELDED STRUCTURAL CONNECTIONS	Lincoln Electric Co. 22801 St. Clair Avenue Cleveland 17, Ohio
Frankland, PIPE FITTER'S AND PIPE WELDER'S HANDBOOK	The Bruce Publishing Co. 400 North Broadway Milwaukee 1, Wisconsin
FABRICATION OF OXY-ACETYLENE WELDED STEEL AND WROUGHT IRON PIPING	The Linde Company 270 Park Avenue New York 17, New York

A detailed outline of the Welding Course follows:

UNIT I - WELDING - OXYACETYLENE CUTTING

Job 1 Set Up Oxyacetylene Equipment (Flat)
Job 2 To Cut Steel Plate (Flat)
Job 3 Cutting Odd Shapes (Flat)
Job 4 To Pierce Steel Plate (Flat)
Job 5 Manipulative Test (Flat)

Course Outline (Continued)

UNIT II - WELDING - OXYACETYLENE WELDING

Job 1 Deposit Beads
Job 2 Welding with Filler Rod
Job 3 Corner Joint
Job 4 Butt Weld Mild Steel
Job 5 Lap Weld Mild Steel
Job 6 Manipulative Test
Job 7 Butt Weld
Job 8 Lap Joint
Job 9 Vee-Butt Joint
Job 10 Butt Joint
Job 11 Lap Joint
Job 12 Manipulative Test
Job 13 Bronze Weld Mild Steel
Job 14 Braze-Weld Cast Iron
Job 15 Silver Solder a Lap Joint of Copper
Job 16 Manipulative Test
Job 17 Butt Weld Pipe (Roll)
Job 18 Butt Weld Pipe (Bell Hold)
Job 19 Butt Weld Pipe
Job 20 Manipulative Test

UNIT III - WELDING - ARC WELDING

Job 1 Stringer Beads (Flat)
Job 2 Weave Beads (Flat)
Job 3 Edge Joint (Flat)
Job 4 Tee Joint (Flat)
Job 5 Outside Corner Joint (Flat)
Job 6 V-Butt Joint - Back up Strip (Flat)
Job 7 V-Butt Joint - Open (Flat)
Job 8 Manipulative Test
Job 9 Stringer Beads (Horizontal)
Job 10 Lap Joint (Horizontal)
Job 11 Tee Joint - Stringer Beads (Horizontal
Job 12 Tee Joint - Weave Beads (Horizontal)
Job 13 V-Butt Joint - Back up Strip (Horizontal)
Job 14 V-Butt (Open) (Horizontal)
Job 15 Manipulative Test
Job 16 Stringer Beads (Travel down) (Vertical)
Job 17 Lap Joint (Travel down) (Vertical)
Job 18 Stringer Beads (Travel up) (Vertical)
Job 19 Weave Beads (Travel up) (Vertical)
Job 20 Lap Joint (Travel up) (Vertical)
Job 21 Tee Joint (Travel up) (Vertical)
Job 22 Corner Joint (Travel up) (Vertical)

UNIT III - WELDING - ARC WELDING

Job 23 V-Butt Joint (Back up strip, travel up) (Vertical)
Job 24 V-Butt Joint (Open) (Vertical)
Job 25 Manipulative Test
Job 26 Stringer Bead (Overhead)
Job 27 Weave Beads (Overhead)
Job 28 Lap Joint (Overhead)
Job 29 Tee Joint (Overhead)
Job 30 V-Butt Joint (Back up strip) (Overhead)
Job 31 V-Butt Joint (Open) (Overhead)
Job 32 Manipulative Test
Job 33 Roll Weld Pipe
Job 34 Butt Weld Pipe
Job 35 Butt Weld Pipe
Job 36 Orange Peel
Job 37 Lay Out 6" Branch for 6" Header
Job 38 Reducing Lateral
Job 39 Concentric Reducer
Job 40 Fabricate Piping Offset
Job 41 Weld Flange on Pipe

UNIT IV - INERT GAS WELDING

Job 1 Stringer Beads without Filler Rod
Job 2 Stringer Beads Using Filler Rod
Job 3 Tee Joint on Aluminum
Job 4 Butt Joint on Aluminum Plate
Job 5 Butt Weld Pipe (Roll Weld)

This course was written in 1950 and revised in 1960. There are X units available in the following book form.

Book I - Unit I Related Study Assignments
Book II - Unit II Related Study Assignments
Book III - Unit III Related Study Assignments
Book IV - Unit IV Related Study Assignments
Book V - Units V & VI Related Study Assignments
Book VI - Units VII & VIII Related Study Assignments
Book VII - Units IX & X Related Study Assignments

Test Book I - Unit I
Test Book II - Unit II
Test Book III - Unit III
Test Book IV - Unit IV
Test Book V - Units V & VI
Test Book VI - Units VII & VIII
Test Book VII - Units IX & X
Answer Book - Units I-X

References for the Carpentry Apprentice Course are listed below.

Title	Source
Dalzell, Ralph J., BUILDING TRADE BLUEPRINT READING, 3rd Ed.	American Technical Society 848 East 58th Street Chicago 37, Illinois
CONCRETE FORM CONSTRUCTION	Delmar Publishers, Inc. Mountainview Avenue Albany 5, New York
Wilson, J. Douglas and Rogers, Clell M., CARPENTRY MATHEMATICS, 2nd Ed.	McGraw-Hill Book Co., Inc. 330 West 42nd Street New York 36, New York
FRAMING, SHEATHING AND INSULATION	Delmar Publishers, Inc. Mountainview Avenue Albany 5, New York
CARPENTRY APPRENTICE TRAINING COURSE	United Brotherhood of Carpenters and Joiners of America 222 E. Michigan St. Indianapolis 4, Indiana
Wilson, J. Douglas and Werner, S. O. SIMPLIFIED ROOF FRAMING	McGraw-Hill Book Co., Inc. 330 West 42nd Street New York 36, New York
INTERIOR AND EXTERIOR TRIM	Delmar Publishers, Inc. Mountainview Avenue Albany 5, New York
THE USE OF HAND TOOLS AND PORTABLE MACHINERY	Delmar Publishers, Inc. Mountainview Avenue Albany 5, New York

References (Continued)

Title	Source
Wilson, J. Douglas and Roger, Clell M., SIMPLIFIED CARPENTRY ESTIMATING	Simmons-Broadman Publishing Corp. 30 Church Street New York 7, New York

A detailed course outline is given below.

Unit I - Foundations

R.S.A. A - Orientation for Carpentry Apprentice (Information Sheet)
R.S.A. B - How to Use This Course in Related Information for Carpentry Apprentices (Information Sheet)
R.S.A. 1 - Whole Numbers
R.S.A. 2 - Fractions
R.S.A. 3 - Measuring Tools and Their Uses
R.S.A. 4 - Plumbing and Leveling Tools
R.S.A. 5 - Cutting and Striking Tools
R.S.A. 6 - Use and Care of the Hand Saw
R.S.A. 7 Form Lumber
R.S.A. 8 - Form Ties
R.S.A. 9 - Batter Boards (Information Sheet)
R.S.A. 10 - Property Lines, Building Location, Excavation Lines, Diagonals (Information Sheet)
R.S.A. 11 - How to Lay Out Building Lines
R.S.A. 12 - How to Use Materials in Form Construction
R.S.A. 13 - Anchor Bolts
R.S.A. 14 - Concrete Footings and Piers
R.S.A. 15 - Pier and Footing Form Construction
R.S.A. 16 - Foundation Wall Forms
R.S.A. 17 - Foundation Wall Forms (Continued) (Information Sheet)
R.S.A. 18 - Openings in Concrete Walls

Unit II - Frame Construction

R.S.A. A - Orientation for Carpenter Apprentice (Information Sheet)
R.S.A. B - How To Use This Course in Related Information for Carpentry Apprentices (Information Sheet)
R.S.A. 1 - The Present-Day Home and its Predecessor (Information Sheet)
R.S.A. 2 - Metal Fastenings
R.S.A. 3 - Carpentry Tools of Wood (Information Sheet)
R.S.A. 4 - Termites and Decay (Information Sheet)
R.S.A. 5 - Types of Frame Construction
R.S.A. 6 - Sills
R.S.A. 7 - Girders
R.S.A. 8 - The Lower Frame in Louisiana (Information Sheet)
R.S.A. 9 - Floor Joists, Herringbone Bridging

Course Outline (Continued)

R.S.A. 10 - Subflooring
R.S.A. 11 - Horizontal Frame Layout (Information Sheet)
R.S.A. 12 - Vertical Frame Layout, The "Story Pole" (Information Sheet)
R.S.A. 13 - Balloon Frame Layout, Corner Post, Walls, and Second-floor Joists (Information Sheet)

Unit III - Roof Framing
R.S.A. A - Orientation for Carpentry Apprentice (Information Sheet)
R.S.A. B - How to Use This Course in Related Information for Carpentry Apprentices (Information Sheet)
R.S.A. 1 - Roofs, Past and Present (Information Sheet)
R.S.A. 2 - Roof Types and Terms
R.S.A. 3 - Principles of Roof Framing
R.S.A. 4 - The Common Rafter (Information Sheet)
R.S.A. 5 - The Hip Rafter "Length"
R.S.A. 6 - The Hip Rafter "Cuts"
R.S.A. 7 - The Hip Jack Rafter
R.S.A. 8 - The Hip Jack Rafter (Continued) (Information Sheet)
R.S.A. 9 - The Valley Rafter
R.S.A. 10 - The Valley and Cripple Jacks
R.S.A. 11 - Special Roof Framing Problems
R.S.A. 12 - The Steel Square and Its Use
R.S.A. 13 - Using the Tables on the Steel Square

Unit IV - Exterior Trim
R.S.A. A - Orientation for Carpentry Apprentice (Information Sheet)
R.S.A. B - How to Use This Course (Information Sheet)
R.S.A. 1 - Description of Common Types of Cornices
R.S.A. 2 - Mouldings (Information Sheet)
R.S.A. 3 - How to Build Common Cornices
R.S.A. 4 - Wood Shingles
R.S.A. 5 - How to Lay Wood Shingles
R.S.A. 6 - Overroofing with Shingles (Information Sheet)
R.S.A. 7 - Composition Roof Covering
R.S.A. 8 - Composition, Iron and Aluminum Roof Covering (Information Sheet)
R.S.A. 9 - Safety (Information Sheet)
R.S.A. 10 - Description of Window Frames
R.S.A. 11 - How to Build and Install Window and Door Frame
R.S.A. 12 - Water Tables, Corner Boards, Belt Course Types, and Installation
R.S.A. 13 - Side Wall Coverings - Types, and Installation
R.S.A. 14 - Side Wall Coverings (Continued) (Information Sheet)
R.S.A. 15 - Porch Trim - Types and Application
R.S.A. 16 - Front Entrances

Course Outline (Continued)

Unit V - Interior Trim

R.S.A. A - Orientation for Carpentry Apprentice (Information Sheet)
R.S.A. B - How to Use This Course (Information Sheet)
R.S.A. 1 - Insulation
R.S.A. 2 - Description of Wallboard (Information Sheet)
R.S.A. 3 - Wallboard Application (Information Sheet)
R.S.A. 4 - Lath
R.S.A. 5 - Finishing Tools
R.S.A. 6 - Finishing Tools (Continued)
R.S.A. 7 - Finish Hardware
R.S.A. 8 - How to fit Window Sash
R.S.A. 9 - Window and Door Jambs and Trim
R.S.A. 10 - Baseboards and Wall Panels
R.S.A. 11 - Finish Hardwood Floors
R.S.A. 12 - How to Apply Finish Hardware
R.S.A. 13 - Millwork Installation (Information Sheet)
R.S.A. 14 - Kitchen Cabinets, Clothes and Linen Closets, and Miscellaneous Millwork
R.S.A. 15 - Current Information (Information Sheet)

Unit VI - Stairs

R.S.A. 1 - Forms for Concrete Steps
R.S.A. 2 - Framing a Stair Well
R.S.A. 3 - Stairway Framing
R.S.A. 4 - Stair Platforms
R.S.A. 5 - Finish Stairs on Carriages and Housed and Open Stringers
R.S.A. 6 - Newel Posts and Handrails
R.S.A. 7 - The Proper Approach to Stair Stringer Layout

Unit VII - Floor Covering

R.S.A. A - Orientation for Carpentry Apprentice (Information Sheet)
R.S.A. B - How to Use This Course (Information Sheet)
R.S.A. 1 - The Resilient Floor-Covering Products
R.S.A. 2 - Tools for Tile Mechanics
R.S.A. 3 - Preparing the Job for Installation of Floor Covering
R.S.A. 4 - Preparing the Sub-floor
R.S.A. 5 - Laying Sheet Goods Wall to Wall
R.S.A. 6 - Pattern Layout
R.S.A. 7 - Cutting, Fitting, and Laying Lining Felt and Resilient Tile
R.S.A. 8 - Cabinet and Backsplash Covering
R.S.A. 9 - Maintenance of the Tile Floors
R.S.A. 10 - Safety

Course Outline (Continued)

Unit VIII - Miscellaneous
R.S.A. 1 - Temporary Building (Information Sheet)
R.S.A. 2 - Window and Door Screens (Information Sheet)
R.S.A. 3 - Anchor Bolts for Column Bases and Machines (Information Sheet)
R.S.A. 4 - Roof and Bridge Trusses (Information Sheet)
R.S.A. 5 - Dimensions (Information Sheet)
R.S.A. 6 - Estimating Fundamentals
R.S.A. 7 - Foundation Materials
R.S.A. 8 - Framing
R.S.A. 9 - Framing
R.S.A. 10 - Exterior Finish
R.S.A. 11 - Interior Finish
R.S.A. 12 - Estimator's Tables
R.S.A. 13 - Estimating Short Cuts
R.S.A. 14 - Labor Hours Per Unit
R.S.A. 15 - The Union

Unit IX - Advanced Related Information
R.S.A. A - Orientation for Advanced Apprentice (Information Sheet)
R.S.A. B - How to Use This Unit in Advanced Related Information for Carpenters (Information Sheet)
R.S.A. 1 - Forms: Concrete Work
R.S.A. 2 - Lumber Measuring and Selecting
R.S.A. 3 - House Framing Methods
R.S.A. 4 - Floor, Wall Framing
R.S.A. 5 - Roof Types Framing
R.S.A. 6 - Exterior Wall Construction
R.S.A. 7 - Roofing Material Installation
R.S.A. 8 - Thermal-Sound Insulation
R.S.A. 9 - Windows and Doors
R.S.A. 10 - Staircase Building
R.S.A. 11 - Interior Walls and Finishes
R.S.A. 12 - Planning a Home

Unit X - Advanced Blueprint Reading and Estimating
R.S.A. 1 - Blueprint Reading and Estimating
R.S.A. 2 - Rough Framing, Exterior Finish, and Roof Framing
R.S.A. 3 - Interior Finish
R.S.A. 4 - Plan Reading and Estimating for Plan B
R.S.A 5 - Plan Reading and Estimating for Plan B
R.S.A. 6 - Plan Reading and Estimating for Plan B
R.S.A. 7 - Plan Reading and Estimating for Plan B
R.S.A. 8 - Plan Reading and Estimating for Plan B
R.S.A. 9 - Plan Reading and Estimating for Plan C

Course Outline (Continued)

Unit X (Continued)

R.S.A. 10 - Plan Reading and Estimating for Plan C
R.S.A. 11 - Plan Reading and Estimating for Plan C
R.S.A. 12 - Plan Reading and Estimating for Plan C
R.S.A. 13 - Plan Reading and Estimating for Plan C
R.S.A. 14 - Plan Reading and Estimating for Plan C

The Electrical Apprentice Course was published in 1952-53 and revised in 1961. It is available in the following forms:

Related Study Assignments
- Book 1 - Units 1, 2, and 3
- Book 2 - Units 4, 5, 6, 7, 8, and 9
- Book 3 - Units 10, 11, 12, and 13
- Book 4 - Units 14, 15, 16, 17, 18, 19, and 20
- Book 5 - Units 21, 22, 23, 24, 25, and Appendix

Test Books
- Book 1 - Units 1, 2, and 3
- Book 2 - Units 4, 5, 6, 7, 8, and 9
- Book 3 - Units 10, 11, 12, and 13
- Book 4 - Units 14, 15, 16, 17, 18, 19, and 20
- Book 5 - Units 21, 22, 23, 24, and 25

Answer Book
- Book 1 - Units 1 - 25

The following instructor's aids are available:
- Progress Charts
- Monthly Reports of Apprentice

The references for the Electrical Apprentice Course are the following:

Title	Source
Welton, Paul L., and Rogers, Wm. W. SHOP MATHEMATICS AT WORK	Silver Burdett Company 707 Browder Street Dallas 1, Texas
Uhl, Dunlap, and Flynn, INTERIOR ELECTRIC WIRING AND ESTIMATING - RESIDENTIAL	American Technical Society 848 East Fifty-Eighth Street Chicago 37, Illinois
Richter, H. P., PRACTICAL ELECTRICAL WIRING	McGraw-Hill Book Co., Inc. 330 West 42nd Street New York 36, New York
National Board of Fire Underwriters, THE NATIONAL ELECTRICAL CODE Pamphlet # 70	National Board of Fire Underwriters 85 John Street
The American National Red Cross, FIRST AID TEXTBOOK	Doubleday and Company, Inc. Gareen City, New York
Hausmann, Erich, SWOOPE'S LESSONS IN PRACTICAL ELECTRICITY	D. Van Nostrand Company, Inc. 120 Alexander Street Princeton, New Jersey

References (Continued)

Title	Source
Cooke, Nelson M. MATHEMATICS FOR ELECTRICIANS AND RADIOMEN	McGraw-Hill Book Co., Inc. 330 West 42nd Street New York 36, New York
Abbott, Arthur L. and Stetka, Frank NATIONAL ELECTRICAL CODE HANDBOOK 10th Edition, 1960	McGraw-Hill Book Co., Inc. 330 West 42nd Street New York 36, New York
Graham, Kennard C., NATIONAL ELECTRICAL CODE AND BLUEPRINT READING, Unit 3	American Technical Society 848 East 58th Street Chicago 37, Illinois
Kruger, Albert M., and Ferry, Trafford J., CONDUIT BENDING MANUAL, 1939	C.B.M. Publications 6555 77th Place Maspeth, New York
Crouse, William H., ELECTRICAL APPLIANCE SERVICING	McGraw-Hill Book Co., Inc. 330 West 42nd Street New York 36, New York
Rosenberg, Robert, ELECTRIC MOTOR REPAIR	Holt, Rinehart and Winston, Inc. 383 Madison Avenue New York 17, New York
Timbie, W. H. ELEMENTS OF ELECTRICITY 3rd Edition, 16th Printing	John Wiley & Sons, Inc. 440 Park Avenue South New York 16, New York
Rasch, William Edward PRACTICAL ELECTRICAL MATHEMATICS	D. C. Heath and Co. 285 Columbus Avenue Boston 16, Massachusetts
Gibbs, J. B. TRANSFORMER PRINCIPLES AND PRACTICES 1950 Edition	McGraw-Hill Book Co., Inc. 330 West 42nd Street New York 36, New York
Crow, Leonard R. LEARNING ELECTRICITY AND ELECTRONICS EXPERIMENTALLY	Educational Publishers, Inc. St. Louis 1, Missouri
Nadon, John M. and Gelmine, Bert J. INDUSTRIAL ELECTRICITY	D. Van Nostrand Co., Inc. 120 Alexander Street Princeton, New Jersey

References (Continued)

Title	Source
Van Valkenburgh, Nooger and Neville, Inc. BASIC SYNCHROS AND SERVO-MECHANISMS	John F. Rider Publisher, Inc. 480 Canal Street New York 13, New York
GENERAL DESCRIPTION FOR D.C. VARIABLE DRIVE	Fidelity Instrument Corp. 1000 E. Boundary Avenue York, Pennsylvania
DESCRIPTION OF OPERATION AND SERVICE INSTRUCTIONS, MODEL F-29B SPEED REGULATOR	Fidelity Instrument Corp. 1000E. Boundary Avenue York, Pennsylvania
WESTINGHOUSE LIGHTING HANDBOOK	Westinghouse Electric Corp. Lamp Division Springfield, Massachusetts

A detailed outline of the Electrical Apprentice Course follows:

BOOK I - Electrical Apprentice

Unit I - Tools, Materials, and Their Uses

R.S.A. 1 How to Use This Course of Study (Information Sheet) No Test

R.S.A. 2 The Apprentice and His Job (Information Sheet)

R.S.A. 3 American Red Cross Standard First Aid Course (Information Sheet)

R.S.A. 4 Care and Use of Hand Tools and Equipment (Information Sheet)

R.S.A. 5 Common Fractions (Mathematics)

R.S.A. 6 Care and Use of Power Operated Tools (Information Sheet)

R.S.A. 7 Types of Fasteners (Information Sheet)

R.S.A. 8 Decimal Fractions (Mathematics)

R.S.A. 9 Introduction to the National Electrical Code

R.S.A. 10 Types of Wires and Cable

Course Outline (Continued)

R.S.A. 11 Use of American Wire Gauge and the Micrometer (Mathematics)

R.S.A. 12 Raceways and Fittings

R.S.A. 13 Measurements (Mathematics)

R.S.A. 14 Wire Connections and Soldering

R.S.A. 15 Using Letters as Numbers (Mathematics)

R.S.A. 16 Employer and Employee Organization (Information Sheet)

Unit II - Fundamental Theory of Electricity

R.S.A. 1 Electron Theory

R.S.A. 2 Literal Numbers, Addition and Subtraction (Mathematics)

R.S.A. 3 Static Electricity (Information Sheet)

R.S.A. 4 Multiplication and Division (Mathematics)

R.S.A. 5 Sketching and Blueprint; Electrical Symbols #1 (Information Sheet)

R.S.A. 6 Exponents, Square Root, and Units (Mathematics)

R.S.A. 7 Electric Current and Electron Flow

R.S.A. 8 Equations (Mathematics)

R.S.A. 9 Voltage, Current, Resistance and Conductance (Information Sheet)

R.S.A. 10 Properties of Magnets and Magnetic Fields

R.S.A. 11 Electromagnetism

R.S.A. 12 Means of Developing Electromotive Forces

R.S.A. 13 Primary Cells

R.S.A. 14 Secondary Cells

Course Outline (Continued)

Unit II (Continued)

R.S.A. 15 Ratio and Proportion (Mathematics)

R.S.A. 16 Sketching and Blueprint; Electrical Symbols #2

Unit III - Principles of Direct Current

R.S.A. 1 Ohm's Law--Series Circuits (Mathematics)

R.S.A. 2 Ohm's Law--Parallel Circuits (Mathematics)

R.S.A. 3 Ohm's Law--Series-Parallel Circuits (Mathematics)

R.S.A. 4 Power in Direct Current Circuits

R.S.A. 5 Problems Concerning Cells (Mathematics)

R.S.A. 6 Circuit Sketching, Cells in Series-Parallel

R.S.A. 7 Low Voltage Signal Circuits

R.S.A. 8 Simple Bell Circuits (Circuit Sketching)

R.S.A. 9 Fuses and Circuit Breakers

R.S.A. 10 Principles of Dynamo-Electric Machines

R.S.A. 11 Problems Concerning Conductors

BOOK II - Electrical Apprentice

Unit IV - Principles of Alternating Current

R.S.A. 1 Introduction to Trigonometry (Mathematics)

R.S.A. 2 Trigonometric Functions (Mathematics)

R.S.A. 3 Tables of Functions (Mathematics)

R.S.A. 4 Solution of Right Triangles (Mathematics)

R.S.A. 5 Periodic Functions (Mathematics)

R.S.A. 6 Elementary Plane Vectors (Mathematics)

Course Outline (Continued)

Unit IV (Continued)

R.S.A. 7 Alternating Currents and Voltages (Information Sheet)

R.S.A. 8 Inductance (Information Sheet)

R.S.A. 9 Capacitance (Information Sheet)

Unit V - Alternating-Current Circuits

R.S.A. 1 Resistance and Power in AC Circuits (Information Sheet)

R.S.A. 2 Inductance in AC Circuits (Information Sheet

R.S.A. 3 Capacitance in AC Circuits (Information Sheet)

R.S.A. 4 Impedance in AC Series Circuits (Information Sheet)

R.S.A. 5 Resistance, Inductance and Capacitance in AC Parallel Circuits (Information Sheet)

R.S.A. 6 Series-Parallel AC Circuits (Information Sheet)

R.S.A. 7 Polyphase Circuits (Information Sheet)

Unit VI - Motors and Generators

R.S.A. 1 Principles of Dynamo-Electric Machine (Information Sheet)

R.S.A. 2 Direct-Current Generators (Information Sheet)

R.S.A. 3 Direct-Current Motors (Information Sheet)

R.S.A. 4 Alternating-Current Motors (Information Sheet)

Unit VII -Transformers

R.S.A. 1 Power Transformers (Information Sheet)

R.S.A. 2 Instrument Transformers (Information Sheet)

Unit VIII - Fundamentals of Meters

R.S.A. 1 Direct-Current Meters (Information Sheet)

R.S.A. 2 Alternating-Current Meters (Information Sheet)

Course Outline (Continued)

Unit VIII (Continued)

R.S.A. 3 Wattmeters and Watthour-meters (Information Sheet)

R.S.A. 4 Care and Use of Portable Meters and Indicating Devices (Information Sheet)

Unit IX - Lighting

R.S.A. 1 Facts About Lighting (Part 1) (Information Sheet)

R.S.A. 2 Facts About Lighting (Part 2) (Information Sheet)

R.S.A. 3 Types of Lamps (Information Sheet)

R.S.A. 4 Computing Electric Light and Power Bills (Information Sheet)

BOOK III - Electrical Apprentice

Unit X - Wiring Methods

R.S.A. 1 General Provisions of the National Electrical Code (Information Sheet)

R.S.A. 2 General Requirements for Wiring Methods (Information Sheet)

R.S.A. 3 Types of Boxes, Box Covers, Box Extensions and Methods of Installation (Information Sheet)

R.S.A. 4 Polarity Identification of Systems and Circuits (Information Sheet)

R.S.A. 5 Types of Cables and Fittings (Information Sheet)

R.S.A. 6 Open Wiring on Insulators and Concealed Knob and Tube Work (Information Sheet)

R.S.A. 7 Branch Circuits and Service Entrance (Information Sheet)

R.S.A. 8 Non-metallic Cable Wiring (Information Sheet)

R.S.A. 9 Armored Cable Wiring (Information Sheet)

Course Outline (Continued)

Unit X (Continued)

R.S.A. 10 Diagramming and Wiring Plans (Information Sheet)

R.S.A. 11 Installing Surface Metal Raceway (Information Sheet)

R.S.A. 12 Installing Conduit (Information Sheet)

R.S.A. 13 Methods of Pulling Conductors in Raceways (Information Sheet)

R.S.A. 14 Use of NEC Tables for Calculating the Number of Conductors in Conduit or Tubing (Information Sheet)

R.S.A. 15 Bending Conduit and Tubing with Hand Benders (Information Sheet)

R.S.A. 16 Bending Conduit and Tubing on Hydraulic and Screw Jack Machines (Information Sheet)

R.S.A. 17 Building Structures and Architectural Symbols (Information Sheet)

R.S.A. 18 Wiring in Hazardous Locations (Information Sheet)

R.S.A. 19 Installing Wireways, Busways, Auxiliary Gutters, and Cellular Metal Floor Raceways (Information Sheet)

R.S.A. 20 Commercial Garages, Service Stations, and Bulk Storage Plants (Information Sheet)

R.S.A. 21 Installation Practice of Lighting Fixtures (Information Sheet)

Unit XI - Low Voltage Circuits

R.S.A. 1 Remote-Control, Low-Energy Power, Low-Voltage Power (Information Sheet)

R.S.A. 2 Introduction to Annunciators (Information Sheet)

R.S.A. 3 Design of Basic Relay Annunciators(Information Sheet)

R.S.A. 4 Remote Control Switching (Information Sheet)

R.S.A. 5 Intercommunicating Telephones (Information Sheet)

Course Outline (Continued)

Unit XII - Appliance-D.C. Motors

R.S.A. 1 Cooking Appliances (Information Sheet)

R.S.A. 2 Electric Hot Water Heaters and Gas Furnace Controls (Information Sheet)

Unit XIII- Direct-Current Motors and Controllers

R.S.A. 1 Direct-Current Motors (Information Sheet)

R.S.A. 2 Direct-Current Controllers (Information Sheet)

BOOK IV - Electrical Apprentice

Unit XIV - Alternating Current Motors and Controllers

R.S.A. 1 Split-Phase Motors (Information Sheet)

R.S.A. 2 Capacitor Motors (Information Sheet)

R.S.A. 3 Repulsion Type Motors (Information Sheet)

R.S.A. 4 Three Phase Motors (Information Sheet)

R.S.A. 5 N.E.C. Specifications for Motors and Controllers (Information Sheet)

R.S.A. 6 Wiring for Motors (Information Sheet)

R.S.A. 7 Across-the-line Magnetic Starters Information Sheet)

R.S.A. 8 Reversing Magnetic Starters (Information Sheet)

R.S.A. 9 Reduced Voltage Starters (Information Sheet)

R.S.A. 10 Drum, Two-Speed and Quick-Stop Controllers (Information Sheet)

R.S.A. 11 Synchronous Drive and Indicating Systems (Information Sheet)

Unit XV - Alternators and Distribution

R.S.A. 1 Alternators (Information Sheet)

R.S.A. 2 Synchronizing and Phase Alternators (Information Sheet)

Course Outline (Continued)

Unit XVI -Transformer Principles and Practices

R.S.A. 1 Introduction to Transformers and Transformer Ratios (Information Sheet)

R.S.A. 2 Checking Polarity of Transformers (Information Sheet)

R.S.A. 3 Single Phase Transformer Connections (Information Sheet)

R.S.A. 4 Three Phase Transformer Connections (Information Sheet)

R.S.A. 5 Special Application of Transformers (Information Sheet)

R.S.A. 6 Transformer Oil, and Oil Maintenance (Information Sheet)

Unit XVII - Meters and Metering

R.S.A. 1 Metering Single Phase Circuits Without Instrument Transformers (Information Sheet)

R.S.A. 2 Metering Single Phase Circuits With Instrument Transformers (Information Sheet)

R.S.A. 3 Metering Polyphase Circuits With and Without Instrument Transformers (Information Sheet)

Unit XVIII - Fundamental Electronics

R.S.A. 1 Vacuum Tubes as Rectifiers (Information Sheet)

R.S.A. 2 Solid State Rectifiers (Information Sheet)

R.S.A. 3 Rectifier Filters (Information Sheet)

R.S.A. 4 Triode Tube (Information Sheet)

R.S.A. 5 Operation Gas Filled Tubes (Information Sheet)

R.S.A. 6 Thyratron Tube (Information Sheet)

R.S.A. 7 Photo-Cells and Controls (Information Sheet)

R.S.A. 8 Electronic Motor Controls (Information Sheet)

Course Outline (Continued)

Unit XVIII (Continued)

R.S.A. 9 Magnetic Amplifier Control in D. C. (Information Sheet)

R.S.A. 10 Magnetic Amplifier Control A.C. (Information Sheet)

Unit XIX - Welding and Cutting

R.S.A. 1 Functions and Operating Principles of Oxy-Acetylene, Regulators, Blowpipes, and Accessories (Information Sheet)

R.S.A. 2 Setting Up Oxy-Acetylene Equipment (Information Sheet)

R.S.A. 3 Oxy-Acetylene Welding (Information Sheet)

R.S.A. 4 Oxy-Acetylene Cutting (Information Sheet)

R.S.A. 5 Characteristics of Arc Welding (Information Sheet)

R.S.A. 6 Types of Electrodes (Information Sheet)

R.S.A. 7 Characteristics of Inert Gas Welding (Information Sheet)

Unit XX - Protective Relaying Principles and Practices

R.S.A. 1 General (Information Sheet)

R.S.A. 2 Differential Protection (Information Sheet)

R.S.A. 3 Line Protection (Information Sheet)

R.S.A. 4 Definitions (Information Sheet)

BOOK V - Electrical Apprentice

Unit XXI - Illumination and Wiring Commercial and Industrial Buildings

R.S.A. 1 Illumination Design Data for Interiors (Information Sheet)

R.S.A. 2 Calculations for Illuminating an Industrial Shop (Information Sheet)

Course Outline (Continued)

Unit XXI (Continued)

R.S.A. 3 Calculating Wiring for an Industrial Shop (Information Sheet)

R.S.A. 3A Calculating, Wiring, and Illumination for Paint Shop and Finishing Room (Information Sheet)

Unit XXII - Fluorescent Lamps

R.S.A. 1 Characteristics and Working Principles of Fluorescent Lamps (Information Sheet)

R.S.A. 2 Circuit Sketching; Fluorescent Lamps (Information Sheet)

R.S.A. 3 N.E.C. Requirements for Lighting Fixtures, Signs and Outline Lighting (Information Sheet)

Unit XXIII - Substations

R.S.A. 1 Types and Uses of Substations (Information Sheet)

R.S.A. 2 Schematic and Pictorial Illustrations of Substations (Information Sheet)

R.S.A. 3 N.E.C. Requirements on Transformers and Circuits and Conductors Operating at More Than 600 Volts Between Conductors (Information Sheet)

Unit XXIV - Special Problems

R.S.A. 1 Calculating Necessary Data for Wiring Wound Rotor Motor (Information Sheet)

R.S.A. 2 Estimating Material for Roughing-in A Single Family Dwelling (Information Sheet

Appendix Steps to Safety

The General Apprentices Course was written in 1954. It is available in the following form:

Book
   Unit I
Book
   Unit II

Test Book
   Book
      Unit I
   Book
      Unit II

Answer Books
   Book
      Unit I
   Book
      Unit II

The following instructor's aids are available:
   Progress Chart

A detailed outline of the General Apprentices Course follows:

R.S.A. 1 - Getting and Holding a Job (Information Sheet)

R.S.A. 2 - Qualities Essential to Success (Information Sheet)

R.S.A. 3 - Workmen's Compensation Law in Louisiana (Information Sheet)

R.S.A. 4 - Social Security Act

R.S.A. 5 - Capital, Labor, and Management

R.S.A. 6 - Employer and Employee Organizations (Information Sheet)

R.S.A. 7 - Everyday Safety (Information Sheet)

R.S.A. 8 - Skilled Training for Workmen (Information Sheet)

R.S.A. 9 - Keeping Up With Occupational Changes (Information Sheet)

R.S.A. 10 - Apprenticeship (Information Sheet)

R.S.A. 11 - Insurance (Information Sheet)

R.S.A. 12 - Business Letters (Information Sheet)

Course Outline (Continued)

R.S.A. 13 - Personal Checks and Drafts

R.S.A. 14 - Keeping Accounts

R.S.A. 15 - Making and Reading Line Graphs

Unit II - Work Habits

R.S.A. 1 - Work Habits (Information Sheet)

R.S.A. 2 - Dependability (Information Sheet)

R.S.A. 3 - Orderliness (Information Sheet)

R.S.A. 4 - Method (Information Sheet)

R.S.A. 5 - Organization (Information Sheet)

R.S.A. 6 - Accuracy (Information Sheet)

R.S.A. 7 - Neatness (Information Sheet)

R.S.A. 8 - Respect for Materials (Information Sheet)

R.S.A. 9 - Economical Use of Materials (Information Sheet)

R.S.A. 10 - Ability to Solve Problems (Information Sheet)

R.S.A. 11 - Part I - Safety (Information Sheet)
Part II - Safety (Information Sheet)

R.S A. 12 - Cooperation (Information Sheet)

R.S.A. 13 - Miscellaneous Work Habits (Information Sheet)

Units I and II of Machinist Apprentice was published in 1949, Unit III 1950, and Units IV through X in 1952. It is available in the following forms:

Related Study Assignments, Mathematics and Blueprint
- Book 1 - Units I and II
- Book 2 - Unit III
- Book 3 - Units IV and V
- Book 4 - Units VI through X

Test Books
- Book 1 - Units I and II
  Final Examination
- Book 2 - Unit III
  Final Examination
- Book 3 - Units IV and V
- Book 4 - Units VI through IX - No Test on Unit X

Answer Books
- Book 1 - Units I and II
- Book 2 - Unit III
- Book 3 - Units IV and V
- Book 4 - Units VI through IX

The following instructor's aids are available:
- Progress Charts
- Monthly Report forms

The references for the Machinist Apprentice Course are the following:

Title	Source
Axelrod Aaron, MACHINE SHOP MATHEMATICS 1947	McGraw-Hill Book Company 330 West 42nd Street New York 36, New York
Burghardt, Henry D., MACHINE TOOL OPERATION, Part I 1941 and Part II	McGraw-Hill Book Company 330 West 42nd Street New York 36, New York
Giachino, J. W., and Feirer, John L. BASIC BENCH-METAL PRACTICE AND PRECISION MEASURING, 1943	Chas. A. Bennett Co., Inc. 237 N. Monroe Street Peoria, Illinois
Jones, J. D., MACHINE SHOP TRAINING COURSE, Volume 1, Second Edition	The Industrial Press 148 Lafayette Street New York 13, New York
Rogers, W. W., and Welton, P. L., BLUEPRINT READING AT WORK, 1944	Silver Burdett Company 45 East 17th Street New York 3, New York

References (Continued)

Title	Source
Ihne, R. W., and Streeter, MACHINE TRADES BLUEPRINT READING, 1948	American Technical Society 848 East Fifty-eighth St. Chicago 37, Illinois
SHAPER WORK	Delmar Publishers, Inc. Mountainview Avenue Albany 5, New York
MILLING MACHINE WORK	Delmar Publishers, Inc. Mountainview Avenue Albany 5, New York
Smith, ADVANCED MACHINE WORK	Industrial Education Book Co. Boston, Massachusetts
Oberg and Jones, MACHINERY'S HANDBOOK, 15th Edition	The Industrial Press 148 Lafayette Street New York 36, New York

A detailed outline of the Machinist Apprentice Course follows:

Unit I - Bench and Floor

R.S.A. 1: Layout Tools and Their Uses
Math: The Machinist's Rule
Blueprint Reading: How to Understand Blueprints

R.S.A. 2: Files and Filing
Math: Angular Measurement
Blueprint Reading: Three-View Drawings: Horizontal and Vertical Surface

R.S.A. 3: Chisels and Their Uses
Math: Cutting Stock
Blueprint Reading: Three-View Drawings: Slanting Surfaces

R.S.A. 4: Heat Treatment of Steel
Math: Expansion of Metals
Blueprint Reading: Three-View Drawings: Hidden Lines

R.S.A. 5: Hack Saws and Sawing
Math: Weight of Stock
Blueprint Reading: Three-View Drawing Scales

Course Outline (Continued)

Unit I - Bench and Floor (Continued)

R.S.A. 6: Reamers and Reaming
Math: Tap Drill Sizes
Blueprint Reading: Two-View Drawings: Curved Surfaces

R.S.A. 7: Die Threading and Tapping
Math: Tap Drill Sizes
Blueprint Reading: Two-View Drawings: Curved Surface

R.S.A. 8: Scrapers and Scraping
Math: Solution of Formulas
Blueprint Reading: Two-View Drawings: Decimal Tolerance

R.S.A. 9: Babbitting
Math: The Circle
Blueprint Reading: Two-View Drawings: Angular Tolerances

R.S.A. 10: Types of Drills
Math: Geometric Construction
Blueprint Reading: One-View Drawings

R.S.A. 11: Fits, Limits, and Tolerance
Math: The Rectangle
Blueprint Reading: Bracket Blueprint

R.S.A. 12: Care and Use of Grinders
Math: Speed of Pulleys
Blueprint Reading: Sectional Drawings: Full Section

R.S.A. 13: The Power Hack Saw
Math: The Right Triangle
Blueprint Reading: Sectional Drawings: Half Section

R.S.A. 14: Color Code of Steel
Blueprint Reading: Sectional Drawings: Detail View

R.S.A. 15: Soldering
Math: Belting

Course Outline (Continued)

Unit I - Bench and Floor (Continued)

R.S.A. 16: Abrasives and Grinding Wheels
Math: Power of Belting

R.S.A. 17: Producing, Processing, and Identifying Iron and Steel
Math: Review Problems on Belting

Unit II - Drill Press

R.S.A. 1: Types of Drill Presses and Their Operation
Blueprint Reading: Sectional Drawings: Special Types of Sections

R.S.A. 2: Speed and Feeds of a Drill Press
Math: Speed of Drills
Blueprint Reading: Screw Fastening: External Threads

R.S.A. 3: Sharpening Drills
Math: Drill Press Feed
Blueprint Reading: Screw Fastenings: Internal Threads

R.S.A. 4: Drill Chucks and Sleeves
Blueprint Reading: Screw Fastenings: Detail Thread Problems

R.S.A. 5: Holding the Work
Blueprint Reading: Auxiliary View Drawings

R.S.A. 6: Coolants
Math: Liquid Measure
Blueprint Reading: T-Slide Bracket

R.S.A. 7: Drilling
Blueprint Reading: Assembly Drawing

R.S.A. 8: Reamers and Reaming
Math: Principles of Micrometer
Blueprint Reading: Drill Jig

R.S.A. 9: Counterboring, Countersinking, Boring, and Tapping
Math: Mechanical Work and Power
Blueprint Reading: Milling Fixture for T-Slot Nut

Bibliography: Required Textbooks

Course Outline (Continued)

Unit III - Lathe

R.S.A. 1: Types of Lathes and Identification of Parts
Blueprint Reading: Introduction

R.S.A. 2: Principles of Lathe
Math: Shop Arithmetic

R.S.A. 3: Care and Use of the Lathe
Math: Cutting Speed

R.S.A. 4: Lathe Holding Devices
Math: Cutting Time
Blueprint Reading: Introduction

R.S.A. 5: Center Drilling and Care of Lathe Centers
Math: Review Problems on Feeds and Speeds

R.S.A. 6: Cutting Tools and Their Holding Devices
Math: Cutting Stock
Blueprint Reading: Isometric and Three View Sketching

R.S.A. 7: Straight Turning
Math: Simple Gearing
Blueprint Reading: Rectangular Objects

R.S.A. 8: Shoulder Turning, Facing and Necking
Math: Compound Gearing
Blueprint Reading: The Rectangular Object

R.S.A. 9: Knurling
Math: The Vernier Caliper

R.S.A. 10: Math: Shop Trigonometry (Right Triangle)

R.S.A. 11: Turning Tapers and Angles with the Compound Rest
Math: Cutting Tapers Using the Compound Rest

R.S.A. 12: Turning Tapers: Tailstock Offset Method
Math: Calculation of Tapers and Tailstock Offset

R.S.A. 13: Turning Tapers: Taper Attachment
Math: Cutting Tapers by Use of Taper Attachment

R.S.A. 14: Drilling and Reaming
Blueprint Reading: Rectangular Objects

Course Outline (Continued)

Unit III - Lathe (Continued)

R.S.A. 15: Filing and Polishing
Blueprint Reading: Invisible Surfaces

R.S.A. 16: Boring and Counterboring
Blueprint Reading: Invisible Surfaces

R.S.A. 17: Undercutting and Back-facing
Blueprint Reading: Start Surfaces

R.S.A. 18: Tapping
Math: The American Standard Screw Thread System
Blueprint Reading: Round Objects

R.S.A. 19: Taper Boring
Blueprint Reading: Round Objects

R.S.A. 20: Screw Thread Standards
Blueprint Reading: Auxiliary Views

R.S.A. 21: Thread Cutting (V-Shape)
Math: Simple Lathe Gearing for Thread Cutting

R.S.A. 22: Threading (Acme and Square) Single and Multiple
Math: Square and Acme Thread Calculations

R.S.A. 23: Internal Threading
Math: Tap Drill Sizes for Square and Acme Threads
Blueprint Reading: Chuck - Working Drawing

R.S.A. 24: Spring Winding in a Lathe
Math: Shop Trigonometry (Equilateral Triangle)
Blueprint Reading: Automatic Oiler - Working Drawing

R.S.A. 25: Interchangeable Manufacturer and Classes of Fits for Assembled Machine Parts
Math: Shop Trigonometry (Isosceles Triangle)
Blueprint Reading: Steering Sector Arm No. 1 - Working Drawing

R.S.A. 26: Cutting Off Bar Stock in a Lathe
Math: Cutting Threads by Compound Gearing
Blueprint Reading: Bar - Working Drawing

R.S.A. 27: Crankshaft Turning
Math: Time Measurement (Wages)

Bibliography: Books Required For Each Apprentice

Course Outline (Continued)

Unit IV - Shaper

R.S.A. 1: Name of Parts

R.S.A. 2: Shaper Construction
Math: Cutting Speeds of Planers and Shapers
Blueprint Reading: Drilling Fixture

R.S.A. 3: Planer Construction
Math: Strokes Per Minute and Cutting Speed

R.S.A. 4: Shaper and Planer Cutting Tools
Math: Planer and Shaper Feed

R.S.A. 5: Shaper and Planer Work Holding Devices
Math: Practical Measurements (Parallelogram)
Blueprint Reading: Shift Fork

R.S.A. 6: Causes of Inaccurate Work
Math: Practical Measurements (Scalene Triangle)
Blueprint Reading: Die

R.S.A. 7: Machining Flat and Horizontal Surfaces
Math: Review Problems

R.S.A. 8: Vertical, Angular, Contour, and Form Planing
Math: Shop Trigonometry (Review Problems)

R.S.A. 9: Slotting and Keyseating
Math: Shop Trigonometry (The Sine and Cosine Law)

R.S.A. 10: How to Cut Serrations
Math: Shop Trigonometry (General Review Problems)

Unit V - Milling Machine

R.S.A. 1: Types, Sizes, and Uses of Milling Machines
Math: Milling Machine Cutting Speeds

R.S.A. 2: Care and Maintenance of the Milling Machine
Math: Milling Machine Feed

R.S.A. 3: Types of Cutter and Work Holding Devices

R.S.A. 4: Proper Care and Use of Cutter and Work Holding Devices

R.S.A. 5: Types of Cutters for the Milling Machine

Course Outline (Continued)

Unit V - Milling Machine (Continued)

R.S.A. 6: Milling Machine Attachments

R.S.A. 7: Coolants and Their Use

R.S.A. 8: Milling Flat Surfaces
Math: Milling Round Stock Into Rectangular Bars

R.S.A. 9: Milling Ends and Faces

R.S.A. 10: Sawing, Slotting, and Keyway Milling

R.S.A. 11: Form Milling

R.S.A. 12: Angular Milling

R.S.A. 13: Gang Milling

R.S.A. 14: Dividing Head and Foot Stock
Math: Direct and Simple Indexing

R.S.A. 15: Spur Gear Rules and Formulas
Blueprint Reading: Spur Gear

R.S.A. 16: Milling Spur Gears
Math: Calculations for Spur Gears
Blueprint Reading: Spur Gear

R.S.A. 17: Bevel Gears
Math: Calculations for Bevel Gears
Blueprint Reading: Bevel Gear

R.S.A. 18: Worm and Gear
Math: Calculations for Worm Gears

R.S.A. 19: Helical Milling

R.S.A. 20: Graduating
Math: Graduating

R.S.A. 21: Milling Helical Gears
Bibliography: Required Textbooks for Shaper and Milling Machine

Course Outline (Continued)

Unit VI - Grinding

R.S.A. 1: Grinding Machine Construction
Math: Dimensions, Areas and Volumes of Geometrical Figures

R.S.A. 2: Grinding Wheels

R.S.A. 3: Principles of Grinding

R.S.A. 4: Cylindrical Grinding
Math: Figuring Tapers

R.S.A. 5: Surface Grinding

R.S.A. 6: Internal Grinding

R.S.A. 7: Grinding Milling Cutters and Reamers

Unit VII - Turret Lathe

R.S.A. 1: Machine Construction and Work Methods
Math: Standard Screw Threads

Unit VIII - Welding

R.S.A. 1: Functions and Operating Principles of Oxy-Acetylene Regulators, Blowpipes, and Accessories

R.S.A. 2: Setting Up Oxy-Acetylene Equipment

R.S.A. 3: Oxy-Acetylene Cutting

R.S.A. 4: Oxy-Acetylene Welding

R.S.A. 5: Characteristics of Arc Welding

R.S.A. 6: Types of Electrodes

Unit IX - General Information

R.S.A. 1: Principles of Bearings

R.S.A. 2: Belts and Pulleys

R.S.A. 3: Cutting Oils and Compounds

R.S.A. 4: Allowance and Tolerances for Fits
Math: Gear Problems

Course Outline (Continued)

Unit IX - General Information (Continued)

R.S.A. 5: Rigging

R.S.A. 6: Band Sawing Machines

R.S.A. 7: Aligning Machine

R.S.A. 8: Metal Spraying

R.S.A. 9: Machine Tools Today

R.S.A. 10: Personal and Social Problems

Unit X - Horizontal Boring, Drilling & Milling Machine

R.S.A. 1: Machine Fundamentals

R.S.A. 2: Basic Operations

R.S.A. 3: Work Methods

The Pipe Fitter Apprentice Course was published in 1952. It is available in the following forms:

Book 1
   Units I - VII
Book 2
   Unit VIII
Book 4
   Units X - XIII

Test Book
   Book 1
      Units I - VII

The following instructor's aids are available:
   Wall Progress Chart

The references for Pipe Fitter Apprentice Course are the following:

Title	Source
Heisler, W. Fred, ELEMENTARY SCIENCE APPLIED TO PETROLEUM PRODUCTION AND REFINING	Oklahoma A & M Book Store Oklahoma A & M College Oklahoma
Castle, Drew W., PROBLEMS IN BLUEPRINT READING	Chas. A. Bennett Co., Inc. Peoria, Illinois
Wolfe and Phelps, PRACTICAL SHOP MATHEMATICS 3rd Ed.	McGraw-Hill Book Co. 330 West 42nd Street New York 36, New York

A detailed outline of the Pipe Fitter Apprentice Course follows:

Book 1: Unit 1 - First Aid

   To be taught using Bureau of Mines 10 hr. First Aid Course.

Unit 2: Human Relations

   R.S.A. 1: Capital, Labor, and Management
   R.S.A. 2: Social Security Act
   R.S.A. 3: Workmen's Compensation
   R.S.A. 4: Attitudes and Behavior
   R.S.A. 5: Skilled Training for Workers
   R.S.A. 6: Interdependence of Employers and Employees

Course Outline (Continued)

Book 1: Unit 3 - Everyday Safety

R.S.A. 1: General Safety

Unit 4: Plant operation, History and organization

To be taught by Plant Officials

Unit 5: Physics

R.S.A. 1: Matter and Properties of Matter
R.S.A. 2: Weights, Measures, and Strength of Materials
R.S.A. 3: Motion, Force, Work, and Leverage
R.S.A. 4: Mechanical Devices, Power and Friction
R.S.A. 5: Liquids and Gases
R.S.A. 6: Heat and Transmission of Heat
R.S.A. 7: Expansion, Contraction, Melting, Freezing, Vaporization, and Condensation
R.S.A. 8: Magnetism and Electricity

Unit 6: Chemistry

R.S.A. 1: Principles of Chemistry and Common Elements
R.S.A. 2: Compounds
R.S.A. 3: Acids, Bases, and Salts
R.S.A. 4: Combustion, Safety, and terms

Unit 7: Refinery Metals

R.S.A. 1: Types of Metals

Book 2: Unit 8 - Mechanical Drawing

R.S.A. 1: Beginning Drawing
R.S.A. 2: Methods of Drawing
R.S.A. 3: Three View Drawing
R.S.A. 4: Three View Problems
R.S.A. 5: Sections
R.S.A. 6: Dimensions and Notes
R.S.A 7: Lettering and Missing Lines
R.S.A. 8: Drawing Exercises
R.S.A. 9: Drawing Exercises and Auxiliary Views
R.S.A. 10: Geometrical Construction
R.S.A. 11: Projection Study
R.S.A. 12: Pictorial Drawing
R.S.A. 13: Layout
R.S A. 14: Layout (Continued)
R.S A. 15: Layout (Continued)

Course Outline (Continued)

Book 2: Unit 8 (Continued)

R.S.A. 16: Layout for Eccentric Reducer
R.S.A. 17: Pipe Sketching
R.S.A. 18: Pipe Drawing
R.S.A. 19: Pipe Bends and Assemblies

Book 4: Unit 10 - Arithmetic

R.S.A. 1: Common Fractions
R.S.A. 2: Decimals
R.S.A. 3: Percentage
R.S.A. 4: Interest and Taxes

Unit 11 - Algebra

R.S.A. 1: Positive and Negative Numbers and Grouping Symbols
R.S.A. 2: Addition, Subtraction, Simple Equations
R.S.A. 3: Ratio and Proportion
R.S.A. 4: Square Root
R.S.A. 5: Formulas and Equations

Unit 12 - Beginning Geometry

R.S.A. 1: Beginning Geometry
R.S.A. 2: Geometry
R.S.A. 3: The Right Triangle
R.S.A. 4: The Right Triangle (Cont'd)
R.S.A. 5: The Circle

Unit 13 - Trigonometry

R.S.A. 1: Beginning Trigonometry
R.S.A. 2: Pipe Layout

The Plumbing and Pipe Fitting Industry was published in 1953-1954. It is available in the following forms:

Related Study Assignments
- Book I - Unit I - General Course
- Book II - Unit I - General Course
- Units II, III, IV & V
- Units VI & VII
- Units VIII, IX, X, & XI
- Units XII, XIII, XIV, XV, & XVI

Test Books
- Test Book for Unit I
- Test Book for Units II, III, IV & V
- Test Book for Units VI & VII
- Test Book for Units VIII, IX, X, & XI
- Test Book for Units XII, XIII, XIV, XV, & XVI

Answer Book
- There is an answer key for each test book

The following instructor's aids are available.
- Class Progress Chart (Pad)
- Monthly Report Blanks (Pad)

The references for the Plumbing and Pipe Fitting Industry are listed below.

Title	Source
Dalzell BUILDING TRADES BLUEPRINT READING, 1950	American Technical Society 848 East 58th Street Chicago 37, Illinois
Matthias, A. J., HOW TO DESIGN AND INSTALL PLUMBING	American Technical Society 848 East 58th Street Chicago 37, Illinois
INSTRUCTION MANUAL FOR STEAMFITTING APPRENTICES, Volume I	Heating, Piping and Air Conditioning Contractors National Association 1250 Avenue of the Americas New York 20, New York
LEAD WORK FOR MODERN PLUMBING	Lead Industries Association 60 East 42nd Street New York 17, New York

References (Continued)

Title	Source
HEATING VENTILATING AIR CONDITIONING GUIDE, 17th Edition	American Society of Heating and Ventilating Engineers 51 Madison Avenue New York, New York
Crosby-Fiske-Forster HANDBOOK OF FIRE PROTECTION	National Fire Protection Association Boston, Massachusetts
REGULATIONS FOR THE INSTALLATION OF STANDPIPE AND HOSE SYSTEMS	National Fire Protection Association Boston, Massachusetts

A detailed outline of The Plumbing and Pipe Fitting Industry follows.

Unit I

R.S.A. A - Background of the Plumbing Industry
R.S.A. B - Development of Steam
R.S.A. C - History of Refrigeration and Air Conditioning
R.S.A. 1 - Introduction to Plumbing and Pipe Fitting Industry
Mathematics: Linear Measurement
Blueprint Reading: Shapes of Surfaces and Solids
R.S.A. 2 - Measuring and Layout Tools
Mathematics: Rule Practice
Blueprint Reading: Elevation Views
R.S.A. 3 - Wood Boring Tools
Mathematics: Rule Practice
Blueprint Reading: Elevations
R.S.A. 4 - Wrenches and Utility Tools
Mathematics: Addition of Rule Graduations
Blueprint Reading: Elevations
R.S.A. 5 - Metal Cutting Tools
Mathematics: Subtraction of Scale Measurements
Blueprint Reading: Elevations
R.S.A. 6 - Driving Tools
Mathematics: Addition of Whole Numbers
Blueprint Reading: Plan Views
R.S.A. 7 - Drilling Holes in Metal
Mathematics: Subtraction of Whole Numbers
Blueprint Reading: Symbols for Elevations
R.S.A. 8 - Punching Holes in Metal
Mathematics: Multiplication of Whole Numbers
Blueprint Reading: Symbols for Elevations

Outline (Continued)

Unit I (Continued)

R.S.A. 9 - Cutting, Reaming, and Threading Tools
Mathematics: Division of Whole Numbers
Blueprint Reading: Symbols for Elevations

R.S.A. 10- Tubing Tools
Mathematics: Reducing Fractions to Lowest Terms
Blueprint Reading: Plan Views

R.S.A. 11- Brazing Copper Pipe
Mathematics: Changing Improper Fractions to Mixed Numbers
Blueprint Reading: Plan Views

R.S.A. 12- Soldering and Brazing Copper Pipe and Tubing
Mathematics: Changing Mixed Numbers to Improper Fractions
Blueprint Reading: Plan Views

R.S.A. 13- Soldering, Tools, and Procedures
Mathematics: Changing Fractions to Higher Terms
Blueprint Reading: Plan Views

R.S.A. 14- Welding
Mathematics: Least Common Denominators
Blueprint Reading: Plan Terms

R.S.A. 15- Mitered Bends
Mathematics: Addition of Fractions
Blueprint Reading: Symbols and Conventions for Plan Views

R.S.A. 16- Branch Layout
Mathematics: Subtraction of Fractions
Blueprint Reading: Symbols and Conventions for Plan Views

R.S.A. 17- Pipe Bend Developing
Mathematics: Multiplication of Fractions
Blueprint Reading: Symbols and Conventions for Plan Views

R.S.A. 18- Pipe Bending
Mathematics: Review Problems
Blueprint Reading: Scaling and Dimensions

R.S.A. 19- Hot Bending
Mathematics: Review Problems
Blueprint Reading: Scaling and Dimensions

R.S.A. 20- Rigging
Mathematics: The Decimal System
Blueprint Reading: Scaling and Dimensions

R.S.A. 21- Valves and Cocks
Mathematics: Addition and Subtraction of Decimals
Blueprint Reading: Scaling and Dimensions

Outline (Continued)

Unit I (Continued)

R.S.A. 22- Gaskets and Gasket Materials
Mathematics: Multiplication of Decimals
Blueprint Reading: Structural Details

R.S.A. 23- Identification of Bolts and Screws
Mathematics: Changing Common Fractions to Decimals
Blueprint Reading: Structural Details

R.S.A. 24- Pipe Supports and Hangers
Mathematics: Changing Common Fractions to Decimals
Blueprint Reading: Structural Details

R.S.A. 25- Insulating Materials
Mathematics: Simple Percentage
Blueprint Reading: Structural Details

R.S.A. 26- Graphical Symbols for Piping
Mathematics: Discount
Blueprint Reading: Structural Details

R.S.A. 27- Functions and Operating Principles of Oxy-Acetylene, Regulators, Blowpipes, and Accessories
Mathematics: Profit and Loss
Blueprint Reading: Structural Details

R.S.A. 28- Oxy-acetylene Welding
Mathematics: Powers and Roots
Blueprint Reading: Structural Details

R.S.A. 29- Arc Welding
Mathematics: Measurement of Angles
Blueprint Reading: Second Floors for One-and-a-half-story Houses

R.S.A. 30- Everyday Safety
Mathematics: Review
Blueprint Reading

Unit II - Sewage Disposal

R.S.A. 1 - Municipal Sewage Treatment
Mathematics: Review of Rectangular Areas
Blueprint Reading

Sketching Problem #1: Sketching Graphic Symbols

R.S.A. 2 - Municipal Sewer Systems
Mathematics: Review of Triangular Areas and Formulas
Blueprint Reading

Sketching Problem #2: Sketching Graphical Symbols (Contd.)

R.S.A. 3 - Private Sewage Treatment
Mathematics: Review of Circles
Blueprint Reading

Sketching Problem #3: Sketching Graphic Symbols

Outline (Continued)

Unit III - Pipes and Fittings

R.S.A. No. 1: Principal Types of Pipes and Fittings
Mathematics: Piping Measurements; Pipe Layouts; Tables
Blueprint Reading

Sketching Problem #1: Sketching Graphic Symbols

R.S.A. No. 2: Joining Vitrified
Mathematics: Square Root
Blueprint Reading

Sketching Problem #2: Sketching Symbols for a Screw-Joint Installation

R.S.A. No. 3: Joining Cast Iron Pipe
Mathematics: Volume
Blueprint Reading

Sketching Problem #3: Sketching Symbols for a Flanged Installation

Unit IV - The House Drainage System

R.S.A. No. 1: The House Sewer
Mathematics: Cylinders
Blueprint Reading

Sketching Problem #1: Hot and Cold Water Piping--Screw Joints

R.S.A. No. 2: The House Drain
Mathematics: Volumes of Cylinders
Blueprint Reading

Sketching Problem #2: Sketching Symbols for a Bell and Spigot Installation

R.S.A. No. 3: House Drain Appliances
Mathematics: Volumes of Cylinders
Blueprint Reading

Sketching Problem #3: Sketching Symbols for a Welded-Joint Installation

Outline (Continued)

Unit IV (Continued)

R.S.A. No. 4: House Drain Appliances (Continued)
Mathematics: Frustrums of Pyramids and Cones
Blueprint Reading

Sketching Problem #4: Sketching Symbols for a Solder-Joint Installation

R.S.A. No. 5: Storm Drainage
Mathematics: Fractions and Decimals
Blueprint Reading

Sketching Problem #5: Sketching Symbols for a Bell and Spigot and Screw-Joint

R.S.A. No. 7: The Waste Pipe
Mathematics: Solution of Formulas
Blueprint Reading

Sketching Problem #7: Sketching Symbols for a Soldered-Joint Installation

Unit V - Traps and Ventilation

R.S.A. No. 1: Traps Used on Plumbing Systems
Mathematics: 45 Degree Elbow Offsets
Blueprint Reading

Sketching Problem #1: Sketching Symbols for a Solder and Screw-Joint Installation

R.S.A. No. 2: Ventilation
Mathematics: To find the Length of an Offset
Blueprint Reading

Sketching Problem #2: Identifying Symbols of a Bell and Spigot Installation

R.S.A. No. 3: Ventilation (Continued)
Mathematics: Calculation of Rolling Offsets
Blueprint Reading

Sketching Problem #3: Identifying Symbols of a Bell and Spigot Installation

Outline (Continued)

Unit V (Continued)

R.S.A. No. 4: Soil, Waste, and Vent Pipe Principles
Mathematics: Radiator Stub Calculations
Blueprint Reading

Sketching Problem #4: Identifying Symbols of a Flange and Screw-Joint Installation

R.S.A. No. 5: Inspection and Test
Mathematics: Piping Measurements
Blueprint Reading

Sketching Problem #5: Identifying Symbols of a Solder and Screw-Joint Installation

Unit VI - Plumbing Water Supply

R.S.A. No. 1: Properties of Water and Its Sources
Mathematics: Oblique Triangles
Problem No. 1: Blueprint Reading
R.S.A. No. 2: Materials Used for Water Distribution
Mathematics: Oblique Triangles - The Law of Cosines
Problem No. 2: Materials Used for Water Distribution
R.S.A. No. 3: Joints on Water Supply Systems
Mathematics: Oblique Triangles
Problem No. 3: Blueprint Questions and Scale Rule Measurement
R.S.A. No. 4: Transite Pressure Pipe
Mathematics: Oblique Triangles
Problem No. 4: Symbols for Blueprints
R.S.A. No. 5: The House Water Supply
Mathematics: Residence Heat-Loss Calculations
Problem No. 5: Graphical Symbols for Plumbing
R.S.A. No. 6: Cold Water Distribution System
Mathematics: Special Pipe Bends
Problem No. 6: Letters and Figures
R.S.A. No. 7: Pumps and Lifts
Mathematics: Special Pipe Bends
Problem No. 7: Drawing the Plan
R.S.A. No. 8: Cold-Water Distribution Systems in Tall Buildings
Mathematics: Subject Matter-Solving by Formulas
Problem No. 8: Drawing for Plumbers

Outline (Continued)

Unit VII - Lead Work

R.S.A. No. 1:	The History and Manufacture of Lead Mathematics: Heat Transmission - Coefficients of Transmission
Problem No. 1:	Three Dimensions on One Drawing
R.S.A. No. 2:	Lead Working Tools Mathematics: Coefficients of Transmissions
Problem No. 2:	Isometric Drawing
R.S.A. No. 3:	Soldering with Irons Mathematics: Coefficients of Transmission
Problem No. 3:	Oblique Drawing
R.S.A. No. 4:	Bending Lead Pipe Mathematics: Calculation of U Factors
Problem No. 4:	Pipes in Three Dimension Drawing
R.S.A. No. 5:	Care and Cleaning of Wiping Solder--Flange Joints Mathematics: Calculation of U Factors
Problem No. 5:	Pipe Fittings
R.S.A. No. 6:	Preparing and Wiping Horizontal Round Joints Mathematics: Heat-Loss Calculations
Problem No. 6:	Pipe Measurement
R.S.A. No. 7:	Preparing and Wiping Vertical Round Joints--Branch Joints Mathematics: Heat-Loss Calculations
Problem No. 7:	Waste and Vent
R.S.A. No. 8:	Wiping Branch Joints and Wiping Lead to Brass Mathematics: Heat-Loss Calculations
Problem No. 8:	Hot and Cold Water
R.S.A. No. 9:	Capping Lead Pipe--Making Sheet Lead Pans and Linings Mathematics: Graphic Representation--Pressure and Head Curves
R.S.A. No. 10:	Lead Welding Mathematics: Trigonometric Ratios--Capacity of Tanks
Problem No. 10:	Layout of Unit Dwellings

Unit VIII - Hot-Water Systems

R.S.A. No. 1:	Domestic Hot-Water Supply
Mathematics 1:	Review; Linear Measurements and Rule Graduations
R.S.A. No. 2:	Hot-Water Distribution Systems
Mathematics 2:	Addition, Subtraction, Multiplication, and Division of Whole Numbers

Outline (Continued)

Unit IX - Special Piping

R.S.A. No.	1:	Domestic Hot-Water Supply
Mathematics	1:	Working With Fractions
R.S.A. No.	2:	Cross-Connection
Mathematics	2:	Working with Decimals
R.S.A. No.	3:	Fire Line Installation
Mathematics	3:	Simple Percentage, Discount, and Profit and Loss

Unit X - Plumbing Fixtures

R.S.A. No.	1:	Water Closets
Mathematics	1:	Powers and Roots
R.S.A. No.	2:	The Lavatory
Mathematics	2:	Review of Areas
R.S.A. No.	3:	The Bathtub
Mathematics	3:	Review of Areas of Triangles and Circles
R.S.A. No.	4:	Sinks
Mathematics	4:	Piping Offset Calculations
R.S.A. No.	5:	Special Plumbing Fixtures
Mathematics	5:	Volumes

Unit XI - Radiant Heating

R.S.A. No.	1:	Radiant Heating
Mathematics	1:	Frustums of Pyramids and Cones
R.S.A. No.	2:	Radiant Heating (Continued)
Mathematics	2:	Calculation Rolling Offsets
R.S.A. No.	3:	Radiant Heating (Continued)
Mathematics	3:	Heat-Loss Calculations
R.S.A. No.	4:	Radiant Heating (Continued)
Mathematics	4:	Final Test
R.S.A. No.	5:	Radiant Heating (Concluded)
Mathematics	5:	Final Test

Unit XII - Household Appliances

R.S.A. No.	1:	The Food-Waste Disposal Unit and the Automatic Dishwasher
R.S.A. No.	2:	The Automatic Washing Machine

Unit XIII - Domestic Heating

R.S.A. No.	1:	Gas Piping

Outline (Continued)

Unit XIII (Continued)

R.S.A. No. 2: Venting Gas Appliances -- Clearance
R.S.A. No. 3: Space Heaters
R.S.A. No. 4: Gas Floor Furnace Installation

Unit XIV - Fire Protection

R.S.A. No. 1: Development of Sprinkler Protection
R.S.A. No. 2: Automatic Sprinkler Installations
R.S.A. No. 3: Special Types of Sprinkler Systems
R.S.A. No. 4: Water-Flow Sprinkler Alarms--Sprinkler Inspection and Supervision

Unit XV - Planning and Estimating

R.S.A. No. 1: Raised Cottage Construction
R.S.A. No. 2: Concrete Slab on Ground Construction
R.S.A. No. 3: Low Priced Raised Cottage Construction
R.S.A. No. 4: Concrete Slab on Ground Construction

Unit XVI - Personal and Social Problems

R.S.A. No. 1: Workmen's Compensation Law in Louisiana
R.S.A. No. 2: Social Security Act

The Plumbing and Pipe Fitting Industry (Steam Fitting) was published in 1953. It is available in the following forms:

Related Study Assignment
- Book 1
  - Unit I
- Book 2
  - Unit I (Continued)
- Book 3
  - Units II and III
- Book 4
  - Units IV and V

Test Books
- Book 1
  - Unit I
- Book 2
  - Unit II and III
- Book 3
  - Unit IV and V

Answer Books
- Book 1
  - Unit I
- Book 2
  - Units II and III
- Book 3
  - Units IV and V

The following instructor's aids are available:
- Progress Chart

The references for the Plumbing and Pipe Fitting Industry (Steam Fitting) Course are the following:

Title	Source
Dalzell, BUILDING TRADES BLUEPRINT READING, 1950	American Technical Society 848 East Fifty-Eighth Street Chicago 37, Illinois
INSTRUCTION MANUAL FOR STEAMFITTING APPRENTICES, Volume I	Heating, Piping and Air Conditioning Contractors National Association 1250 Avenue of the Americas New York 20, New York

A detailed outline of the Plumbing and Pipe Fitting Industry (Steam Fitting) Course follows:

Course Outline

UNIT I - General Course

R.S.A. No. A: Part I: Background of the Plumbing Industry
R.S.A. No. B: Part 2: Development of Steam
R.S.A. No. C: Part 3: History of Refrigeration and Air Conditioning

R.S.A. No. 1: Introduction to Plumbing and Pipe Fitting Industry
Mathematics: Linear Measurement
Blueprint Reading: Shapes of Surfaces and Solids

R.S.A. No. 2: Measuring and Layout Tools
Mathematics: Rule Practice
Blueprint Reading: Elevation Views

R.S.A. No. 3: Wood Boring Tools
Mathematics: Rule Practice
Blueprint Reading: Elevations

R.S.A. No. 4: Wrenches and Utility Tools
Mathematics: Addition of Rule Graduations
Blueprint Reading: Elevations

R.S.A. No. 5: Metal Cutting Tools
Mathematics: Subtraction of Scale Measurements
Blueprint Reading: Elevations

R.S.A. No. 6: Driving Tools
Mathematics: Addition of Whole Numbers
Blueprint Reading: Plan Views

R.S.A. No. 7: Drilling Holes in Metal
Mathematics: Subtraction of Whole Numbers
Blueprint Reading: Symbols for Elevations

R.S.A. No. 8: Punching Holes in Metal
Mathematics: Multiplication of Whole Numbers
Blueprint Reading: Symbols for Elevations

R.S.A. No. 9: Cutting, Reaming, and Threading Tools
Mathematics: Division of Whole Numbers
Blueprint Reading: Symbols of Elevations

R.S.A. No. 10: Tubing Tools
Mathematics: Reducing Fractions to Lowest Terms
Blueprint Reading: Plan Views

Course Outline (Continued)

UNIT I (Continued)

R.S.A. No. 11: Brazing Copper Pipe
Mathematics: Changing Improper Fractions to Mixed Numbers
Blueprint Reading: Plan Views

R.S.A. No. 12: Soldering and Brazing Copper Pipe and Tubing
Mathematics: Changing Mixed Numbers to Improper Fractions
Blueprint Reading: Plan Views

R.S.A. No. 13: Soldering, Tools, and Procedures
Mathematics: Changing Fractions to Higher Terms
Blueprint Reading: Plan Views

R.S.A. No. 14: Welding
Mathematics: Least Common Denominators
Blueprint Reading: Plan Terms

R.S.A. No. 15: Mitered Bends
Mathematics: Addition of Fractions
Blueprint Readings: Symbols and Conventions for Plan View

R.S.A. No. 16: Branch Layout
Mathematics: Subtraction of Fractions
Blueprint Reading: Symbols and Conventions for Plan View

R.S.A. No. 17: Pipe Bend Developing
Mathematics: Multiplication of Fractions
Blueprint Reading: Symbols and Conventions for Plan Views

R.S.A. No. 18: Pipe Bending
Mathematics: Division of Fractions
Blueprint Reading: Scaling and Dimensions

R.S.A. No. 19: Hot Bending
Mathematics: Review Problems
Blueprint Reading: Scaling and Dimensions

R.S.A. No. 20: Rigging
Mathematics: The Decimal System
Blueprint Reading: Scaling and Dimensions

Course Outline (Continued)

UNIT I (Continued)

R.S.A. No. 21: Valves and Cocks
Mathematics: Addition and Subtraction of Decimal
Blueprint Reading: Scaling and Dimensions

R.S.A. No. 22: Gaskets and Gasket Materials
Mathematics: Multiplication of Decimals
Blueprint Reading: Structural Details

R.S.A. No. 23: Identification of Bolts and Screws
Mathematics: Changing Common Fractions to Decimals
Blueprint Reading: Structural Details

R.S.A. No. 24: Pipe Supports and Hangers
Mathematics: Changing Common Fractions to Decimals
Blueprint Reading: Structural Details

R.S.A. No. 25: Insulating Materials
Mathematics: Simple Percentage
Blueprint Reading: Structural Details

R.S.A. No. 26: Graphical Symbols for Piping
Mathematics: Discount
Blueprint Reading: Structural Details

R.S.A. No. 27. Functions and Operating Principles of Oxy-Acetylene, Regulators, Blowpipes, and Accessories
Mathematics: Profit and Loss
Blueprint Reading: Structural Details

R.S.A. No. 28: Oxy-Acetylene Welding
Mathematics: Powers and Roots
Blueprint Reading: Structural Details

R.S.A. No. 29: Arc Welding
Measurement of Angles
Blueprint Reading: Second Floors for One-and-a-half-story houses

R.S.A. No. 30: Everyday Safety
Mathematics: Review
Blueprint Reading:

Course Outline (Continued)

UNIT II - Related Science

R.S.A. No. 1: Pressure of Liquids at Rest-Heads
Mathematics: Review of Rectangular Areas
Blueprint Reading

R.S.A. No. 2: Atmospheric Pressure
Mathematics: Review of Triangular Area and Formulas
Blueprint Reading

R.S.A. No. 3: Weight, Density, and Specific Gravity
Mathematics: Review of Circles
Blueprint Reading

R.S.A. No. 4: Buoyancy
Mathematics: Piping Measurements, Pipe Layouts; Tables
Blueprint Reading

R.S.A. No. 5: Water Head
Mathematics: Square Root
Blueprint Reading

R.S.A. No. 6: Molecular Basis of Heat
Mathematics: Volume
Blueprint Reading

R.S.A. No. 7: An Elementary Study of Heat
Mathematics: Cylinders
Blueprint Reading

R.S.A. No. 8: Intensity of Heat-Temperature
Mathematics: Volumes
Blueprint Reading

R.S.A. No. 9: Specific Heat
Mathematics: Volumes of Cylinders
Blueprint Reading

R.S.A. No. 10: A Study of B.T.U.
Mathematics: Frustrums of Pyramids and Cones
Blueprint Reading

R.S.A. No. 11: Generation of Heat
Mathematics: Fractions and Decimals
Blueprint Reading

Course Outline (Continued)

UNIT II (Continued)

R.S.A. No. 12: Expansion
Mathematics: Piping Measurements
Blueprint Reading

R.S.A. No. 13: Steam Tables and Latent Heat
Mathematics: Solution of Formulas
Blueprint Reading

R.S.A. No. 14: Work and Power
Mathematics: 45 Degree Elbow Offsets
Blueprint Reading

UNIT III - Related Science

R.S.A. No. 1: Forms of Heat
Mathematics: To Find the Length of an Offset
Blueprint Reading

R.S.A. No. 2: Properties of Water
Mathematics: Calculation of Rolling Offsets
Blueprint Reading

R.S.A. No. 3: Evaporation and Boiling
Mathematics: Radiator Stub Calculations
Blueprint Reading

R.S.A. No. 4: Pressure
Mathematics: Piping Measurements
Blueprint Reading

R.S.A. No. 5: Relations of Temperature, Pressure and Volume of Steam
Mathematics: Arithmetic--Square Root

R.S.A. No. 6: Flow of Steam in Pipes
Mathematics: To Find the Unknown Angles

R.S.A. No. 7: Critical Velocity
Mathematics: Trigonometry Method

R.S.A. No. 8: Miscellaneous Procedures
Mathematics: Trigonometry Method

R.S.A. No. 9: Review Test

R.S.A. No. 10: Review Test

Course Outline (Continued)

UNIT IV - Related Science

R.S.A. No. 1: Considerations in Installing a One-Pipe Gravity Steam System
Mathematics: Review of Right Triangles

R.S.A. No. 2: Piping Connections to Boiler
Mathematics: Oblique Triangles--The Law of Sines

R.S.A. No. 3: Piping Between Boiler and Radiators
Mathematics: Oblique Triangles

R.S.A. No. 4: Standards for Sizing Boilers
Mathematics: Oblique Triangles--The Law of Cosines

R.S.A. No. 5: Air Elimination
Mathematics: Oblique Triangles

R.S.A. No. 6: Unit Heater Connections
Mathematics: Oblique Triangles

R.S.A. No. 7: Special Piping Arrangements
Mathematics: Review Test

R.S.A. No. 8: Vapor Heating
Mathematics: Review Test

R.S.A. No. 9: Radiator Traps -- Boiler Return Traps
Mathematics: Review Test

R.S.A. No. 10: Air Eliminator
Mathematics: Special Pipe Bends

R.S.A. No. 11: Automatic Boiler Water Feeder
Mathematics: Special Pipe Bends

R.S.A. No. 12: Vacuum System of Steam Heating--Jennings Vacuum Heating Pump
Mathematics: Heat Transmission

R.S.A. No. 13: Dunham Sub-Atmospheric System
Mathematics: Calculation of U Factors

V - Related Science

R.S.A. No. 1: Dunham Vacuum Heating Pump
Mathematics: Heat-Loss Calculations

Course Outline (Continued)

UNIT V (Continued)

R.S.A. No. 2: Differential Controller and Selector
Mathematics: Residence Heat Loss Calculations

R.S.A. No. 3: Control Valve and Panel
Mathematics: Heat Loss Calculation for Two Apartment Building

R.S.A. No. 4: Illinois Selective Pressure System
Mathematics: Heating Estimate for Industrial Building

R.S.A. No. 5: Webster Moderator System
Mathematics: Graphic Representation

R.S.A. No. 6: High Vacuum Pump--Comparison of Controls
Mathematics: Pressure-Head Curves of Water

The Electrical Utility Workers Training Program material was published in 1962-1963. It is available in book form for the Instructors and Handouts are available for students.

Unit I
    Book - Basic Mathematics
Unit II
    Book - Simplified Electricity
Unit III
    Book - Transformers
Unit IV
    Book - Power Distribution and Transmission

The references for the Electrical Utility Workers Training Program are the following:

Title	Source
Cooke, Nelson M. BASIC MATHEMATICS FOR ELECTRONICS Second Edition	McGraw-Hill Book Co., Inc. 330 West 42nd Street New York 36, New York
Van Valkenburgh, Nooger and Neville, Inc. BASIC ELECTRICITY	John F. Rider Publisher, Inc. 116 West 14th Street New York 11, New York
TRANSFORMER TRAINING PROGRAM Instructor's Manual	Westinghouse Electric Corp. 3875 Florida Avenue Baton Rouge, Louisiana
TRANSFORMER STUDY MANUALS SA-6789-6B, 1955	Westinghouse Electric Corp. 3875 Florida Avenue Baton Rouge, Louisiana
"ON LINE," Part of Unit III, Electrical Utility Workers Training Program	Louisiana State Voc.-Tech. Curriculum Laboratory P. O. Box 657 Natchitoches, Louisiana
DISTRIBUTION TRANSFORMER MANUAL 2485A	General Electric Company Post Office Box 15338 Baton Rouge 15, Louisiana
Croft, Terrell AMERICAN ELECTRICIAN'S HANDBOOK	McGraw-Hill Book Co., Inc. 330 West 42nd Street New York 36, New York

References (Continued)

Title	Source
Student Handout #1 DISTRIBUTION APPARATUS HANDBOOK EXCERPTS AND RELATED INFORMATION Courtesy of Westinghouse Electric Corp.	Louisiana State Voc.-Tech. Curriculum Laboratory P. O. Box 657 Natchitoches, Louisiana
DISTRIBUTION SYSTEMS Volume III	Westinghouse Electric Corp. 3875 Florida Avenue Baton Rouge 15, Louisiana
Skrotzki, Bernhardt G. A. ELECTRIC TRANSMISSION AND DISTRIBUTION, 1954	McGraw-Hill Book Co., Inc. 330 West 42nd Street, New York 36, New York
ELECTRICAL UTILITY WORKERS TRAINING PROGRAM, Unit III, Transformers	Louisiana State Voc.-Tech. Curriculum Laboratory P. O. Box 657 Natchitoches, Louisiana
INDUSTRIAL POWER SYSTEM DATA BOOK	General Electric Company Post Office Box 15338 Baton Rouge 15, Louisiana
NATIONAL ELECTRICAL CODE	The National Board of Fire Underwriters 85 John Street New York 38, New York
NATIONAL ELECTRICAL SAFETY CODE HANDBOOK, latest edition	American Standards Association 70 East 45th Street New York, New York
SPECIFICATIONS AND DRAWINGS FOR 7.2/12.5 KV. LINE CONSTRUCTION 1962	Rural Electrification Administration Washington, D. C.
SPECIFICATIONS MANUAL, ELECTRIC EQUIPMENT A1A File #31.R, 1959	General Electric Company Post Office Box 15338 Baton Rouge 15, Louisiana
Knowlton, A. E. STANDARD HANDBOOK FOR ELECTRICAL ENGINEERS 9th edition	McGraw-Hill Book Co., Inc. 330 West 42nd Street New York 36, New York

References (Continued)

Title	Source
Kurtz, E. B. THE LINEMAN'S HANDBOOK 3rd edition	McGraw-Hill Book Co., Inc. 330 West 42nd Street New York 36, New York

A detailed outline of the Electrical Utility Workers Training Program follows:

Unit I - BASIC MATHEMATICS

Lesson Plan 1 - Review of Addition and Subtraction
Lesson Plan 2 - Review of Multiplication and Division
Lesson Plan 3 - Common Fractions - Addition and Subtraction
Lesson Plan 4 - Common Fractions - Multiplication and Division
Lesson Plan 5 - Mixed Numbers
Lesson Plan 6 - Decimal Fractions and Conversions
Lesson Plan 7 - Percentage, Ratio and Proportion
Lesson Plan 8 - Square Root
Lesson Plan 9 - Introduction to Algebra
Lesson Plan 10 - General Numbers
Lesson Plan 11 - Solving Problems by Equations
Lesson Plan 12 - Literal Equations with One Unknown

Unit II - SIMPLIFIED ELECTRICITY

Lesson Plan 1 - Magnetism
Lesson Plan 2 - Methods of Producing Electricity
Lesson Plan 3 - Current Electricity
Lesson Plan 4 - Measuring Voltage, Current and Resistance
Lesson Plan 5 - Ohm's Law--Series Circuits
Lesson Plan 6 - Electric Power
Lesson Plan 7 - Ohm's Law--Parallel Circuits
Lesson Plan 8 - Alternating Current
Lesson Plan 9 - Inductance and Inductive Reactance
Lesson Plan 10 - Capacitance and Capacitive Reactance
Lesson Plan 11 - Impedance in A.C. Series Circuits

Unit III - TRANSFORMERS

Lesson Plan 1 - Basic Theories and Principles
Lesson Plan 2 - Transformer Parts, Construction and Assembly
Lesson Plan 3 - Transformer Protection
Lesson Plan 4 - Transformer Connections (Part I)
Lesson Plan 5 - Transformer Connections (Part II)
Lesson Plan 6 - Transformer Maintenance

Course Outline (Continued)

Unit IV - POWER DISTRIBUTION AND TRANSMISSION

Lesson Plan 1 - Distribution Systems
Lesson Plan 2 - A Study of Primary Distribution Systems
Lesson Plan 3 - Power Factor
Lesson Plan 4 - Power Factor (Continued)
Lesson Plan 5 - Distribution Transformers
Lesson Plan 6 - The Secondary Distribution System and Primary System Protection
Lesson Plan 7 - Methods of Increasing the Capacity, Improving Voltage Regulation and Grounding the Distribution System
Lesson Plan 8 - Electrical Measuring Instruments
Lesson Plan 9 - Electrical Measurement Instruments (Continued)
Lesson Plan 10 - Street Lighting
Lesson Plan 11 - Distribution Line Construction

Slides to be used with this course are also available.
There are 277 slides in a set at $1.00 per slide.

The Highway Engineering Aide Training Program material was published in 1958-1959. It is available in the following forms:

Unit I
- Book - Arithmetic (Lessons)

Unit II
- Book - Algebra (Lessons)

Unit III
- Book - Geometry and Trigonometry

Unit IV
- Book - Drawing

Unit V
- Book - Surveying

The following instructor's aids are available:

Book 1 - Instructor's Lesson Plans (Arithmetic)
Tests
Answers

Book 2 - Instructor's Lesson Plans (Algebra)
Tests
Answers

Book 3 - Instructor's Lesson Plans (Geometry and Trigonometry)
Tests
Answers

Book 5 - Instructor's Lesson Plans (Surveying)
Tests
Answers

The references for the Highway Engineering Aide Training Program are the following:

Title	Source
Slade, Samuel and Margolis, Lois, MATHEMATICS FOR TECHNICAL AND VOCATIONAL SCHOOLS	John Wiley and Sons, Inc. 440 Fourth Avenue New York 16, New York
Giesecke, Mitchell, and Spencer, TECHNICAL DRAWING	The MacMillan Co. Ross Avenue and Akard St. Dallas 1, Texas
Castel, Drew W., PROBLEMS IN BLUEPRINT READING	Chas. A. Bennett Co., Inc. 237 N. Monroe Street Peoria, Illinois

References (Continued)

Title	Source
APPLIED MATHEMATICS FOR PETROLEUM INDUSTRY	Petroleum Extension Service University of Texas Austin, Texas
Virgil S. Mallory, FIRST ALGEBRA	I. W. Singer Company, Inc. 249-259 West Erie Blvd. Syracuse 12, New York
Davis and Kelly, SHORT COURSE IN SURVEYING	McGraw Hill Book Co. 330 West 42nd Street New York 36, New York

A detailed outline of the Highway Engineering Aide Training Program material follows:

Unit I - Arithmetic

Lesson #1
- I. Introduction
- II. Whole Numbers
  - A. Reading and Writing Numbers
  - B. Addition and Checking Addition
  - C. Subtraction
  - D. Multiplication

Lesson #2
- II. Whole Numbers (Continued)
  - E. Division
- III. Common Fractions
  - A. Addition
  - B. Substraction

Lesson #3
- III. Common Fractions (Continued)
  - C. Multiplication
  - D. Division
- IV. Mixed Numbers
  - A. Addition

Lesson #4
- IV. Mixed Numbers (Continued)
  - B. Subtraction
  - C. Multiplication
  - D. Division

Lesson #5
- V. Decimal Fractions
  - A. Reading and Writing Decimals
  - B. Addition of Decimals
  - C. Subtraction of Decimals

Course Outline (Continued)

Unit I - Arithmetic (Continued)

Lesson #6
- V. Decimal Fractions (Continued)
  - D. Multiplication
  - E. Division

Lesson #7
- VI. Conversions
  - A. Common Fractions to Decimal Fractions
  - B. Decimal Fractions to Common Fractions
  - C. Review

Lesson #8
- VII. Examination

Lesson #9
- VIII. Percentage
  - A. Definitions
  - B. Equivalents
- IX. Ratio and Proportion
  - A. Ratio
  - B. Proportion
  - C. Inverse Proportion

Lesson #10
- X. Square Root
  - A. Examination Critique
  - B. Definition
  - C. Extracting the Square Root

Lesson #11
- XI. Measurements
  - A. Feet and Inches
  - B. Time
  - C. Weight
  - D. Temperatures

Lesson #12
- XI. Measurements (Continued)
  - E. Density and Specific Gravity

Lesson #13
- XI. Measurements (Continued)
  - F. Absorption and Surface Moisture
  - G. Board Measure
  - H. Review

Lesson #14
- XI. Measurements (Continued)
  - I. Land Measure

Lesson #15
- XII. Plane Figures
  - A. Areas and Perimeters of Rectangles
  - B. Areas and Perimeters of Parallelograms
  - C. Areas and Perimeters of Trapezoids
  - D. Areas and Perimeters of Triangles
  - E. Areas and Perimeters of Circles
  - F. Areas and Perimeters of Elipses

Course Outline (Continued)

Unit I - Arithmetic (Continued)

Lesson #16
XIII. Solid Figures
- A. Volumes of Rectangular Shaped Solids
- B. Volumes of Cylinders
- C. Volumes of Cones
- D. Volumes of Frustrums of Pyramids and Cones
- E. Volumes of Spheres

Lesson #17
XIV. Examination
Pass out the examination. Be sure that the students return all question sheets

Unit II - Algebra

Lesson #1
I. Introduction
- A. Comparison
- B. Definition
- C. Signs or Symbols of Operation
- D. General Application of Signs and Symbols

Lesson #2
II. General Numbers
- A. Addition and Subtraction of Literal Numbers
- B. Multiplication and Division of Literal Numbers
- C. Exponents and Powers in Formulas
- D. Developing Formulas

Lesson #3
III. Solving Problems by Equations
- A. Axiom I - Division
- B. Axiom II - Multiplication
- C. Axiom III - Subtraction
- D. Axiom IV - Addition
- E. Consecutive Integers
- F. Changing the Subject of a Formula

Lesson #4
IV. Signed Numbers
- A. Definition
- B. Number Scales
- C. Use in Graphs
- D. Addition of Signed Numbers
- E. Subtracting Signed Numbers
- F. Multiplication of Signed Numbers
- G. Signs of Powers
- H. Division of Signed Numbers
- I. Division Written as a Fraction
- J. Algebraic Terms

Course Outline (Continued)

Lesson #4 (Continued)
- K. Addition of Polynomials
- L. Subtraction of Polynomials
- M. Multiplication of a Polynomial by a Signed Number
- N. Use of Parentheses
- O. Translation of statements into symbols

Lesson #5

V. Graphs
- A. Bar Graphs
- B. Circle Graphs
- C. Line Graphs
- D. Line Graph of Formulas
- E. Line Graphs to Solve Problems
- F. Location of Points on a Graph
- G. Graphs of Equations with two Unknowns
- H. Solving a pair of Linear Equations by Graphs
- I. Formula for a Linear Equation

Lesson #6

VI. Equations with two Unknowns
- A. Solving by Addition
- B. Solving by Substitution
- C. Problems involving two Unknowns

Lesson #7

VII. Product and Quotient of Literal Numbers
- A. Product of Two Monomials
- B. Product of more than Two Monomials
- C. Product of a Polynomial by a Monomial
- D. Product of Two Binomials
- E. Quotient of Two Monomials
- F. Quotient of a Polynomial by a Monomial

Lesson #8

VIII. Special Products and Factors
- A. How to find Monomial Factors
- B. Factoring of a Trinomial
- C. Square of a Binomial
- D. Product of the Sum and Difference of Two Quantities
- E. Factoring the Difference of Two Squares
- F. Finding all the prime Factors
- G. Squaring a Binomial like ab + cd
- H. Factoring a Perfect Square
- I. Factoring a Quadratic Trinomial
- J. Shortcuts in Computation

Course Outline (Continued)

Unit II - Algebra (Continued)

Lesson #9
IX. Using Algebraic Fractions in Formulas and Equations
- A. Reduction of a Fraction
- B. Changing an Improper Fraction to an Integer or Mixed Expression
- C. Multiplication of Fractions
- D. Division of Fractions
- E. Addition of Fractions with Monomial Denominators
- F. Addition of Fractions with Binomial Denominators
- G. Signs of a Fraction
- H. Changing a Mixed Expression to a Fraction
- I. Complex Fractions in Algebra

Lesson #10
X. Ratio and Proportion
- A. Using Ratios
- B. Constants, Variables, and Functions
- C. Similar Figures and Proportion

Lesson #11
XI. Square Root and Radicals
- A. Definitions
- B. Approximate
- C. Exact Computation
- D. The Square Root of a Product
- E. Multiplication of Radicals
- F. Addition and Subtraction of Radicals
- G. Value of Mixed Expressions
- H. Finding the Square Root of a Fraction
- I. Rationalization of the Denominator of a Fraction
- J. Use of Fractional Exponents
- K. Division of a Radical

Lesson #12
XII. Quadratic Equations
- A. Definition
- B. Perfect Square Trinomials
- C. Solving by Completion of the Square
- D. Quadratic Equations with Irrational Roots
- E. A Formula for Solving Quadratic Equations
- F. Graphs of Quadratic Equations

Lesson #13
XIII. Quadratic Systems
- A. Equation of a Circle
- B. The Equation of a Parabola
- C. The Equation of an Ellipse
- D. One equation of a Hyperbola
- E. Second Equation of a Hyperbola
- F. Graphical Solution of a Linear Equation and a Quadratic Equation
- G. Algebraic Solution of a Linear and Quadratic Equation
- H. Graphical Solution of Two Quadratic Equations

Course Outline (Continued)

Unit II - Algebra (Continued)

Lesson #14
XIV. Logarithms
- A. Meaning of Logarithms
- B. Logarithms to the Base 10
- C. Determination of Complete Logarithms
- D. Finding N When Log N is Given
- E. Finding the Logarithms of numbers not given in the Tables
- F. Multiplying with Logarithms
- G. Dividing with Logarithms
- H. Finding Powers with Logarithms
- I. Finding Roots With Logarithms

Lesson #15
XV. Progressions and the Binomial Theorem
- A. Sequences
- B. Arithmetic Progressions
- C. Last Term of An Arithmetic Progression
- D. Finding Arithmetic Means
- E. Sum of An Arithmetic Progression
- F. Geometric Progressions
- G. The Last Term of a Geometric Progression
- H. Finding Geometric Means
- I. Sum of a Geometric Progression
- J. Expanding a Binomial
- K. Factorial Notation
- L. Finding a Particular Term of $(a + b)^n$
- M. Expansions with Negative and Fractional Exponents
- N. Finding a Root by the Binomial Theorem

Unit III - Geometry and Trigonometry

Lesson #1
I. Introduction of Mensuration
II. Squares and Rectangles
- A. Angles, right angles, squares and units of area
- B. Area of rectangles and related problems
- C. Square roots of various types of numbers

Lesson #2
III. Triangles
- A. Definitions of right triangle, base, altitude and hypotenuse
- B. Pythagorean Theorem
- C. Area of a right triangle
- D. Definition of isosceles triangle, base angle, base and vertex

Course Outline (Continued)

Unit III - Geometry and Trigonometry (Continued)

Lesson #2 (Continued)
- E. Area of an Isosceles Triangle
- F. Definition of an Equilateral Triangle
- G. Area of an Equilateral Triangle
- H. Define Scalene or Oblique Triangle and Find the Areas
- I. Angle Measurement and Sum of Angles in a Triangle

Lesson #3
- IV. Use of constants, area of quadrilaterals and scale Drawing
  - A. Hexagon, Octagon and the Use of Constants
  - B. Quadrilaterals
  - C. Use of Scale Drawings

Lesson #4
- V. The Circle and Ellipse
  - A. Radius, Diameter, Circumference and Area of a Circle
  - B. Arc, Sectors and Central Angles
  - C. Area of a Sector and Length of an Arc
  - D. Circumscribed and Inscribed Figures and Relationships
  - E. Segment of a Circle and its Area
  - F. Area of an Ellipse
  - G. Practical Application Problems and Formulas

Lesson #5
- VI. Solid Figures and Volumes
  - A. Volume and Surface Areas of Prisms, Cylinders, and Cones
  - B. Volumes and Surface Areas of a Frustum of a Cone or Pyramid
  - C. Volume and Surface Area of a Sphere
  - D. Volumes of Composite Figures

Lesson #6
- VII. Basic Geometric Construction Including Lines
  - A. Construction of Bisectors of Lines, Angles, and Arcs
  - B. Construction of Perpendiculars of Various Types to a Given Line
  - C. Construction of Parallel Lines to a Given Line
  - D. Division of a Line Into Any Number of Equal Parts
  - E. Construction of an Equilateral Triangle and Angles of any Size

Lesson #7
- VIII. Construction Involving Circles
  - A. Determination of Center of Circle or Circular Area

Course Outline (Continued)

Unit III - Geometry and Trigonometry (Continued)

Lesson #7 (Continued)
- B. Inscription of Various Types of Plane Figures in a Circle
- C. Construction of Circles Equal in Area to the Sum or Difference of the areas of two given circles
- D. Construction of Tangents of Various Types to a Given Circle or Circles

Lesson #8
- IX. Miscellaneous Constructions
  - A. Construction of a Square Equal in Area to the Sum or Difference of the Areas of Two Given Squares
  - B. Construction of a Square of a Given Area
  - C. Construction of a Hexagon With Sides of a Given Length and With One Side on a Given Line
  - D. Construction of an Octagon, an Ellipse, and a Pentagon

Lesson #9
- X. Introduction to Trigonometry

Lesson #10
- XI. The Oblique Triangle
  - A. Use of the Law of Sines in Solving an Oblique Triangle (2 Cases)
  - B. Use of the Law of Cosines to Solve an Oblique Triangle (2 Cases)
  - C. Use of Formulas Involving Trigonometric Functions to Find the Area of Triangle
  - D. Summary of Methods of Solving a Triangle of any Type.

Unit IV - Drawing

Lesson #1 Beginning Drawing
Lesson #2 Geometrical Construction
Lesson #3 Lettering
Lesson #4 Methods of Drawing
Lesson #5 Three View Drawing
Lesson #6 Three View Problems
Lesson #7 Sections
Lesson #8 Dimensions and Notes
Lesson #9 Drawing Exercises
Lesson #10 Drawing Exercises and Auxiliary Views
Lesson #11 Projection Study
Lesson #12 Topographical Drawing
Lesson #13 Reproduction of Drawings

Course Outline (Continued)

Unit V - Surveying

Lesson #1
- I. Field and Office Work
  - A. Description
    - (a) Field work
    - (b) Office work
    - (c) Errors
      1. Sources of errors
      2. Kind of error
      3. Theory of Probability
      4. Probable Value
      5. Probable Error

Lesson #2
- II. Measurement of Distances
  - A. Methods
  - B. Equipment for Chaining
  - C. Chaining on Level Ground
  - D. Horizontal Measurements over Uneven or Sloping Ground
  - E. Measurements on Slopes
    - (a) Corrections for Slopes
    - (b) Errors in Chaining; Corrections for Changes in Temperature
    - (c) Mistakes in Chaining

Lesson #3
- III. Measurements of Difference in Elevation
  - A. Curvature of the Earth; Refraction
  - B. Methods
    - (a) Direct or Differential Leveling
    - (b) Indirect or Trigonometric Leveling
    - (c) Profile Leveling
  - C. Direct Leveling
    - (a) General Applications
    - (b) Instruments
    - (c) Leveling Rods
    - (d) Reading the Rod

Lesson #4
- IV. Differential and Profile Leveling
  - A. Definitions
  - B. Procedure
  - C. Common Mistakes in Leveling
  - D. Errors in Ordinary Leveling
    - (a) Imperfect Adjustment of Instruments
    - (b) Earth's Curvature and Atmospheric Refraction
    - (c) Rod not Standard Length
    - (d) Rod not Held Plumb
    - (e) Faulty Turning Points
    - (f) Bubble not Exactly Centered at Time of Reading

Course Outline (Continued)

Unit V - Surveying (Continued)

Lesson #4 (Continued)
- E. Profile Leveling
- F. Vertical Curves
  - (a) Plotting Profiles
  - (b) Fixing Grades
  - (c) Borrow Pit Cross-sections
  - (d) Cut and Fill Stakes
  - (e) Cross Sections of Roadway
  - (f) Plotting and Computing Earthwork

Lesson #5
- V. Measurements of Angles and Direction
  - A. General Discussion
  - B. Magnetic Meridian
  - C. Magnetic Declination
  - D. Angles and Direction
  - E. Bearings
  - F. Azimuths
  - G. Deflection Angles
  - H. Traverses
  - I. Triangulation
  - J. Surveyor's Compass

Lesson #6
- VI. The Engineer's Transit
  - A. General Description
    - (a) Telescope
    - (b) Verniers
    - (c) Graduated Circles
  - B. Use of Transit
    - (a) Setting up the Transit
    - (b) Measuring a Horizontal Angle
    - (c) Common Mistakes
    - (d) Measuring an Angle by Repetition
    - (e) Measuring a Vertical Angle
    - (f) Prolonging a Straight Line

Lesson #7
- VII. Transit Tape Surveys
  - A. General Description
  - B. Transit Surveys
  - C. Radiation
  - D. Intersection
  - E. Traversing
    - (a) Deflection-angle Traverse
    - (b) Azimuth Traverse
    - (c) Traverse Computations
    - (d) Checking Traverses
    - (e) Referencing Transit Stations

Course Outline (Continued)

Unit V - Surveying (Continued)

Lesson #8
VIII. Stadia Surveying
- A. Principle of the Stadia
- B. Inclined Sights

Lesson #9
IX. Map Drafting
- A. Drawings of Surveying
  - a. Vicinity Map
  - b. Typical Sections
  - c. Standards

Lesson #10
X. Calculation of Areas of Land
- A. Methods of Determining Area
- B. Determining Plane Areas by Use of Coordinates

Lesson #11
XI. Topographic Surveying
- A. General Field Methods (Definition)
- B. Control
  - (a) Horizontal Control
  - (b) Vertical Control
- C. Site and Construction Surveys
  - (a) Alignment and Grade
- D. State Systems of Plane Coordinates

Lesson #12
XII. Route Surveying
- A. General (Definition)
- B. Preliminary Survey
  - (a) Transit-tape-level Method
  - (b) Transit-stadia Method
- C. Preliminary Profile and Map
- D. Location Survey: (Paper Location)
- E. Field Location and Office Work

Lesson #13
XIII. Construction Surveys
- A. General (Definition)
- B. Highways
- C. Bridges

Lesson #14
XIV. Curves
- A. Circular Curves
- B. Curve Formulas
- C. Laying Out Curve by Deflection Angles
- D. Transit Set-ups on Curves
- E. Transition Curves

Course Outline (Continued)

Lesson #15

XV. Cross-Sections
- A. Form of Cross-Sections
- B. Original Cross-Sections
- C. Final Cross-Section
- D. Cuts and Fills
- E. Setting Slope Stakes
- F. Plotting Cross-Sections
- G. Computations of Cross-Sections
  - (a) Volumes of Earth Work in General
  - (b) Volumes of Borrow Pits
  - (c) Volumes by Average End Areas

Lesson #16

XVI. Land Surveying
- A. Instruments and Methods
- B. Corners and Monuments
- C. Meander Lines
- D. Liability of a Surveyor
- E. Standard Lines
- F. Townships
- G. Sections
- H. Subdivision of Sections

Instructor's Lesson Plans

Unit I - Arithmetic

Lesson Plan 1 - Whole Numbers
Lesson Plan 2 - Common Fractions
Lesson Plan 3 - Mixed Numbers
Lesson Plan 4 - Decimal Fractions and Conversions
Lesson Plan 5 - Percentage, Ratio and Proportion, and Square Roots
Lesson Plan 6 - Measurements
Lesson Plan 7 - Plane Figures
Lesson Plan 8 - Solid Figures

Class Problem #1 - Whole Numbers and Common Fractions
Class Problem #2 - Percentages, Ratio and Proportion, Square Root and Measurements
Class Problem #3 - Land Measures, Plane Figures, and Solid Figures

Examination #1
Examination #2

Answer Sheet

Course Outline (Continued)

Unit II - Algebra

Lesson Plan 1 - Introduction to Algebra
Lesson Plan 2 - General Numbers
Lesson Plan 3 - Solving Problems by Equations
Lesson Plan 4 - Signed Numbers
Lesson Plan 5 - Graphs
Lesson Plan 6 - Equations with two Unknowns
Lesson Plan 7 - Product and Quotient of Literal Numbers
Lesson Plan 8 - Special Products and Factors
Lesson Plan 9 - Using Algebraic Fractions in Formulas and Equations
Lesson Plan 10 - Ratio and Proportion
Lesson Plan 11 - Square Roots and Radicals
Lesson Plan 12 - Quadratic Equations
Lesson Plan 13 - Quadratic Systems
Lesson Plan 14 - Logarithms
Lesson Plan 15 - Progressions and the Binomial Theorem

Unit III - Geometry and Trigonometry

Lesson Plan 1 - Introduction to Mensuration
Lesson Plan 2 - Triangles
Lesson Plan 3 - Use of Constants, Area of Quadrilaterals, and Scale Drawing
Lesson Plan 4 - The Circle and Ellipse
Lesson Plan 5 - Solid Figures and Volumes
Lesson Plan 6 - Basic Geometric Constructions Involving Lines
Lesson Plan 7 - Constructions Involving Circles
Lesson Plan 8 - Miscellaneous Constructions
Lesson Plan 9 - Introduction of Trigonometry
Lesson Plan 10 - The Oblique Triangle

Test on Unit 3 Lesson Plans 1, 2, and 3
Test on Unit 3 Lesson Plans 4 and 5
Test on Unit 3 Lesson Plans 6, 7, and 8
Test on Unit 3 Lesson Plans 9 and 10

Answer Sheet

Unit V - Surveying

Lesson #1 - Field and Office Work
Lesson #2 - Measurement of Distances
Lesson #3 - Measurements of Difference in Elevation

Course Outline (Continued)

Unit V - Surveying (Surveying)

Lesson #4 - Differential and Profile Leveling
Lesson #5 - Measurements of Angles and Directions
Lesson #6 - The Engineer's Transit
Lesson #7 - Transit Tape Surveys
Lesson #8 - Stadia Surveying
Lesson #9 - Map Drafting
Lesson #10 - Calculation of Areas of Land
Lesson #11 - Topographic Surveying
Lesson #12 - Route Surveying
Lesson #13 - Construction Surveys
Lesson #14 - Curves
Lesson #15 - Cross-Sections
Lesson #16 - Land Surveying

Test on U5LP 1, 2, & 3
Test on U5LP 4
Test on U5LP 5, 6, & 7
Test on U5LP 8, 9, & 10
Test on U5LP 11, 12, 13, 14, 15, & 16

Answers for U5 Lessons Plans

Answers for Tests for Unit 5

The Business Letter Writing For Industrial Supervisors Course was written in 1959. It is available in book form. This book consists of 13 Lessons. An Instructor's Guide is also available.

The references for this course are listed below.

Title	Source
Hagar, Stewart, and Hutchinson BUSINESS ENGLISH AND LETTER WRITING	McGraw-Hill Book Company, Inc. 330 West 42nd Street New York 36, New York
Robertson and Carmichael, BUSINESS LETTER ENGLISH, 2nd Edition	McGraw-Hill Book Company, Inc. 330 West 42nd Street New York 36, New York
Gavin and Hutchinson, REFERENCE MANUAL FOR STENOGRAPHERS AND TYPISTS, Second Edition	McGraw-Hill Book Company, Inc. 330 West 42nd Street New York 36, New York
Lucy Graves Mayo, COMMUNICATIONS HANDBOOK FOR SECRETARIES	McGraw-Hill Book Company, Inc. 330 West 42nd Street New York 36, New York

A detailed outline of the Business Letter Writing For Industrial Supervisors Course follows:

Lesson I: Business Letter Writing
- A. Past
- B. Present
- C. Future

Lesson II: Why We Write Business Letters
- A. Four Basic "musts" of business correspondence
  1. Clearness
  2. Completeness
  3. Conciseness
  4. Courtesy

Lesson III: Overhead and the Business Letter
The Words We Use
- A. Master-Bailiff words and phrases
- B. Overworked words and phrases
- C. Unnecessary repetitions
- D. Negative Words

Lesson IV: Business Letter Format
- A. The Parts of a Business Letter
  1. The heading
  2. The date line
  3. The inside address
  4. The attention line

Course Outline (Continued)

5. The salutation
6. The subject line
7. The body of the letter
8. The complimentary closing
9. The signature lines
10. Identification initials
11. Enclosure reference

Lesson V: Styles in Business Letters
- A. Style accessories
- B. Eight styles for study
  1. Blocked
  2. Semiblocked
  3. Indented
  4. Full blocked
  5. Two-page Modified Block
  6. Hanging-indented
  7. Square-blocked
  8. The Simplified Letter

Lesson VI: Paragraphing and Business Letter
- A. The opening paragraph
- B. Paragraph or paragraphs containing the message
- C. The closing paragraph containing words of leave-taking

Lesson VII: Writing the Letter
- A. Classification of business letters
- B. A specimen formula

Lesson VIII: Credit and Collection Letters
- A. The three credit "C's"
- B. Letters granting credit
- C. Letters refusing credit
- D. Classification of credit risks
- E. Four collection letters

Lesson IX: Order Letters
- A. A formula for order letters
- B. Acknowledgments of routine orders
  1. Faulty orders
  2. Unavoidable delays in shipment
  3. Welcome to new customers

Lesson X: Inquiries and Requests
- A. Solicited inquiries
- B. Unsolicited inquiries
- C. Mutual-inquiry requests

Lesson XI: Claim and Adjustment Letters
- A. Formula for a claim letter
- B. Formula for granting an adjustment
- C. Formula for refusing a claim
- D. Formula for a compromise settlement offer

Course Outline (Continued)

Lesson XII: Sales Letters
- A. The relation between sales and human behavior
- B. The general principles applicable to sales letters
- C. The letter plan designed especially for sales letters
  1. Arouse interest
  2. Create desire
  3. Convince the prospect
  4. Get action

Lesson XIII: Form Letters

The Conference Leadership material was written in 1958. The material is complete and bound in one book. The Hand Outs can be ordered separately if needed.

There are no references. A detailed course outline follows.

Introduction

I. The Conference
   1. Kinds of conferences
   2. The training conference - definitions
      a. What it is not
      b. A typical sequence of events
   3. Conference training and vocational education
   4. Comparison of conference methods
   5. The "J" programs
      a. Canned vs. tailored programs
   6. Executive development programs
   7. Definition of terms
   8. Public relation values to schools
      a. Supervisor role in hiring
      b. A definite useful service to industry
      c. Entree to other programs

II. The Conference Leader
   A. The leader
      1. A social skill
      2. Personal values
      3. Duties of the leader
      4. Techniques
      5. Need for continuous study, practice and self evaluation
      6. Not to expert
   B. The Conferee
      1. Line and staff
      2. Experience and its effect on the conference
      3. Typical characters and how to handle
      4. Seating
      5. Scheduling of conference
      6. One or more companies
      7. Size of the groups

III. Preparing for a Conference
   A. The Outline
      1. How to go about making it - forms
      2. Formulation question and objectives
      3. Notes in margin
      4. Plan what is to be charted
         a. Chart headings
      5. Plan the visual aids

Course Outline (Continued)

III. Preparing for a Conference (Continued)
    6. Techniques in planning group participation
        a. Role playing
        b. Buzz sessions
        c. Quiz sheets
        d. Evaluate by rating
        e. Hand out
        f. Film case
    7. Your source material
        a. Current magazines
        b. Other reports
        c. Basic reading library (hand out list)
        d. Files - by block and by subject (helpful sources)
    8. Learn your outline
    9. Samples of conference outlines
B. Aids and Devices
    1. The chart of blackboard
    2. Projector equipment and films
    3. Charts, graphs, etc.
    4. Flannel Board
    5. Balancing ring
C. Physical Arrangements
    1. The room
        a. Free of distraction
        b. Near comfort facilities
    2. Tables
        a. Destroy classroom atmosphere
        b. Ways of arranging table
        c. Who arranges the room
    3. Name cards - in advance
        a. How to insert names
        b. Do not move around
        c. Used for enrollment purpose.
    4. Projector, extension cord, etc.
    5. Charts, paper, etc.
    6. Leaders position, rostrum - affect on seating
    7. Time needed to make arrangements
    8. Plant pass

IV. Conducting a Conference
A. First Conference - getting started
    1. Introduction - yourself by a Company or School Official - information about yourself and others
    2. Graphic demonstration (3 ring)
    3. Swapping dollars

Course Outline (Continued)

IV. Conducting a Conference (Continued)
    4. Outline responsibility - yours and theirs - cards
    5. Place cards - do not switch
    6. Hand out session titles
    7. Conference mood
  B. Keeping on the track
  C. Chart objectives and first question
  D. Pacing the conference
  E. Conference situations
  F. Key probing words
  G. To initiate, stimulate, and control discussion
  H. Draw all into discussion
  I. Start and stop on time
  J. Deal with principles not personalities
  K. Gain and hold confidence of group
  L. Remember minority groups
  M. Do not expert
  N. Presents information or cases in the third person
  O. Do not let conference become too academic
  P. Gestures and movements - redirect thinking
  Q. Humor and its use
  R. Evaluates by order of preference not voting
  S. Side tracking a subject for future consideration
  T. Avoid the feeling that all you're trying to do is develop a list
  U. Hints on overcoming "stage fright"
  V. Rate instead of voting
  W. Mother Hubbard terms
  X. Evaluation
    1. Self
    2. Rating sheets
    3. Participation charts
    4. Group reaction
    5. For the company
    6. Any repeats?
    7. Value to your school
    8. Work shop and other evaluators
    9. The conference report
  Y. Visitors
  Z. Break after one hour
  AA. Common weakness of inexperienced conference leaders
    1. Spends too much time getting definition
    2. Votes on importance of contribution
    3. Opposite or reverse charting contribution
    4. Does not reach conclusion
    5. Becomes a slave to rapid contributions
    6. Starts with an excessive group
    7. Drives too hard
    8. Looses control - fails to plan closing of session
    9. Participants freeze
    10. Thrown by Mother Hubbard

Course Outline (Continued)

V. The Conference Report
   1. What it is and why write it
   2. What information to and not to include
   3. Mechanics of writing and binding
   4. Copies to print
   5. Piece meal type of report
   6. What the bound volume should include

VI. Scope of Supervisory Personnel Development
   1. Interest makes it broad
   2. Functions of local school and State Department of Education
   3. Canned vs. tailored
   4. Methods
      a. Conference series
      b. Workshop
      c. Panels
      d. Symposiums
      e. Question and answer method
      f. Case study
      g. Brainstorming
      h. Lecture
   5. Typical content of programs
      a. Now and expected needs
      b. Skill development - heavy participation
   6. Typical prospects for supervisory personnel development programs
   7. Approaching industry
   8. Local and national organizations that are helpful
   9. "Call Staff" and its use
   10. The "Executive Development" idea

VII. The Forty-hour Workshop
   1. How material is presented
      a. Hand outs and binders
   2. Topics for practice conferences
   3. Time schedule
   4. Evaluation
   5. Practice report writing
   6. Use of outside help
   7. Displace aids and references
   8. The film "All I Need is a Conference"
   9. Demonstrate techniques
   10. State specific objectives for the workshop
   11. Use variety of techniques
   12. Surplus stock of material
   13. Prompt on first practice session

Course Outline (Continued)

Unit VII (Continued)

14. Round-robin idea
15. Selection of participants
16. Reversing the procedure
17. Participants reach a level of experting

Appendix

Slides to be used with this course are also available. There are 54 slides in a set at $1.00 per slide.

Industrial Economics was written in 1964. It is available in bound form in one book.

The reference for the Industrial Economics Course is the following:

Title	Source
INDUSTRY AND THE AMERICAN ECONOMY (11 booklets)	National Association of Manufacturers Education Department 2 East 48th Street New York 17, New York

A detailed outline of the Industrial Economics Course follows:

Session I - Introduction to Free Competitive Enterprise

Session II - What Makes an Economy Grow

Session III - The Role of Competition

Session IV - The Role of Marketing

Session V - Incentive and its Results

Session VI - The Role of Organization in our Economy

Session VII - Government's Role in our Economy

The Extemporaneous Talk for Industrial Supervisors was published in 1959. It is available in book form.

The references for this course are as follows.

Title	Source
Effective Expression Part D	USAF Extension Course Institute Superintendent of Pub. Documents Washington 25, D. C.
Effective Expression Part E	USAF Extension Course Institute Superintendent of Pub. Documents Washington 25, D. C.
Irving J. Lee How To Make The Safety Speech	National Safety Council 425 North Michigan Avenue Chicago 11, Illinois
M. Joseph Dooher Effective Communication on the Job	American Management Association 1515 Broadway - Times Square New York 36, New York
Richard C. Borden Public Speaking as Listeners Like It	Harper & Brothers Publishers 49 East 33rd Street New York 16, New York
William Norwood Brignance Speech Communication	Appleton-Century-Crofts, Inc. 35 W. 32nd Street New York 1, New York
Rudolf Flesch The Art of Plain Talk	Harper & Brothers Publishers 49 East 33rd Street New York 16, New York
Edward L. Friedman The Speechmaker's Complete Handbook	Harper & Brothers Publishers 49 East 33rd Street New York 16, New York
Irving J. Lee How to Talk With People	Harper & Brother Publishers 49 East 33rd Street New York 16, New York
Effective Speaking for Supervisory Personnel	Trade & Industrial Ed. Service Division of Vocational Education State Department of Education Columbus, Ohio

An outline of the material follows.

Part I
You and Speech

Part II
Stage Fright

Part III
Planning Your Speech

Part IV
Delivering Your Speech

Part V
Adding Zest To Your Speech

Appendix
"A Speech That Fits Any Occasion"

Bibliography

Slap-ons
Session No. 1
Session No. 2
Session No. 3
Session No. 4
Session No. 5

The Highway Economics Course was published in 1960. It is available in book form.

The references for the Highway Economics Course are the following:

Title	Source
Bach, G. L., ECONOMICS, AN INTRODUCTION TO ANALYSIS AND POLICY, 3rd Ed.	Prentice-Hall, Inc., Englewood Cliffs, New Jersey
Hailstones, Thomas J., BASIC ECONOMICS	Southwestern Publishing Co. 221 Pacific Avenue Dallas 2, Texas
Samuelson, Paul A., ECONOMICS, AN INTRODUCTORY ANALYSIS, 4th Ed.	McGraw-Hill Book Company 330 West 42nd Street New York 36, New York
Federal Reserve Bank of St. Louis, YOUR MONEY SUPPLY	Research Department Federal Reserve Bank of St. Louis St. Louis, Missouri
Shultz, Wm., J. and Harriss, C. L., AMERICAN PUBLIC FINANCE, 6th Ed.	Prentice-Hall, Inc., Englewood Cliffs, New Jersey
Automotive Safety Foundation LOUISIANA'S HIGHWAY PROBLEM	Automotive Safety Foundation Washington D. C.
Biannual report of the Highway Commission of Louisiana, REPORT	Louisiana Department of Highways Baton Rouge, Louisiana
Public Affairs Research Council LOUISIANA STATE AGENCIES HANDBOOK	Public Affairs Research Council of Louisiana Baton Rouge, Louisiana
STATE OF LOUISIANA HIGHWAY FINANCE	Public Affairs Research Council of Louisiana Baton Rouge, Louisiana
Ross, William D., FINANCING HIGHWAY IMPROVEMENTS IN LOUISIANA	Division of Research College of Commerce Louisiana State University Baton Rouge, Louisiana

A detailed outline of the Highway Economics Course follows:

Preface

Session I - Introducing the Economic System

1 - Business and People
2 - Money's Place in the System
3 - Prices and Their Function Under Capitalism
4 - Government
5 - Other Business (Capital Goods)
6 - Summary

Session II - The Performance of the Economy

A - Introduction
B - Recessions and Depressions
  1 - Cures for Recession
  2 - Inflation
  3 - Cures for Inflation
Appendix A - The Special Role of Money and Banks
  1 - Money Supply
  2 - The Role of Banks
  3 - The Control of Banks and the Money Supply

Session III - The Role of Government

A - Introduction
B - Government Spending
  1 - The "Comparative Benefit" Principle
  2 - Expanding Government's Service
  3 - Is Government Spending Mere Waste?
C - Taxes
  1 - The "Benefit" Principle
  2 - The "Ability-to-pay" Principle
D - Government Debts and Borrowing
  1 - Why Borrow?
  2 - The Real Dangers and Limits of Debt

Session IV - The Highway Dollar--Source

A - Introduction
B - Sources of Tax Income
  1 - The Gasoline Tax and Its Use
  2 - Motor Vehicle Tax
  3 - Other Taxes
  4 - Other Tax Idea
C - Dedication and Limitations
  1 - Economic Limitations
  2 - The Nature of Dedicated Revenues

Course Outline (Continued)

Session IV - (Continued)

D - Other Sources of Income
1 - Mineral Lands
2 - General Fund Appropriations
3 - Federal Grants-in-aid
4 - The Interstate System
E - Borrowing for Highways
1 - The Reason for Borrowing
2 - To borrow or not to borrow
Appendix B - Bonds and the Bond Market
1 - The Borrowing Process
2 - Interest, the Cost of Borrowing
F - Summary
1 - A Recent History
2 - The Long Range Highway Program
3 - Highway and the Economy

Session V - The Highway Dollar, Expenditures

A - Introduction
B - Construction
1 - Paying for Construction
2 - Contracting and Construction Work
C - Maintenance
D - Debt
1 - Who Pays for the Debt
E - Other Costs and Expenditure
1 - State Aid to Parishes and Cities
2 - Employees and Spending
F - Collecting from Highways

Table 1 - Detail of Resources and Expenditures, Highway Department

Table 2 - Encumbered Funds, by Purpose

Table 3 - Estimates of Highway User Taxes Dedicated To Highway Department (In Thousands)

Table 4 - State Aid to Parishes

Industrial Housekeeping was written in 1962. It is available in bound form in one book.

A detailed outline of Industrial Housekeeping follows:

Session I - Indoctrination and Overview of Program
Definitions - Policies - Practices - Results

Session II - Housekeeping and You

Session III - Housekeeping and The Company

Session IV - Fire Protection and Good Housekeeping

Session V - What Can We (The Company and The Employee) Do To Improve and Maintain a Good Housekeeping Program?

Industrial Relations for Supervisory Personnel was written in 1965 and is available in bound form in one book. It is composed of eight sessions.

A detailed outline of Industrial Relations for Supervisory Personnel follows:

The First Session	- History and Principles of Industrial Relations
The Second Session	- Personnel Management
The Third Session	- Employee Training
The Fourth Session	- Joint Relations and Collective Bargaining
The Fifth Session	- Union Security, Management Rights, and Arbitration
The Sixth Session	- The Labor Union in the Plant
The Seventh Session	- Wage and Salary Administration
The Eighth Session	- Seniority, Job Evaluation, and Merit Rating

Interviewing for Supervisory Personnel was written in 1963. It is available in bound form in one book.

A detailed outline of Interviewing For Supervisory Personnel follows:

The First Session	- Interviewing Responsibilities of Supervisors
The Second Session	- Counseling Interview
The Third Session	- The Employment Interview (Background and Planning)
The Fourth Session	- The Employment Interview (Conducting and Evaluating)
The Fifth Session	- The Performance Interview
The Sixth Session	- The Corrective Interview
The Seventh Session	- Other Interviews (The Exit Interview, The Stress Interview, The Group Interview, The Board Interview, and the Grievance Interview)
The Eighth Session	- Practice Interviewing

The Introduction to Management for Industrial Supervisors Course was written in 1964 and is available in bound books.

A detailed course outline follows.

Session I History of Management

Session II Organizational Structure

Session III Major Responsibilities of Management

Session IV Organized Labor

Session V Leadership

Bibliography

Handout Material

Handout 1 Course Contents

Handout 2 Objectives of Management

Handout 3 Principles of Scientific Management

Handout 4 Summarization of the Hawthorne Experiment

Handout 5 Characteristics of the Corporation

Handout 6 Corporate Form of Organization

Handout 7 Authority, Responsibility, and Delegation

Handout 8 Line-Type Organization

Handout 9 Line and Staff Organizational Structure

Handout 10 Planning--A Function of Management

Handout 11 Organizing--A Function of Management

Handout 12 Delegating--A Function of Management

Handout 13 Controlling--A Function of Management

Handout 14 Co-ordinating--A Function of Management

Handout 15 Structural Organization of the American Federation of Labor and Congress of Industrial Organization

Course Outline (Continued)

Handout 16	The Structure of the A.F.L.-C.I.O. in Louisiana
Handout 17	The Supervisor--Driver or Leader?
Handout 18	Qualifications for Leadership
Handout 19	Leadership Self-Appraisal Test
Handout 20	Principles of Effective Human Relations

Listening was written in 1962. It is available in bound form in one book. Slides which are used with the course are available.

A detailed outline of Listening follows:

Introduction

Chapter I, Section I, Why Listen - Outline

Chapter I, Section I, Why Listen

Section Two, Introduction

Chapter I, Section II, Exercise

Chapter II, Section I, What Happens - Outline

Chapter II, Section I, What Happens

Chapter II, Section II, Exercise

Chapter III, Section I, What's the Matter and What to do - Outline

Chapter III, Section II, Exercise

Chapter IV, Section I, What Strikes the Ear - Outline

Chapter IV, Section I, What Strikes the Ear

Chapter IV, Section II, Exercise

Chapter V, Section I, Semantics - Outline

Chapter V, Section I, What Do You Mean

Chapter V, Section II, Exercise

Chapter VI, Section I, No H-Ear - Outline

Chapter VI, Section I, No H-Ear

Chapter VI, Section II, Exercise

Films

Books

Course Outline (Continued)

Published Articles

Sources - Recorded Materials

Hamlet Text

Slides to be used with this course are also available.
There are 46 slides in the set at $1.00 per slide.

Report Writing was written in 1963. It is available in bound form in one book.

A detailed outline of Report Writing follows:

The First Session - The Importance of Report Writing

The Second Session - The Characteristics of a Good Report

The Third Session - Organization and Form in Report Writing

The Fourth Session - The Style of the Report

The Fifth Session - How to Outline a Report

The Sixth Session - Writing the Report

The Seventh Session - The Use of Illustrations and Tables

The Eighth Session - Problems in Preparing and Writing Reports

The Ninth Session - The Oral Presentation of a Report

The Tenth Session - Security Requirements

Understanding Human Nature was written in 1959. It is available in book form. There are eight sessions, each session is bound separately. The ninth book will be the Handouts, Self-tests and Student Summary.

The references for the Understanding Human Nature Course are the following:

Title	Source
Anastasi, Ann DIFFERENTIAL PSYCHOLOGY	The Macmillan Company 60 Fifth Avenue New York 11, New York
Cameron, Norman, THE PSYCHOLOGY OF BEHAVIOR DISORDERS	Houghton Mifflin Company 432 Fourth Avenue New York 16, New York
READER'S DIGEST, April, 1947	Reader's Digest Association, Inc. Pleasantville, New York
Harper, Robert A., PSYCHOANALYSIS AND PSYCHOTHERAPY	Prentice-Hall, Inc. Englewood Cliffs, N. J.
Hepner, Harry Walker PSYCHOLOGY APPLIED TO LIFE AND WORK	Prentice-Hall, Inc. Englewood Cliffs, N. J.
Leavitt, Harold L., MANAGERIAL PSYCHOLOGY	University of Chicago Press 5750 Ellis Avenue Chicago 37, Illinois
Maier, Norman R.F., PSYCHOLOGY IN INDUSTRY Second Edition	Houghton Mifflin Company 432 Fourth Avenue New York 16, New York
Marlow, A. H., MOTIVATION AND PERSONALITY	Harper and Brothers 49 East 33rd Street New York 16, New York
Mullahy, Patric , Oedipus, MYTH AND COMPLEX	Hermitage House, Inc. 8 West 13th Street New York 11, New York
Smith, Karl U. and William M. Smith THE BEHAVIOR OF MAN	Henry Holt and Co., Inc. 383 Madison Avenue New York 17, New York
Tiffin, Joseph and Earnest J. McCormick, INDUSTRIAL PSYCHOLOGY	Prentice-Hall, Inc. Englewood Cliffs, N. J.

A detailed outline of Understanding Human Nature follows:

First Session - People are All alike in Different Ways

I. People are all the Same
   A. Popular Generalizations
   B. Useful Generalizations
      1. All Behavior Is Caused
      2. All Behavior Is Motivated
      3. All Behavior Is Goal-Seeking
      4. Self-Actualizing Urge
      5. Same Basic Needs
      6. Products of Heredity and Environment

II. People Are All Different
   1. Different Bases of Behavior
   2. Different Need-Behavior

Second Session - Human Needs - Origin of Behavior

I. Blueprint and Behavior

II. Levels of Needs

Third Session - What Makes People The Way They Are?

I. What Determines Personality?
   1. Receptors
   2. Connectors
   3. Effectors
   4. Endocrine Glands

   1. Sources of Satisfactions
   2. Care in Infancy
   3. Examples Set by Parents
   4. Treatment by Intimates
   5. Demands vs Capacities
   6. Success vs Failure

II. Psychoanalytic Interpretations

Fourth Session - What Makes People the Way They Are (Continued

I. Frustration

II. Significant Traits

III. Habits--Curse or Blessings?

Fifth Session - Nature and Uses of Motivation

I. The Nature of Motives

II. Universal Motives

III. Applying Motivation

Sixth Session - Attitudes and Morale

I. Checking Attitudes

II. How Attitudes Work
1. Imitation
2. Emotional Experiences
3. Informative Experiences
4. Self-Cultivation

III. Job Aspects Important to Workers

IV. Team Spirit on the Job
1. Supervisory Relationships
2. Decision Making
3. Clean Communications

Seventh Session - How Working Conditions Affect Human Behavior

I. The Human Nature of Accidents
1. Vision
2. Age or Length of Service
3. Emotions
4. Mental Ability
5. Impulsiveness
6. Popularity

II. Working Conditions and Efficiency
1. Visual Conditions
2. Noise Conditions
3. Temperature Conditions
4. Work Hours
5. Rest Pauses
6. Boredom

III. Human Engineering
1. Information-Receiving
2. Decision-Making
3. Action-Taking

Eighth Session - How Co-Workers Affect Behavior of Each Other

I. Person-to-Person Behavior

II. Structure and Operation of a Group

III. Communication Systems in Groups

Selected Bibliography

Handouts #1, 2, 3, 4.

Slides to be used with this course are also available.
There are 76 slides in a set at $1.00 per slide.

Work Simplification was written in 1962. It is available in bound form in one book.

A detailed outline of Work Simplification follows:

The First Session, Part I	Introduction to the Program
The First Session, Part II	Discussion of the Work Distribution Chart
The Second Session	Group Laboratory Meeting on The Work Distribution Chart
The Third Session	Discussion of the Process Chart
The Fourth Session	Group Laboratory Meeting on the Process Chart
The Fifth Session	Discussion of the Work Count
The Sixth Session	Individual Laboratory on the Work Count
The Seventh Session	Final Group Laboratory "Work Simplification Roundup"

Slides to be used with this course are also available. There are 72 slides in a set at $1.00 per slide.

ED013339

A Suggested
Guide for a
Training Course

ELECTRICAL APPLIANCE SERVICEMAN

VT 02409

U.S. Department of Health, Education, and Welfare
Office of Education

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

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ELECTRICAL APPLIANCE SERVICEMAN

(D.O.T. Occupational Code 5-83.041)

Suggested Guide for a Training Course

U.S. Department of Health, Education, and Welfare
John W. Gardner, Secretary

Office of Education
Francis Keppel, Commissioner

Manpower Development and Training Program

Developed and first published
pursuant to a contract with the U.S. Office of Education
by
Oklahoma State University
1965

FOREWORD

Electrical appliance repair has become important to the American householder and to the American economy as the number of electric motors has multiplied and as automatic controls have become more commonplace. Work performed by the electrical appliance serviceman involves locating trouble, installing new parts, testing the appliance, and making minor adjustments to insure proper functioning of the unit. The serviceman needs a general understanding of the functions of all appliances, although he may develop special competency in one type or "line" of equipment.

The appliance serviceman should have an understanding of good business practices and should know how to get along well with customers. He must be tactful and courteous and should present a neat, clean appearance.

The increase in marriages and population growth will continue to make the demand for appliances high. The complexity of many modern appliances places heavy emphasis upon the need for skilled servicemen to handle problems of malfunction. Capable servicemen with a working knowledge of electricity, electronics, and mechanical devices will find many job opportunities open to them. Preparation for employment through vocational courses should open the way for many job opportunities within the occupation.

The hours allocated in the guide to the various units are merely a suggestion. Active advisory committees should be called upon by the school administrator when arranging courses to meet local conditions in the industry. The course content should be considered flexible enough to meet local appliance shop conditions and the level of the group to be trained.

Pertinent references are given at the end of each Course Unit in this publication. A complete list of references, with the names of authors, titles, publishers, and addresses is given in the Suggested List of Textbooks and References.

Prepared under contractural arrangement with the Oklahoma State University, the material has been reviewed by competent advisory groups. Recognition is given to Maurice W. Roney, Director, School of Industrial Education, for having supervised the development of the content, and to L. Carl Love, Oregon State University, Corvallis, for his assistance as a consultant during the preparation of the guide.

Walter M. Arnold
Assistant Commissioner for
Vocational and Technical Education

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TRAINING COURSE FOR ELECTRICAL APPLIANCE SERVICEMAN

Purpose of the Guide

This training guide has been prepared to assist in planning and developing the course of training for workers who expect to find employment in the field of household appliance maintenance and repair. The guide has been organized in a manner to be of maximum value to school administration personnel who are not themselves specialists in the occupation. Sufficient details have been included, however, to provide an outline of instruction for the instructor who will be expected to develop and operate an efficient training program.

No attempt has been made to cover every detail of instruction, but rather to suggest a basic approach to the training of electrical appliance servicemen. The suggested course outline may require modification to meet special needs. The sequence of presentation as well as the final selection of topics for special emphasis should be determined by instructional specialists and will vary, depending upon the needs and background of the trainee group. Supplemental material may be found in the suggested textbooks, references, manufacturers' bulletins and catalogs, and films.

Although this training guide has been developed primarily for use by the Manpower Development and Training Program, it includes instructional material that will help those people involved to develop and advance beyond the basic skill requirements for job application. Much of the related material included in the course outline has been added specifically for the purpose of assisting the trainee to meet the public and to progress beyond the entry level classification.

Job Description

The work of the electrical appliance serviceman requires a knowledge of mechanical and electrical devices such as those used in homes. In the larger cities, the appliance repairman may specialize in certain types of appliance work. However, many small dealers require employees who are competent in the range of jobs normally found in the field of appliance repair. There are many distinctly different types of jobs in this industry; the repairman needs to have some broad understanding of the function of all appliances, although he may develop a special competency in one type of equipment.

The serviceman in this field of work may have a great deal more contact with the public than either the salesman or the management; consequently, the appliance serviceman needs to have some of the abilities of the salesman and some understanding of good business practices. Good public relations are important. Much of the minor repair work of an appliance repairman will be carried on at the customer's home. Good personal habits of cleanliness, promptness, honesty, and courtesy are mandatory.

The demand for trained workers far outweighs the supply; yet there is considerable competition for the good jobs. The average worker can expect earnings of about $5,700 per year.

Length of Course and Course Units

The training course as outlined covers a period of 28 weeks with a total of 840 hours of class instruction and laboratory practice. Instruction is planned for 6 hours per day and 5 days per week.

Unit	Title	Suggested class hours	Suggested laboratory hours
I.	Related Instruction	110	0
II.	Fundamentals of Electricity	40	110
III.	Basic Controls and Electronic Components	50	140
IV.	Resistance Heating Appliances	10	40
V.	Motors for Electric Appliances	15	60
VI.	Motor Driven Appliances	10	100
VII.	Refrigeration	25	100
VIII.	Miscellaneous Operations	8	22
	Sub-total	268	572
			268
		Total	840

Qualifications of Trainees

Generally, the equivalent of a high school education is expected of candidates prior to training. This is important because the serviceman is actually representing his organization to the public. Since public relations are so important, the trainee is expected to have the ability to greet customers on a friendly, yet business-like basis. Being a good listener, while not mandatory, may be exceedingly helpful in providing clues for diagnosing existing appliance problems.

Trainees are expected to possess enough initiative to work out the specific servicing problems. Workers in this field, which is becoming more technical each year, are expected to possess a continuing desire to learn about new products, new installations, new tools, and new testing equipment.

Teacher Qualifications

A teacher for this program must have experience in electrical appliance repair and preferably, should have business experience as an owner or operator of an appliance repair service.

If the person selected for this teaching assignment has no teaching experience, he should be given teacher education including fundamental principles of lesson planning and presentation.

Suggestions for the Organization of Instruction

The total program in this guide is intended to develop a skill-level which will qualify individuals for employment. While this is the major objective, the program is also designed to provide the trainee with a background of related material that will help him develop versatility and enable him to meet the changing requirements in the appliance service field.

Laboratory experiences, as well as classroom instruction, should be carefully selected to give the trainee as many varied experiences as possible. When the training program is being organized the instructor should evaluate the total experiences listed in view of local requirements.

The allocation of hours to each unit of instruction serves to indicate the relative emphasis to be placed on the units. However, this program was designed to represent a typical situation, and changes in the distribution of time may be necessary to adapt the program to local conditions and to the background of the group in training. The sequence of instructional units shown in the outline may be varied in any way. For example: the unit on Related Instruction may be spread throughout the course in one or two weekly sessions. Further, the ratio of classroom time to actual shop practice should be left to the discretion of the instructor.

This training guide was designed for a class of 20 persons, but the optimum trainee-teacher ratio in the laboratory would be about 10 to 1.

Course Unit I

RELATED INSTRUCTION

Training Time Classroom, 110 hrs; laboratory, 0 hours

Objectives

To orient trainees to the nature and scope of the electrical appliance serviceman's work and to provide certain specialized skills trainees will need for successful employment.

To provide selected skills in mathematics, business English, and business practices.

Unit Outline

A. Orientation
   1. Class procedure
   2. Methods of evaluating progress
   3. Safety in industry
   4. How to use parts and service manuals
B. Basic Mathematics
   1. Definition of terms
   2. Using fractions and decimals
   3. Shop computations involving measurement and conversion factors
C. Business English
   1. Spelling
   2. Use of words
   3. Sentence structure
   4. Composition
D. Business Practices
   1. Public relations
   2. Salesmanship

References

Blumenthal, Joseph C. English 3200: A Programmed Course in Grammar and Usage.

Fergus, Patricia M. Spelling Improvement: A Program for Self-Instruction.

Graham, Frank Duncan. Audel's New Electric Library.

Huffman, Harry. Programmed Business Mathematics, Concepts, Skills, and Applications, Parts I and II.

Parkhurst, Charles Chandler. English for Business, 4th Edition.

See SUGGESTED LIST OF TEXTBOOKS AND REFERENCES for complete details on ordering books

Course Unit II

FUNDAMENTALS OF ELECTRICITY

Training Time Classroom, 40 hrs; laboratory, 110 hours

Objectives

To develop an understanding of basic electrical theory, use of testing equipment, and safety relating thereto.

Unit Outline

A. Introduction to electricity
B. Definitions and explanations of terms
C. Discussion of atomic structure
D. Discussion of the flow of electricity
E. Explanation of electrical symbols
F. A discussion of the electrical circuit and Ohm's Law
G. Introduction to Kirchhoff's Law
H. Explanation of testing equipment
I. Use, care, and safety of tools and testing instruments
J. Introduction to future appliances
   1. Dielectric heating
   2. High frequency heating
   3. Electric devices

Suggested Laboratory Exercises

1. Exercises in reading electrical symbols
2. Problems in electrical circuitry involving Ohm's Law
3. Exercises in drawing involving the use of electrical symbols
4. Analysis of electrical devices involving the use of test equipment

References

Graham, Frank Duncan. Audel's New Electric Library.
Suffern, M. G. Basic Electrical Principles.

Course Unit III

BASIC CONTROLS AND COMPONENTS

Training Time Classroom, 50 hrs; laboratory, 140 hours

Objectives

To provide understanding of principles and practices in the repair and replacement of electro-mechanical sensing devices and controllers.

Unit Outline

A. Introduction to theory of electronics
B. Definition and explanation of terms
C. Electronic symbols
D. Identification of schematic drawings
E. Manual switching
F. Electro-mechanical switching devices
G. Electric timers
H. Use of thermostats
I. Methods of speed control

Suggested Laboratory Exercises

1. Locating basic controls from a schematic drawing
2. Troubleshooting controls with power off
3. Testing controls while in operation
4. Analysis of machine controls while operating with full load or overload
5. Precautions to be taken during removal and replacement of controls
6. Analysis of whether to repair or replace specific controls

References

Graham, Frank Duncan. Audel's New Electric Library.
Schweitzer, Gerald. Basis of Fractional Horsepower Motors & Repair.
Westinghouse. Factory Testing of Electrical Apparatus.

Course Unit IV

RESISTANCE HEATING APPLIANCES

Training Time Classroom, 10 hrs; laboratory, 40 hours

Objectives

To provide students with the necessary knowledge and skills in the operation and repair of resistance heating appliances.

Unit Outline

A. Visual examination while in operation
B. Theory of resistance heating
C. Discussion of preventive maintenance
D. Use of precision instruments for calculating proper operation
E. Importance of visualizing electrical circuits for troubleshooting
F. Aspects of installation
G. Preparing work orders for repair
H. Discussion of nomenclature of parts

Suggested Laboratory Exercises

1. Construct schematic diagrams for tracing complete electrical circuit
2. Remove and replace heating assembly
3. Analyze power requirements and check rated wattage against manufacturer's rating
4. Calculate size of wire needed to furnish power
5. Study wire sizes required by the electrical code
6. Become familiar with local requirements concerning a disconnect beyond main power panel
7. Ground appliances and use instruments to analyze whether or not connections are adequate
8. Make sketch for each different type of machine, showing theory of operation

References

Anderson, Edwin. Audel's Home Appliance Guide.
Brockwell, P. T. How to Repair Household Appliances.
Brockwell, P. T. Major Appliance Service.
Gabbert, William. Electrical Appliance Service Manual.
Tricomi, Ernest. How to Repair Major Appliances.

Course Unit V

MOTORS FOR ELECTRIC APPLIANCES

Training Time Classroom, 15 hrs; laboratory, 60 hours

Objectives

To teach the students the theory, operation, and repair of motors for electrical appliances.

Unit Outline

A. Advantages and disadvantages of specific types of motors
B. Details of construction
C. Theory of operation
D. Care during disassembly and assembly
E. Preventive maintenance to extend the life time of specific types of operation
F. General points of attention during troubleshooting
G. When to repair or to replace electric motor parts or complete units
H. Discussion of nomenclature of parts

Suggested Laboratory Exercises

1. Complete a schematic diagram of specific types of motors showing complete electrical circuit
2. Study faulty motors of specific types and locate source of trouble
3. Conduct tests of faulty motors with power off
4. Isolate trouble in specific motors with power on
5. Remove and clean complete motor units
6. Explain procedures for examining and correcting end-play
7. Study theory of controlling rotation of specific motors
8. Make safety analysis of electrical motors.

References

Fuller, Roger Alden. Motor Troubles and Their Correction.
Graham, Frank Duncan. Audel's New Automobile Guide for Mechanic Operations and Servicemen.
Green, Phillip T. Electrical Testing & Troubleshooting.
McCullough, William Wallace. Electric Motor Maintenance.
Schweitzer, Gerald. Basis of Fractional Horsepower Motors & Repair.

Course Unit VI

MOTOR DRIVEN APPLIANCES

Training Time Classroom, 10 hrs; laboratory, 100 hours

Objectives

To provide the students with the knowledge and skills needed in troubleshooting and repairing specific fractional-horsepower electric units.

Unit Outline

A. Theory of operation of specific units
B. Symptoms preceding trouble
C. Efficiency in methods of troubleshooting
D. Advantages and disadvantages in repair or replacement
E. Introduction to power transfer assemblies
F. Discussion of nomenclature of parts

Suggested Laboratory Exercises

1. Make a list and name main parts of specific units
2. Analyze vee belt for replacement
3. Replace specific transmission gears
4. Analyze and troubleshooting driving mechanism
5. Replace accessories
6. Study unit in operation for optimum service
7. Make approved installations of specific units

References

Brockwell, P. T. Major Appliance Service.
Manly, Harold. Electrical Appliance Repair & Servicing.
Tricomi, Ernest. How To Repair Major Appliances.

Course Unit VII

REFRIGERATION

Training Time Classroom, 25 hrs; laboratory, 100 hours

Objectives

To acquaint the students with the basic theory of refrigeration and the approved methods of diagnosing trouble and replacing components.

Unit Outline

A. Basic theory of refrigeration
B. Definition of the components and their function in a refrigeration system
C. Explanation and importance of making a diagnosis
D. Discussion of the tools and instruments used in making a diagnosis
E. Procedures in changing components

Suggested Laboratory Exercises

1. Make a schematic diagram showing theory of operation
2. Analyze the problem when motor-compressor will not run
3. Study a defective unit which runs continuously
4. Diagnose the problems on a unit with high cabinet temperature
5. Discharge a system preliminary to component replacement
6. Disconnect and prepare the new motor compressor for installation
7. Replace the condenser
8. Install a precooler
9. Repair and replace a freezer coil
10. Install the molecular sieve drier
11. Sweep the system to eliminate moisture
12. Conduct a check for restrictions
13. Test for leaks
14. Charge the system

References

Althouse, A. D., and Carl H. Turnquist. Modern Refrigeration and Air Conditioning.

American Society of Refrigeration Engineers. Air Conditioning Refrigeration Data Book.

Derman, Joseph, Floyd Maksten and Harold Seaman. Home Air Conditioning Installation and Repair.

Manly, Harold P. Drake's Refrigeration Service Manual.

Marsh, R. Warren and Thomas Olivo. Principles of Refrigeration.

Course Unit VIII

MISCELLANEOUS OPERATIONS

Training Time Classroom, 8 hrs; laboratory, 22 hours

Objectives

To develop within the students the ability to lay out sheet metal work and to use tools and equipment associated with sheet metal operations.

Unit Outline

A. Introduction to sheet metal work
B. Discussion of metal finishing
C. Introduction to metal fastening and joining
D. Use of the soldering iron, propane torch, and oxyacetylene torch
E. Discussion of the installation survey

Suggested Laboratory Exercises

1. Exercises in simple sheet metal operations
2. Assignments using the oxyacetylene torch
3. Brazing and soldering exercises
4. Exercises in refinishing scratches and complete panels
5. Complete installation surveys related to customer convenience of operation

References

Ruden, Edword M. and Juan R. Griffin. Basic Arc Welding.
Ruden, Edword M. and Juan R. Griffin. Basic Oxyacetylene Welding.

TEACHING THE COURSE

Planning the Lesson

The best guide or lesson plan is, of course, one that has been prepared by the individual teacher, based on personal experience and manner of teaching. Although teachers differ in their ways of organizing and coordinating important parts of their presentations, they agree that the purpose of a lesson is effective and meaningful class room instruction.

Written plans may be brief, but the good teacher will know before the class starts:

1. The goals or objectives of the lesson - the kind of learning desired
2. The outline and suggested time schedule for the lesson, including:
   a. An interest approach - a way to introduce the lesson, to capture the interest of the trainees and to direct their attention to the lesson's goals or objectives
   b. Activities which will involve the trainees in discovering new facts and principles, solving realistic problems, or practicing skills
   c. A way to summarize the lesson - to help trainees arrive at some valid conclusions and/or to evaluate the extent to which lesson goals have been achieved
3. The subject matter content - the facts and principles or main ideas to be brought out in the lesson
4. The teaching materials and references to be used

Training Facility Considerations

It is the purpose of this guide to describe a typical training facility, see Appendix D, that may be adapted to meet local requirements. The physical layout, space, machines, equipment, and tool lists, contained as Appendixes A, B, and C, should be considered minimum requirements for an optimum program; however, the specialists responsible for particular programs may wish to make some substitutions, deletions, or additions to suit individual needs. In the list of equipment, estimated prices have been included to indicate quality requirements. Should it be advisable to order from the equipment list, more detailed specifications will be required for purchase orders.

The laboratory should contain the necessary electrical, hot water, cold water, sewer, and gas outlets. Glare-free lighting with an illumination of approximately 50-foot candles at work table height is recommended. An attempt has been made to arrange the work stations to permit at least three men to work together in repairing or analyzing each large appliance.

The spray booth and the welding area should be connected to exhaust fans capable of providing good ventilation. It is advisable to check with the local building code for specifications.

The training facility and items related thereto, which are included as Appendixes A through E, are designed for a class of 20 trainees.

Criteria for Evaluating Trainee Readiness for Employment

The criteria which serve as guides in determining whether the trainee is ready for employment as an electrical appliance serviceman may be more stringent than in some other occupations. However, some understanding and insight into how to provide various services are of such importance that every attempt should be made to evaluate trainee progress.

The use of various evaluative devices is necessary for the teacher and the trainee to accumulate objective information about the growth of the trainee. The following kinds of competencies are important to develop or to strengthen during the training program:

A. Personal qualities
   1. Courtesy, friendliness, and tact in dealing with supervisors, fellow workers, and the general public
   2. Acceptable appearance - good grooming, cleanliness and neatness in dress, and sensible choice of clothing
   3. Good personal habits in speech, mannerisms, cleanliness, and method of work
   4. Acceptable attitudes - calmness in disorganized situations, positive attitude toward work, cooperativeness, willingness to work with others
   5. Understanding the role of the electrical appliance repairman

B. Activities showing knowledge, understanding, and skill
   1. Demonstrates knowledge of basic electrical appliance repair
   2. Understands and conforms to instructions or directions
   3. Demonstrates ability to work with minimum immediate supervision
   4. Demonstrates the ability to keep repair facilities clean and orderly
   5. Demonstrates the ability to maintain hand tools and test equipment used in electrical appliance repair
   6. Demonstrates the ability to order electrical appliance repair materials and to keep records on electrical supplies
   7. Demonstrates the ability to develop and follow a work plan or schedule
   8. Demonstrates understanding of basic safety precautions

SUGGESTED LIST OF TEXTBOOKS AND REFERENCES

Althouse, A.D. and Carl H. Turnquist. Modern Refrigeration and Air Conditioning. Chicago: Goodheart-Wilcox Publishing Co. 1960.

American Society of Refrigeration Engineers. Air Conditioning Refrigeration Data Book. New York. 1959.

Anderson, Edwin P. Audel's Home Appliance Guide. New York: Audel, 1958.

Blumenthal, Joseph C. English 3200, A Programmed Course in Grammar and Usage. New York: Harcourt, Brace and World, Inc. 1962.

Brockwell, P. T. How To Repair Household Appliances. New York: McGraw-Hill Book Co., Inc. 1957.

Brockwell, P. T. Major Appliance Service. New York: McGraw-Hill Book Co., Inc. 1957.

Darr, Jack. How To Repair Small Appliances. Indianapolis: Bobbs-Merrill Co., Inc. 1961.

X Derman, Joseph, Floyd Maksten and Harold Seaman. Home Air Conditioning Installation and Repair. New York: J. H. Rider Publisher, Inc. 1964.

Fergus, Patricia M. Spelling Improvement: A Program for Self-Instruction. New York: McGraw-Hill Book Co., Inc. 1964.

Fuller, Roger Alden. Motor Troubles and Their Correction. Detroit, Michigan: Business News Publishing Co., 1944.

Gabbert, William. Electrical Appliance Service Manual. New York: Holt, Rinehart and Winston Inc. 1961.

X Graham, Frank Duncan. Audel's New Automobile Guide for Mechanic Operations and Servicemen. New York: Theodore Audel & Co. 1963.

Green, Phillip T. Electrical Testing & Troubleshooting. New York: Industrial Press. 1956.

Huffman, Harry. Programmed Business Mathematics, Concepts, Skills, and Applications, Parts I and II. New York: McGraw-Hill Book Co., Inc. 1962.

McCullough, William Wallace. Electric Motor Maintenance. New York: John Wiley & Sons, Inc. 1947.

Manly, Harold. Electrical Appliance Repair & Servicing. Chicago: Frederick J. Drake and Co. 1958.

Manly, Harold. Drake's Refrigeration Service Manual. Chicago: Frederick Drake and Co. 1962.

X Marsh, R. Warren and Thomas Olivo. Principles of Refrigeration. Albany, New York: Delmar, 1963.

Morgan. Alford Powell. Home Electrical Repair. New York: Crown Publishers, 1950.

Parkhurst, Charles Chandler. English for Business. 4th Ed. Englewood Cliffs, N. J.: Prentice-Hall. 1963.

Ruden, Edword M. and Juan R. Griffin. Basic Arc Welding. Albany, New York, Delmar, 1962.

Ruden, Edword M. and Juan R. Griffin. Basic Oxyacetylene Welding. Albany, New York: Delmar, 1962.

Schweitzer, Gerald. Basis of Fractional Horsepower Motors & Repair. New York: John F. Rider. 1960.

Stafford, Harry Earl. Troubles of Electrical Equipment, Their Symptoms, Causes and Remedy. New York: McGraw-Hill Book Co., Inc. 1947.

Suffern, M. G. Basic Electrical Principles. New York: McGraw-Hill Book Co., Inc. 1956.

Tricomi, Ernest. How To Repair Major Appliances. Indianapolis: Howard W. Sams & Company, Inc. 1962.

Westinghouse. Factory Testing of Electrical Apparatus. East Pittsburgh, Pennsylvania. 1951.

Wiring Master. Vols. I through IV. Joseph L. Spence, Ed. Los Angeles: The Master Publishers. 1963.

SUGGESTED LIST OF FILMS

BALSAM WOOL RESEARCH HOUSE
16 mm, sound, color, 15 minutes
Depicts the results of intricate measurements of heat loss and heat gain in two identical houses built for this experiment. It includes effect of solar energy, basement heating, insulation, efficiency, triple versus double glazing of windows, room temperature studies, calculated heat loss versus actual heat loss, etc.
Wood Conversion Company
Director of Advertising
W-1800 First National Bank Building
St. Paul 1, Minnesota

BASIC ELECTRICITY--THE ELECTRON THEORY
16 mm, sound, 5 minutes
Encylopedia Britannica Films
65 E. South Water Street
Chicago 1, Illinois

ELECTROMAGNETS
16 mm, sound, black and white, 10 minutes
McGraw-Hill Book Co., Inc.
330 West 42nd Street
New York, N. Y. 10036

ELEMENTS OF ELECTRIC CIRCUITS
16 mm, sound, black and white, 11 minutes
Encylopedia Britannica Films
65 E. South Water Street
Chicago 1, Illinois

ELECTRONS
16 mm, sound, black and white, 10 minutes
Encyclopedia Britannica Films
65 E. South Water Street
Chicago 1, Illinois

THE FACTORY: HOW A PRODUCT IS MADE
16 mm, black and white, 13 minutes
Designed to teach basic principles of oxyacetylene safety
Airco Welding Products Division
Air Reduction Co., Inc.
150 East 42nd Street
New York, N. Y. 10017

HOME ELECTRICAL APPLIANCES
16 mm, sound, black and white, 11 minutes
Encyclopedia Britannica Films
65 E. South Water Street
Chicago 1, Illinois

INTRODUCTION TO ELECTRICITY
16 mm, sound, black and white
Coronet Films
Wilmette, Illinois

MAGNETISM
16 mm, sound, black and white, 16 minutes
Encylopedia Britannica Films
65 E. South Water Street
Chicago 1, Illinois

MEASUREMENT OF ELECTRICITY
16 mm, sound, black and white
Coronet Films
Wilmette, Illinois

NATURE OF HEAT
16 mm, sound, black and white, 10 minutes
Coronet Films
Wilmette, Illinois

MODERNIZING MOTORS
16 mm, sound, color, 19 minutes, 1960
Dow Corning Corporation
8555 16th Street
Silver Spring, Md.

Note: Send directly to appliance manufacturers for training films that will cover specific equipment.

APPENDIX A. SUGGESTED LIST OF MACHINES

Quantity	Description	Estimated Total Price
1	Bench grinder, ½ hp., double arbor, equipped with flexible abrasive belt attachment	$ 140.00
1	Drill press, ½ inch chuck capacity	300.00
1	Metal lathe & armature under cut	300.00
1	Arc welder, type: transformer, 250 amp. capacity	225.00
1	Spot welder, 220 volt, 60 cycle, 1.5 KVA	175.00
1	Arbor press, 3 ton capacity	115.00
1	Air compressor complete, air delivery @ 175 psi - 4 cu. ft. per min.	500.00
	Total	$1,755.00

APPENDIX B. SUGGESTED LIST OF TOOLS

Quantity	Description	Estimated Total Price
2	Portable electric drills ¼ inch	$ 60.00
1	Portable electric drill, ½ inch	50.00
1	Bearing puller	7.75
4	Machinist's vise, 3½ inch jaw, 5¼ inch max. opening	160.00
1	External growler	40.00
1	Internal growler	35.00
10	Machinist's vises, 2½ inch jaw, 2½ inch max. opening	50.00
20	Soldering guns, 150 watt	116.00
5	Vise grip pliers, 4 inch	8.75
5	Vise grip pliers, 6 inch	12.50
5	Needle nose pliers, 6 inch, curved nose	13.75
2	Pliers, 6½ inch	2.60
2	Pliers, 8 inch	4.00
2	Wire hose-clamp pliers, 7 inch	4.00
2	Sheet metal shears, combination pattern, length of cut, 3 inches	13.00
4	Terminal crimpers	8.00
1	Pipe wrench, 6 inch	2.30
1	Pipe wrench, 8 inch	2.75
1	Pipe wrench, 12 inch	4.00
3	Allen wrench sets, sizes 5/64 to 1/2 inch, 7 pieces	3.00
3	Socket sets, ½" drive, 7/16" to 1 1/4", 17 pieces	57.00
3	Socket sets, ¼" drive, 7/32" to 7/16", 17 pieces	27.00
1	Ball peen hammer, 8 oz.	2.45
1	Ball peen hammer, 12 oz.	2.75
2	Rawhide mallets	4.00
5	Soldering guns, 250 w.	55.00
1	Soldering copper, ½ lb. size	1.25
1	Wire gauge	4.50
1	Micrometer, 0-1 inch	15.00
10	Feeler gauges, .003 to .025	10.00
1	Tap and die set, NC - 1/4 x 20 to 3/4 x 10, NF - 1/4 x 28 to 3/4 x 16	10.00

Quantity	Description	Estimated Total Price
1	Screw extractor set, for bolts, 3/16 to 1", 6 pieces	$ 10.00
2	Hacksaws, tubular frame	6.00
20	Individual toolboxes consisting of:	1,770.00
	a. 4 oz. ball peen hammer	
	b. Punch & chisel set, 12 pieces	
	c. Pin punch set, sizes 1/16" to 1/4", 7 pieces	
	d. Set of 3 cresent wrenches, 4, 6, 8, inches	
	e. Set of box-end-open-end wrenches, 1/4" to 1" by 1/16" steps, 13 pieces	
	f. Chain nose plier	
	g. Diagonal plier	
	h. Lineman's plier	
	i. Combination plier, 6 inch	
	j. Water pump plier, 10" length	
	k. Stubby slot-head screwdriver	
	l. Set of screwdrivers, 4, 6, 8, 10 inch	
	m. Stubby phillips screwdriver, tip No. 1	
	n. Set of phillips screwdrivers sizes 0, 1, 2, 3, 4, 6, 8, 10 inch, tip	
	o. Offset screwdriver set, std. tip bit widths - 1/4", 5/16", 3/8", phillips tip 1 & 2, 3-4	
	p. Nutdriver set (7 sizes)	
	q. Test lamp	
	r. Electrician's knife	
	s. Point file	
	t. Hacksaw	
	u. Toolbox	
	Total	$2,572.35

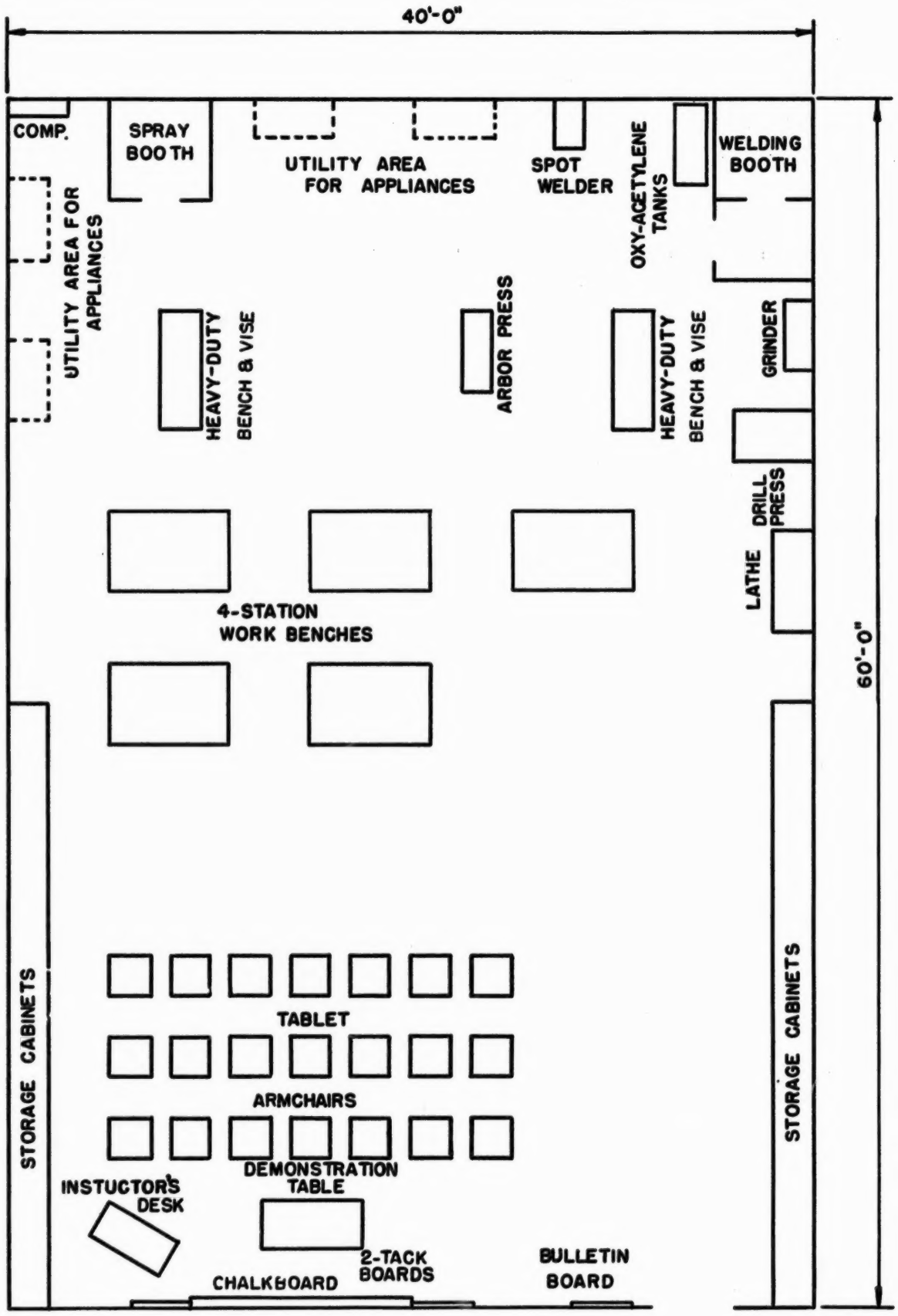
APPENDIX C. SUGGESTED LIST OF EQUIPMENT

Quantity	Description	Estimated Total Price
1	Twist drill set, (high speed, 1/16" to 1/2") 32 drills	$ 88.00
1	Gas welding and cutting torch complete	95.00
1	Welding booth	75.00
1	Spray booth and exhaust system	500.00
1	Solvent tank	35.00
1	Shop anvil, weight, 30 lbs	30.00
6	Thermometers, scale 100° - 350° Fahrenheit	24.00
2	Thermometers, scale 30° - 212° Fahrenheit	10.00
6	Thermocouples, complete, scale 50° - 1000° Fahrenheit	70.00
1	Recording watt meter, 2 scale	200.00
10	Ammeters, tong type, range: 0-5/15/40/100 A.C. and 0-150/600 V.A.C.	400.00
6	A.C. ammeters, 0 to 10 scale	72.00
6	A.C. volt meters, 0 to 150 scale panel meters	72.00
3	A.C. volt meters, 0 to 250 scale	36.00
10	Multi-meters	400.00
4	Ohm meters, ranges: .1 ohm, 1 ohm, 10 ohms	600.00
20	Test lamps, 100 watt	10.00
5	Electric workbenches, 4 station top 72" x 48"	940.00
20	Armchair desks	300.00
20	Lab stools, 26" high	200.00
1	Chalkboard and equipment	75.00
1	Teacher's desk and chair	139.00
1	Demonstration test bench Includes: 6 storage drawers, 1 file drawer, 8 15 amp. duplex outlets, 1 duplex outlet variable A.C. 0-120 volts @ 5 amps., variable A.C. 0-12 volts from 2 jacks @ 10 amps., variable A.C. 0-24 volts from 2 jacks @ 5 amps., variable D.C. 0-30 volts from 2 jacks @ 5 amps. Complete with panel pilot light, controls and breakers.	420.00

Quantity	Description	Estimated Total Price
1	File cabinet, 3-drawer	$ 75.00
1	Bulletin board	25.00
2	Storage cabinets, 10 compartment (metal) 30' x 24"	200.00
2	Heavy duty work benches (metal) 48" x 72" x 32"	180.00
1	Moving picture projector, 16 mm, sound	450.00
1	Slide projector, 35 mm	150.00
1	Overhead projector	150.00
	Miscellaneous; manufacturers specialty tools, training aids, films, transparencies, etc.	1,000.00
	Total	$7,021.00

APPENDIX D

SUGGESTED TRAINING FACILITY



APPENDIX E. SUGGESTED LIST OF EXPENDABLE SUPPLIES

Quantity	Description	Estimated Total group Price
1	Nut & bolt assortment	$100.00
1	Sheet metal screw assortment	15.00
1 box	Stove bolts, 150 pieces per box, 3/16" x 1/2" and 1/4" x 2"	3.00
4 boxes	Hexagon nuts, 113 pieces per box, 1/4" to 9/16"	15.00
1 box	Cotter pins, 750 pieces per box, size from 1/16" x 1" to 1/8" x 2"	2.50
1 box	Lock washer assortment, 425 pieces per box, size from 3/16" to 9/16"	2.20
5 doz.	Hexagon socket set screws, size from 8-32 x 3/16" to 3/8-16 x 1/2"	7.50
5 lbs.	Steel washers	2.00
10 gal.	Synthetic enamel	60.00
2 gal.	Enamel undercoat	10.00
5 gal.	Paint reducer	4.00
2 gal.	Lacquer thinner	3.50
10 qts.	Lacquer, assorted colors	15.00
10	Assorted paint brushes	10.00
4 gal.	Rust inhibitive metal primer	21.00
10 rolls	Masking tape, 3/4" wide, latex adhesive binding with paper crepe backing	12.50
5 lbs.	Steel wool, grade N, 00 to 2	4.00
1 gal.	Rubbing compound, coarse grade	3.50
2 lbs.	Acid core solder, alloy 40/60, 1/8" diameter	2.50
4 lbs.	Rosin core solder, alloy 50/50, 1/8" diameter	2.50
2 lbs.	Aluminum flux-core solder	7.80
10 oz.	Silver solder, 1100° F. melting range	17.50
1	Silver solder flux, 10 oz. jar	1.20
200 lbs.	Arc welding electrodes. E6011-1/8" and E6018-1/8"	70.00
100 lbs.	Gas welding rods, 1/16" and 1/8"	35.00
20 lbs.	Cast iron rod, 3/16" x 18"	20.00
8 lbs.	Aluminum brazing rod, 1/16" diameter	22.00

Quantity	Description	Estimated Total group Price
16 lbs.	Maganese bronze rod, 3/32" and 1/8" diameter	$ 25.60
2 lbs.	Cast iron brazing flux	3.00
1 lb.	Aluminum brazing flux	2.75
2 lbs.	All purpose brazing flux	3.00
2 lbs.	Cast iron welding flux	2.40
2 tanks	One of oxygen, one of acetylene	15.00
1	Supply of lubricating oils, greases and materials	30.00
4 doz.	Hacksaw blades, 12 inches long, 24 and 32 teeth per inch	30.00
4 doz.	Assorted files	57.00
4 doz.	Sheets of abrasive paper	4.25
1	Assortment of electrical wire	50.00
1	Allowance for used appliances to use for demonstration and training aids	200.00
	Total	$892.20

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A Suggested Guide
for a Training
Course

MACHINE TOOL OPERATOR

General, Entry

U.S. Department of Health, Education, and Welfare
Office of Education

VT 02411

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

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MACHINE TOOL OPERATOR

General, Entry

(D.O.T. Occupational Code 6-78.905)

Suggested Guide for a Training Course

U. S. Department of Health, Education, and Welfare
John W. Gardner, Secretary

Office of Education
Francis Keppel, Commissioner

Manpower Development and Training Program

Developed and first published
pursuant to a contract with the U. S. Office of Education

by

Oklahoma State University
Stillwater

1965

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FOREWORD

Throughout American industry almost every product contains metal parts or is processed by machines made of metal. Many of these metal parts are made by machine operators. The largest group of workers in the metal-working trades is made up of machine operators and totals 570,000 persons.

Employment of machine tool operators is expected to rise moderately during the remainder of the 1960's and beyond. Most job opportunities, however, will arise from the need to replace experienced workers who transfer to other jobs, retire or die. Retirements and death (alone) may result in about 12,000 job openings each year.

Technological developments will affect both the number and skill requirements of machine tool operators. The continued development and use of faster and more versatile automatic machine tools will result in greater output per operator. Workers with thorough backgrounds in machine operations, mathematics, blueprint reading, and a good working knowledge of the properties of metals will be better able to adjust to future technological changes and to transfer to new jobs in the machining field.

The purpose of this guide is to assist administrators and teachers in organizing courses and developing course content for programs designed to prepare persons for employment in this occupation.

The guide was prepared for the Division of Vocational and Technical Education under contractual arrangements with Oklahoma State University. Recognition is given to Maurice W. Roney, Professor of Industrial Education, Oklahoma State University, for supervising the guide; to L. Carl Love, Oregon State University, for his assistance as consultant; and to Ollie B. Stone, Machine Shop Instructor, Oklahoma City Public Schools, for gathering the technical content.

This guide contains eleven major units covering 1080 hours of instruction in the classroom and shop. The sequence of instructional units and the hours assigned to each unit are flexible; therefore, both time and content may be adjusted to better meet local needs.

A suggested list of machines, tools, equipment, textbooks, films, and a floor plan of the training facility have been included to assist administrators and teachers in organizing the course. The assistance of local advisory groups should be sought for guidance in selecting equipment and developing content of courses which will best serve the local conditions.

Walter M. Arnold
Assistant Commissioner
for Vocational and
Technical Education

TRAINING COURSE FOR MACHINE TOOL OPERATOR--GENERAL, ENTRY

Purpose of the Guide

This guide has been prepared to assist in planning and developing a training course for machine tool operators. It has been organized in a manner to be of maximum value to school administration personnel who are not themselves specialists in the occupation. Sufficient detail has been included, however, to provide a basic outline of instruction to assist the instructor who will be responsible for the operation of the training program.

The suggestions outlined in the training guide are not intended to delineate instruction in every detail. Supplemental material can be found in the suggested textbooks, references, and films. In addition, the suggested course outline may require modification to meet special needs. The sequence of presentation, as well as the final selection of topics for special emphasis, should be determined by instructional specialists, and may vary according to the needs and background of the trainee group.

Although this training guide has been developed primarily for use in the Manpower Development and Training program, it includes instructional material that goes beyond the development of manipulative exercises to impart simple skills. Some of the related material included in the course outline has been added to assist the trainee to progress beyond the entry level job.

Job Description

Machine tool operators shape metal to precise dimensions by the use of machine tools. Although some operators can operate several tools, most can operate only one or two machine tools. Many operators are essentially machine tenders who perform simple, repetitive operations which can be learned quickly. Other machine tool operators, however, are much more skilled and can perform complex and varied machining operations.

Lathes, drill presses, boring machines, grinding machines, milling machines, and automatic screw machines are among the machine tools used by machine operators. Both skilled and semiskilled operators have job titles based upon the kind of machine they operate, such as engine lathe operator, milling machine operator, and drill press operator.

A typical job of the semiskilled operator is to place rough metal stock in a machine tool on which the speeds, feeds, and operation sequence have already been set by a skilled worker. The operator watches the machine and calls his supervisor when anything unusual happens. Special, easy-to-use gages help him to measure work quickly and accurately. The operator with limited training may make minor adjustments to keep his machine tool operating, but he depends on skilled machining workers for major adjustments. The majority of machine tool operators fit this category and are less skilled than the skilled operators described in the following paragraph.

The work of skilled machine tool operators is similar to that of all-round machinists, except that often it is limited to a single type of machine and involves little or no hand fitting or assembly work. (By contrast, all-round machinists can operate almost every machine tool.) The skilled machine tool operator plans and sets up the correct sequence of machining operations in accordance with blueprints, layouts, or other instructions. He adjusts speed, feed, and other controls and selects the proper cutting tools for each operation. Adjustments may be necessary during machine operations, and changes in setup also may be required. Therefore, the skilled operator must be able to use all the special attachments of his machine. Upon completing his work, he checks measurements with micrometers, gages, and other precision-measuring instruments to see whether they meet specifications. The skilled machine tool operator also may select cutting and lubricating oils used to cool metal and tools during machining operations.

The work of the machine tool operator requires knowledge and skill in the use of several different machines for the production of devices which may consist of a variety of metals. The skilled machine tool operator produces parts and assemblies that conform to certain specified tolerances; at the same time, he must meet certain requirements for quantity output.

Qualifications of Trainees

High school graduation, or its equivalent, is desirable for those who plan to enter the machine tool operator trade. Machining operations require planning with the aid of mathematics; some mathematical computations involving trigonometry will be encountered and trainees should have a background of mathematics. The trainee should be of average physical condition and health; good vision is especially important and should be at least correctable to 20/20.

The United States Employment Service General Aptitude Test Battery B-397 for machine operator, general, would be helpful in the selection of trainees.

Teacher Qualifications

A teacher for this program must have broad experience as a skilled machine tool operator and, preferably, should have experience as a supervisor of machine tool operators.

If the person selected for this teaching assignment does not have teaching experience, he should be given the necessary teacher education fundamentals such as: lesson planning, teaching methods, and course construction.

Suggestions for the Organization of Instruction

The field of machine tool operation has changed quite rapidly during the last few years. A recent publication by the American Society of Tool and Manufacturing Engineers carried a statement that our metal cutting capacity has been doubled every ten years since 1930. Because of the vast changes being made in machine processes, it is suggested that trainees be given an overview of industry in addition to a sound foundation in the fundamentals of basic operations.

In accordance with the job description, it is suggested that the trainees develop skills on one or more of the machine tools included in the course. In other situations the training may include all of the content covered in this guide thereby meeting the specific needs of industries in the community who require their operators to have a degree of skill on all machines. The instructor should be aware of the course organizational and operational problems which will arise if either one or a combination of these plans are followed. Whatever plan is finanlized will affect the number of specific machines and supplies needed, and the scheduling of both shop and related instruction in order to conduct an effective course.

As indicated in the course outline, emphasis on theory, related shop mathematics, and sketching and blueprint reading relfects the need to provide the trainee with as much related theory as possible. It is becuase of this understanding of "why" that he can transfer from job to job and remain employable. While related theory is important, it is expected that the instructor will maintain a direct correlation between theory and actual shop practice. Assignments in mathematics, sketching, and related theory should be carried on concurrently with the development of skills in the shop.

The allocation of hours to each unit of instruction serves to indicate the relative emphasis to be placed on these units. Changes in this distribution of time may be necessary, depending on the ability and background of the trainees and the needs of industry. The administrator or instructor must keep in mind that this training course is designed for job entry.

At some appropriate point in the training program field trips to local industries will be helpful. Special equipment and processes such as: electrical discharge machining, free abrasive grinding, or numerical control, can best be introduced by visits to industry. Additional information covering modern methods of machining and related material will be found in the suggested list of textbooks and references.

Length of Course and Course Units

The training program, as outlined, covers a period of 27 weeks with a total of 1080 hours of class instruction and laboratory practice. The training is programmed for 8 hours per day and 5 days per week.

Unit	Title	Suggested class hours	Suggested shop hours
I.	Orientation	6	6
II.	Bench Work	10	30
III.	Shop Mathematics	50	0
IV.	Blueprint Reading and Sketching	40	0
V.	Power Saws	5	10
VI.	Drill Press	10	33
VII.	Engine Lathe	60	300
VIII.	Milling Machine	40	150
IX.	Surface and Cylindrical Grinders	25	100
X.	Shaper	15	70
XI.	Mass Production Methods	20	100
	Sub-total	281	799
			281
	Total		1080

Course Unit I

ORIENTATION

Training Time Classroom, 6 hours; shop, 6 hours

Objectives

To orient trainees to the nature and scope of the training course and the machine tool operator's work.

To develop an understanding and appreciation of shop safety.

Unit Outline

A. Departmental policies
B. Overview of course
C. Safety policies in the shop

Suggested Activities

1. Tour of shop facilities
2. Personal safety practices
3. Safety practices in using equipment, machines, and tools
4. Civil Defense procedures, fires, etc.

References

Accident Prevention Manual for Shop Teachers. American Technical Society.
Hall, Herbert D. and Horace E. Linsley. Machine Tools, What They Are and How They Work; An Introduction to the Fundamentals of Mass Production--The Tools, Machines, Gages, and Methods That Make Up Our Modern Metal Working Industries and Automated Production Lines.
Shop Safety Education. The University of The State of New York.

Course Unit II

BENCH WORK

Training Time Classroom, 10 hours; shop, 30 hours

Objectives

To develop knowledge and skills in the identification, use, care, maintenance and safety of hand tools, and to develop knowledge and skills in layout.

Unit Outline

A. Identification, use, care, and maintenance of hand tools
B. Laying out work
   1. Tools
   2. Measurements
   3. Procedures
C. Hand-threading
   1. Taps
   2. Dies
D. Filing and burring
E. Holding devices
F. Assembly procedures
G. Safety

Suggested Activities

1. Hand hacksawing
2. Filing
3. Hand drilling, portable electric
4. Chipping and shearing with cold chisel
5. Hand-threading, taps and dies
6. Finishing with file and emery cloth

References

Morgan, Alfred P. How to Use Tools.
Machine Trades I, Learner's Manual. Instructional Materials Laboratory, Ohio State University.

Course Unit III

SHOP MATHEMATICS

Training Time Classroom, 50 hours

Objectives

To provide the necessary knowledge and skills in shop mathematics relating to machine operations.

Unit Outline

A. Arithmetic
   1. Definition of terms
   2. Fractions and decimals
   3. Ratio and proportion
   4. Areas and volumes
   5. Measurements and conversion factors
B. Algebra
   1. Equations
   2. Shop formulas
C. Geometry
   1. Geometrical constructions
   2. Areas and volumes
D. Trigonometry
   1. Sines and co-sines
   2. Tangents and cotangents

Suggested Activities

1. Using measuring devices and calculations needed for precision measurement
2. Solving problems in measuring stock for layout
3. Using formulas for cutting speeds and feeds
4. Figuring angles
5. Solving problems in indexing
6. Solving problems on screw threads and tapers

References

Felker, C. A. Shop Mathematics.
Graham, Frank Duncan. Audel's Mathematics and Calculations for Mechanics, A Ready Reference.
McMackin, Frank J. and John H. Shaver. The Mathematics of the Shops.

Course Unit IV

BLUEPRINT READING AND SKETCHING

Training Time Classroom, 40 hours

Objectives

To develop knowledge and skills in blueprint reading and freehand sketching.

Unit Outline

A. Graphic language
B. Working drawings
C. Selection of views
D. Orthographic drawings
E. Dimensioning
F. Isometric drawings
G. Auxilliary views
H. Sectional views
I. Tolerances
K. Sketching

Suggested Activities

1. Freehand sketching practice
2. Blueprint reading practice
3. Laying out jobs from blueprints

References

Elementary Blue Print Reading for Beginners in Machine Shop Practice. Delmar Publishers, Inc.

Course Unit V

POWER SAWS

Training Time Classroom, 5 hours; shop, 10 hours

Objectives

To develop knowledge and skills in the operation, maintenance, and safety of power saws.

Unit Outline

A. Layout for cutting operations
B. Band saw
   1. Types of blades
   2. Welding blades
   3. Straight sawing
   4. Contour sawing
   5. Speeds
C. Power hacksaw
   1. Types of blades
   2. Holding the work
D. Coolants
E. Safety and maintenance

Suggested Activities

1. Sawing to length
2. Angular sawing
3. Contour sawing
4. Removing and installing blade

References

Apprentice Training Handbook. National Tool, Die, and Precision Machining Assn.
Burghardt, Henry D. and Aaron Axelrod. Machine Tool Operation, Part II.
Habicht, Frank H. Modern Machine Tools.
Krar, S. F. and J. E. St. Almand. Machine Shop Training.

Course Unit VI

DRILL PRESS

Training Time Classroom, 10 hours; shop, 33 hours

Objectives

To develop knowledge and skills in the operation, maintenance, and safe use of the drill press.

Unit Outline

A. Types of drilling machines
   1. Drill press
   2. Sensitive drill press
   3. Radial drill press
   4. Jig borer
B. Work holding devices
   1. Drill vise
   2. V-Blocks
   3. Angle plates
   4. Jigs and fixtures
C. Feeds and speeds
D. Types of drills
   1. Sizes
   2. Sharpening
E. Drilling operations
F. Reaming operations
G. Counterboring and countersinking operations
H. Tapping operations
I. Care, maintenance, and safety

Suggested Activities

1. Mounting tools
2. Drilling
3. Reaming
4. Tapping
5. Using jigs and fixtures
6. Counterboring and countersinking
7. Grinding drills
8. Holding work

References

Habicht, Frank H. Modern Machine Tools.
Increased Production, Reduced Costs Through a Better Understanding of the Machining Process and Control of Materials, Tools, and Machines. Curtiss-Wright Corp.

Course Unit VII

ENGINE LATHE

Training Time Classroom, 60 hours; shop, 300 hours

Objectives

To provide knowledge and skills in the operation, maintenance, and safe use of the engine lathe.

Unit Outline

A. Types and sizes
B. Tool holders and tool bits
   1. Sharpening tool bits
C. Speeds and feeds
D. Mounting work
   1. Between centers
   2. Chucking
E. Types of operations
   1. Turning
   2. Facing
   3. Shouldering
   4. Chamfering
   5. Knurling
   6. Taper turning
   7. Thread cutting (external and internal)
   8. Drilling and reaming
   9. Boring
      a. Straight and shoulder
      b. Tapers
   10. Undercutting and necking
   11. Cutting off
   12. Tapping
F. Planning job and sequence of operations
G. Safety and maintenance

Suggested Activities

Performing repetitive operations listed in E above on practical jobs.

References

DeGroat, George H. Metal Working Automation.
Hallett, F. H. Machine Shop Theory and Practice
How to Run a Lathe. South Bend Lathe Works.
Smith, Robert E. Machining of Metal.

Course Unit VIII

MILLING MACHINE

Training Time Classroom, 25 hours; shop, 150 hours

Objective

To develop knowledge and skills in the operation, maintenance, and safe use of the milling machine.

Unit Outline

A. Types and sizes
B. Types of cutters
C. Work holding devices and clamping methods
   1. Milling machine vise
   2. Angle plates
   3. Clamps
D. Feeds and speeds
E. Installing arbors and cutters
F. Milling operations
   1. Plain milling
   2. Face milling
   3. Straddle milling
   4. Slotting
   5. End milling
   6. Gang milling
   7. Helical milling
   8. Gear cutting
G. Indexing methods
H. Coolants
I. Care, maintenance, and safety

Suggested Activities

Performing the various milling operations listed in F above on practical jobs.

References

Burghardt, Henry D. and Aaron Axelrod. Machine Tool Operation, Part II.
DeGroat, George H. Metal Working Automation.
Smith, Robert E. Machining of Metal.

Course Unit IX

SURFACE AND CYLINDRICAL GRINDERS

Training Time Classroom, 25 hours; shop, 100 hours

Objectives

To develop knowledge and skills in the operation, maintenance, and safe use of surface cylindrical grinders.

Unit Outline

A. Grinding wheels
   1. Types and sizes
   2. Grades
   3. Wheel selection
B. Surface grinders
   1. Types
   2. Work holding devices
      a. Magnetic chuck
      b. Vise
   3. Mounting and dressing wheel
   4. Surface grinding operations
      a. Grinding flat surfaces
      b. Squaring stock
      c. Grinding angles
   5. Care, maintenance, and safety
C. Cylindrical grinders
   1. Types and accessories
   2. Mounting and dressing wheel
   3. Holding the work
   4. Cylindrical grinding operations
      a. Straight grinding
      b. Grinding to a shoulder
      c. Taper grinding
   5. Care, maintenance, and safety

Suggested Activities

Performing the various grinding operations listed above in B.4 and C.4 on practical jobs.

References

Burghardt, Henry D. and Aaron Axelrod. Machine Tool Operation, Part II.
Habicht, Frank H. Modern Machine Tools.
Smith, Robert E. Machining of Metal.

Course Unit X

SHAPER

Training Time Classroom, 15 hours; shop, 70 hours

Objectives

To develop knowledge and skills in the operation, maintenance, and safe use of the shaper.

Unit Outline

A. Types and sizes
B. Feeds and speeds
C. Work holding devices
   1. Vise
   2. Parallels
   3. Clamps
D. Cutting tools
   1. Types and shapes
   2. Sharpening tools
E. Shaper operations
   1. Horizontal shaping
   2. Angular shaping
   3. Vertical shaping
   4. Contour shaping
   5. Keyway and slot shaping
F. Care, maintenance, and safety

Suggested Activities

Performing repetitive shaper operations listed above in E on practical jobs.

References

Habicht, Frank H. Modern Machine Tools.
Shop Theory. McGraw-Hill Book Co., Inc.
Smith, Robert E. Machining of Metal.

Course Unit XI

MASS PRODUCTION METHODS

Training Time Classroom, 20 hours; shop, 100 hours

Objectives

To develop an understanding of mass production methods and knowledge and skills in the operation of certain specialized mass production machines.

Unit Outline

A. Turret lathes
   1. Application to mass production
   2. Types and sizes
   3. Feeds and speeds
   4. Methods of holding work
      a. Chucks
      b. Collets
      c. Special fixtures
   5. Tooling of turret
      a. Number and kinds of operations
      b. Progressive sequence of operations
      c. Tooling for maximum efficiency
      d. Types of cutting tools
   6. Coolants
   7. Turret lathe operations
   8. Care, maintenance, and safety

B. Screw machines
   1. Application to mass production
   2. Types and sizes
   3. Methods of holding work
   4. Screw machine tooling
      a. Number and kinds of operations
      b. Sequence of operations
      c. Actuating and controlling tools
   5. Speeds and feeds
   6. Cutting fluids
   7. Screw machine operations
   8. Care, maintenance, and safety

Suggested Activities

Performing the variety of turret lathe and screw machine operations on practical jobs.

References

Automatic Machining, (magazine). Screw Machine Publishing Co.
Bower, C. T. Aids to Machine Shop Practice.
DeGroat, George H. Metal Working Automation.
Increased Production, Reduced Costs Through a Better Understanding of the Machining Process and Control of Materials, Tools, and Machines. Curtiss-Wright Corp.

TEACHING THE COURSE

Planning the Lesson

The best guide or lesson plan is, of course, one that has been prepared by the individual teacher, based on personal experience and manner of teaching. Although teachers differ in their ways of organizing and coordinating important parts of their presentation, they agree that the purpose of a lesson is effective and meaningful classroom instruction.

Written plans may be brief, but the good teacher will know before the class starts:

1. The goals or objectives of the lesson--the kind of learning desired
2. The outline and suggested time schedule for the lesson, including:
   a. An interest approach--a way to introduce the lesson, to capture the interest of the trainees and to direct their attention to the lesson's goals or objectives
   b. Activities which will involve the trainees in discovering new facts and principles, solving realistic problems, or practicing skills
   c. A way to summarize the lesson--to help trainees arrive at some valid conclusions and/or to evaluate the extent to which lesson goals have been achieved
3. The subject matter content--the facts and principles or main ideas to be brought out in the lesson
4. The teaching materials and references to be used

Training Facility Considerations

The items of machines, tools, equipment and supplies included as appendixes in this guide indicate what is needed to prepare a group of twenty trainees to enter the machine tool operator occupation. The items listed represent an optimum program, however, the instructor responsible for a particular program may wish to make some substitutions, deletions, and additions to the lists shown depending on the particular industrial needs of the community. If the course is to be offered in an existing facility, the administrator should make a careful inventory of existing equipment in order to avoid costly duplications.

The laboratory floor plan indicates a typical arrangement that might be used in industry to give the greatest production schedule with the lowest overhead cost. The arrangement is planned for maximum safety. It is suggested that the safety lane be a full 36 inches wide, and that no machinery be located within one foot of this area. To make the safety lane especially effective, green anti-slip paint should be used with yellow 4-inch borders, also of anti-slip material. The use of a standard industrial color scheme on every machine throughout the working area is also recommended as a safety measure.

Prices shown on listed items are for the purpose of indicating the approximate quality of each item. No attempt has been made to list the complete specifications needed by a supplier for the purpose of completing a purchase order.

Criteria for Judging Trainee Readiness for Employment

The criteria which serve as guides for determining whether the trainee is ready for employment as a machine tool operator may be more stringent than in some other occupations. However, some understanding and insight into how to provide various services are of such importance that every attempt should be made to evaluate trainee progress.

The use of various evaluative devices is necessary for the teacher and the trainee to accumulate objective information about the growth of the trainee. The following kinds of competencies are important to develop or to strengthen during the training program.

A. Personal qualities:
   1. Courtesy, friendliness, and tact in dealing with supervisors, and the general public
   2. Acceptable appearance--good grooming
   3. Mature judgment in a variety of typical situations
   4. Good personal habits in speech, mannerisms, cleanliness, and methods of work
   5. Acceptable attitudes--calmness in disorganized situations, positive attitude toward work, cooperativeness, willingness to work with others
   6. Assumption of role appropriate for the machine tool operator

B. Activities showing knowledge, understanding, and skills:
   1. Understands and carries out instructions or directions
   2. Works effectively under supervision
   3. Demonstrates knowledge of basic machine operation techniques
   4. Understands need for safety--dangerous areas, basic precautions
   5. Uses common machine tools and equipment carefully
   6. Demonstrates ability to develop and follow a work plan or schedule

SUGGESTED LIST OF TEXTBOOKS AND REFERENCES

Accident Prevention Manual for Shop Teachers. Edited by William A. Williams, American Technical Society, Chicago, Ill.: 1963.

American Machinist, (magazine) Paul F. Cowie, Publisher, 330 West 42nd Street, New York: 10036.

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Hall, Herbert D. and Horace E. Linsley. Machine Tools, What They Are and How They Work; An Introduction to the Fundamentals of Mass Production - The Tools, Machines, Gages, and Methods That Make Up Our Modern Metal Working Industries and Automated Production Lines. Sponsored by Herbert D. Hall Foundation. New York: Industrial Press, 1957.

Hallett, F. H. Machine Shop Theory & Practice. Toronto, Canada: MacMillan, 1961.

How to Run a Lathe. South Bend, Ind.: South Bend Lathe Works.

Increased Production, Reduced Costs Through a Better Understanding of the Machining Process and Control of Materials, Tools and Machines. Wood-Ridge, N. J.: Curtiss-Wright Corp., 1950.

Johnson, H. V. General-Industrial Machine Shop. Peoria, Ill.: Bennett, 1963.

Krar, S. F. and J. E. St. Almand. Machine Shop Training. Toronto, Canada: McGraw-Hill Co. of Canada, 1962.

McMackin, Frank J. and John H. Shaver. The Mathematics of the Shops. New York: D. Van Nostrand Co., 1947.

Machine and Tool Blue Book, (magazine) William F. Schleicher, Publisher, Hitchcock Publishing Co., Hitchcock Building, Wheaton, Ill.

Machinery, (magazine) Charles O. Herb, editor, Industrial Press, 93 Worth Street, New York, 10013.

Machine Trades I Learners Manual. Trade and Industrial Education, Instructional Materials Laboratory, Ohio State University, College of Education, Columbus 10, Ohio.

Machine Trades II Learners Manual. Trade and Industrial Education, Instructional Materials Laboratory, Ohio State University, College of Education, Columbus 10, Ohio.

Machining Data. Compiled at Metal Cut Research Associates Machining Information Center, Office of Technical Services, U. S. Department of Commerce, Washington D. C. 20230, 1961, (publication, P.B. 181039 - $3.50).

Machining With Carbides and Oxides. New York: American Society of Tool Manufacturing Engineers, New York: McGraw-Hill, 1962.

Mathematics--Machine Shop Series. Delmar Publishers, Inc., Albany, N. Y., 1946.

Metal Progress, (magazine) Published by American Society for Metals, Metals Park, Ohio.

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Numerical Control in Manufacturing. New York: McGraw-Hill Book Co., Inc., 1963.

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Shop Theory. New York: McGraw-Hill Book Co., Inc., 4th Ed., 1955.

Smith, Robert E. Machining of Metal. Bloomington, Ill.: McKnight & McKnight, 1949.

Tool and Manufacturing Engineer, (magazine) Harry E. Conrad, publisher. The American Society of Tool and Manufacturing Engineer's, 5400 W. Good Hope Road, Milwaukee, Wis.

Tooling & Production, (magazine) Ray L. Heubner, publisher. Huebner Publications, Inc., 13601 Euclid Avenue, Cleveland, Ohio.

SUGGESTED LIST OF FILMS

TEAM WORK--THE TOOL STEEL STORY
16 mm, sound, color, 30 minutes
Modern Talking Picture Service, Inc.
3 East 54th Street
New York, N. Y., 1956

ALUMINUM ON THE MARCH
16 mm, sound, color, 28 minutes
Associated Films, Inc
347 Madison Avenue
New York 17, N. Y., 1956

OPTICAL TOOLING
16 mm, sound, color, 35 minutes
Sales Planning Department
Charles Bruning Co.
4700 Montrose Avenue
Chicago, Ill.

THE FORD PEOPLE
16 mm, sound, color, 22 minutes
Ford Film Libraries
16 East 52nd Street
New York 22, N. Y.

ABC OF HAND TOOLS, Part 1 and 2
16 mm, sound, color, 33 minutes
General Motors Corporation
405 Montgomery Street
San Francisco 4, Calif.

THE ART OF REAMING
16 mm, sound, 47 minutes
The Cleveland Twist Drill Company
1242 East 49th Street
Cleveland 14, Ohio

BEING ON TIME
16 mm, sound
Audio-Visual Center
Brigham Young University
Provo, Utah

CHISELS & HAMMERS
16 mm, sound, 23 minutes
Cromers' Modern Films
28 East 9th Avenue
Denver 3, Colo.

COOL CHIPS
16 mm, sound, 13 minutes
The Cincinnati Milling Machine Company
Cincinnati Milling Products Division
Advertising Department
4701 Marburg Avenue
Cincinnati 9, Ohio

DON'T DROP YOUR GUARD
16 mm, sound, color, 10 minutes
Aetna Life Affliated Companies
Public Education Department
151 Farmington Avenue
Hartford 16, Conn.

ELEMENTARY OPERATIONS ON THE ENGINE LATHE
16 mm, sound
Iowa State College
Department of Public Instruction
Division of Vocational Education
Ames, Iowa

GRINDING CUTTER BIRS
16 mm, sound, color, 20 minutes
425 East Madison Street
South Bend 22, Ind.

THE GRINDING WHEEL, ITS CARE AND USE
16 mm, sound, color, 17 minutes
Norton Company
Publicity Department
Worcester 6, Mass.

HIGHWAY TO PRODUCTION
16 mm, sound, 30 minutes
The Cincinnati Milling Machine Co.
Cincinnati Milling Products Division
Advertising Department
4701 Marburg Avenue
Cincinnati 9, Ohio

NUMERICAL CONTROL
16 mm, sound, color, 30 minutes
(Application of numberical control to turret drilling, tapping, boring and milling. Also advantages such as reduced lead time, precise machining, exact repetition, reduced tooling costs, etc.)
Burgmaster Corp.
15001 South Figueroa Street
Gardena, Calif.

GRINDING WHEEL SAFETY
16 mm, sound, color, 20 minutes
Norton Company
Publicity Department
Worcester 6, Massachusetts

PRECISION TOOL MAKING AND MACHINING--KEYSTONE OF AMERICAN INDUSTRY
16 mm, sound, 30 minutes
Examines Role of: Tool, Die, and precision maching industry in mass production and shows how apprentices are trained.
National Tool, Die and Precision Machining Assn.
907 Public Square Building
Cleveland, Ohio 44113

KEY TO THREADING ECONOMY
16 mm, sound, color, 20 minutes
Advertising Department
Landis Machine Co.
Waynesboro, Pennsylvania

COMMAND PERFORMANCE
16 mm, sound, color, 13 minutes
Traces in Detail: Six basic cycles of a numerically controlled turret drill
Cincinnati Lathe and Tool Co.
Attention: John Mitchell, Sales Manager
Cincinnati 9, Ohio

APPENDIX A. SUGGESTED LIST OF MACHINES

Quantity	Description	Estimated total cost
3	Sensitive drill presses, floor model, size 15"	$ 840.00
1	Upright drill press	350.00
1	Radial drill press, 3 ft. arm	500.00
2	Grinders, bench or pedestal, 6-8" wheel dual arbor	300.00
1	Grinder, pedestal, 10-14" wheel, dual arbor	308.00
1	Disc sander, 15"	150.00
1	Belt sander, 4" x 60"	400.00
1	Upright metal cutting band saw	980.00
1	Power hacksaw	450.00
1	Tool grinder, with attachments	952.00
1	Surface grinder	1995.00
1	Cylindrical grinder - distance between centers 22", swing over table 8½", table travel 14".	2000.00
5	Engine lathes with motor, complete tooling 10" x 3'	6500.00
5	Engine lathes with motor, complete tooling 13" x 5'	9500.00
1	Engine lathe with motor, complete tooling 30" x 8'	2400.00
1	Milling machine, universal	4000.00
1	Milling machine, vertical	4000.00
1	Shaper, 20"	3000.00
1	Shaper, 30"	4000.00
1	Turret lathe with tooling, No. 3	6000.00
1	Jig boring machine for drilling, reaming and precision boring	1495.00
1	Screw machine, 10-inch swing, 40" bed, collet capacity -- 1"	1490.00
2	Hardness testing machines, complete with accessories for testing hard and soft materials	1300.00
1	Arbor press, hydraulic, 25 ton capacity	325.00

APPENDIX B. SUGGESTED LIST OF TOOLS

Quantity	Description	Estimated total cost
20 sets	Hand tools (hammers, punches, chisels, scales, try-squares, pliers, wrenches, screwdrivers, files, hacksaw, 20-drawer roller cabinet, etc.)	$1980.00
20	Small micrometers, 0-1", 1-2", 2-3", and 3-4"	500.00
3	Dial-test indicators, complete, assorted fixed gages	75.00
1	Electric drill, portable, ¼" capacity	45.00
1	Electric drill, portable, ½" capacity	70.00
3	Drill set, fractional, 1/64" to 2"	600.00
3	Drill set, numbered, 1 to 60	75.00
3	Drill set, letter, A to Z	75.00
3	Tap and die sets, N.C. and N.F. series, No. 4 screw to 1" bolt	100.00
3	Die sets, N.C. and N.F. Series, No. 4 screw to 1" bolt	300.00
	Clamps, "C" and parallel, assorted	85.00
	Center drills, countersinks, spot facer, assorted sizes	50.00
1	Tap wrenches, T handle, set	25.00
-	Reamers, assorted sizes	200.00
1	Pipe tapes and dies, set, 1/8" to 2"	125.00
	Small specialty tools and gages and measuring instruments	400.00
6	Angle plates 2-4x4, 2-6x6, 2-10x10	360.00
1	Micrometer depth gage, range 0" to 6", 5" base	35.00
2	Micrometer calipers, inside, range 2" to 12"	60.00

APPENDIX C. SUGGESTED LIST OF EQUIPMENT

Quantity	Description	Estimated total cost
1	Indexing head	$240.00
3	Tilting, indexing, and rotary tables	420.00
8	Drill press vises	120.00
2	Milling machine vises, graduated swivel	338.00
8	Bench vises, swivel base, 4" jaws	440.00
2	Work benches	146.00
	Lathe tools and attachments (boring bars, knurling tools, dogs, drill chucks, sleeves), assorted	500.00
1	Tapping attachment for high production tapping on drill press with chuck and lead screw	550.00
2	Bench plates, precision ground, 14" x 18"	224.00
2 sets	Mechanical drawing equipment, complete including: T-square, instruments, 31 x 42 board, triangles curves, drawing pencils, erasing shield, etc.	90.00
20	Personnel lockers, steel, double compartments 31" h x 24" d x 18" w	500.00
3	Laboratory work tables, 30" x 5' top	114.00
2	Drawing tables, adjustable, 30" x 36" top	
20	Tablet armchairs	300.00
2	Drafting stools	18.00
1	Instructor's chair and desk	150.00
1	File cabinet, 4-drawer	75.00
1	Projector, filmstrip or slide	75.00
1	Overhead projector	185.00
1	Projector, 16 mm, sound	500.00
	Allowance for slides and transparencies	300.00

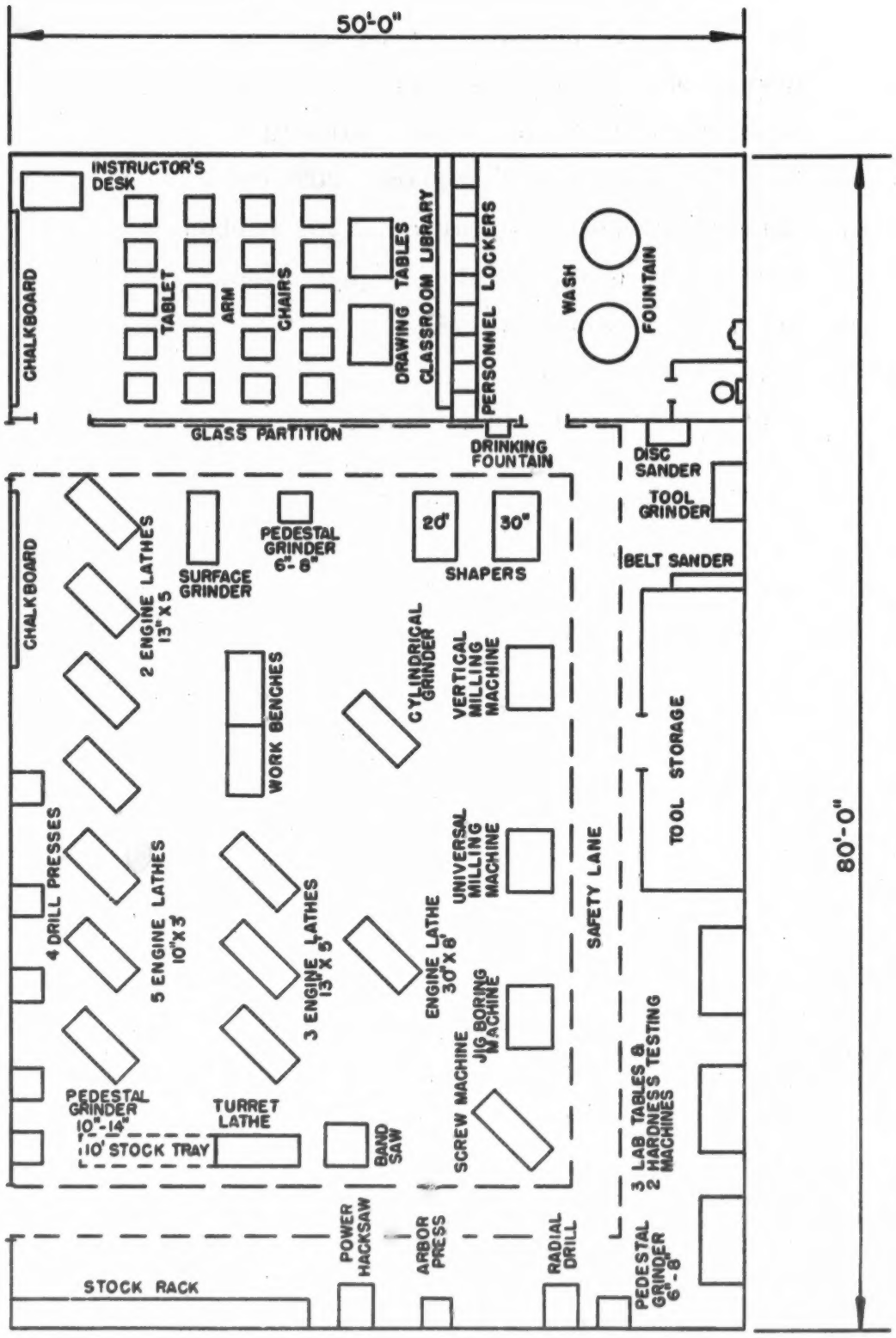
APPENDIX D. SUGGESTED LIST OF EXPENDABLE SUPPLIES

Quantity	Description	Estimated total cost
100 lbs.	Rags	$ 10.00
60	Power hacksaw blades, 18 teeth by .932" by 14" long HSS	35.00
60	Hand hacksaw blades, 24 teeth by .025" by 10"	10.25
60	Hand hacksaw blades, 32 teeth by .025" by 10"	10.25
15 gal.	Machine oil	30.00
30 gal.	"Bestol" thread cutting oil	90.00
2 boxes	Rex AAA tool bits, 1/4"	40.00
2 boxes	Rex AAA tool bits, 5/16"	45.00
2 boxes	Rex AAA tool bits, 7/16"	55.00
2 boxes	Rex AAA tool bits, 3/8"	50.00
2 boxes	Rex AAA tool bits, 1/2"	75.00
500 sheets	Fine emery cloth	50.00
1 doz.	12" mill files	15.00
1 doz.	10" bastard files	13.00
100'	Cold rolled steel, 1/4" round	4.77
100'	Cold rolled steel, 3/8" round	11.30
100'	Cold rolled steel, 1/2" round	20.64
100'	Cold rolled steel, 5/8" round	31.30
100'	Cold rolled steel, 3/4" round	45.06
100'	Cold rolled steel, 1" round	70.10
100'	Cold rolled steel, 1 1/8", round	95.00
100'	Cold rolled steel, 1 1/4", round	102.50
100'	Cold rolled steel, 1 3/8", round	135.00
100'	Cold rolled steel, 1 1/2", round	146.00
100'	Cold rolled steel, 2", round	254.50
100'	Cold rolled steel, 1/2", square	29.85
100'	Cold rolled steel, 5/8", square	46.50
100'	Cold rolled steel, 3/4", square	64.90
100'	Cold rolled steel, 1", square	115.65

Quantity	Description	Estimated total cost
100'	Cold rolled steel, 1/2" hex	$ 35.00
100'	Cold rolled steel, 5/8" hex	52.50
100'	Cold rolled steel, 3/4" hex	68.90
72'	Stainless steel, 1" diameter, type 303, machining quality	288.00
120'	Brass rod, 1" diameter, free cutting	367.20
36'	Brass rod, 2" diameter, free cutting	421.20
72'	Aluminum rod, 2" diameter, 2011-T3	324.00
72'	Aluminum rod, 1 1/2" square, 2024-T4	194.40
60 lbs.	Carbon vanadium tool steel, 1.0% carbon	60.00
20'	High speed tool, steel 1/2" bar stock	35.00
60'	Drill rod, carbon steel	780.00
500 lbs.	Grey iron castings	500.00
1	Refill kit first aid supplies	15.00

APPENDIX E

SUGGESTED TRAINING FACILITY



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SHEET METAL WORKER

A Suggested Training Course

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Office of Education, Division of Vocational and Technical Education
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FOREWORD

THE TRADITIONAL APPROACH to training sheet metal workers has been through an organized apprenticeship program. Vocational educators have worked with organized labor and governmental agencies to provide the related instruction important in developing a skilled journeyman. The schools have offered courses in drafting, mathematics, science, physics, and the like, in either day or evening classes for apprentices in the trade. In addition, some skill development activity has been included in apprenticeship courses where the craft recognized the capability of the schools to provide activity in the advanced manipulative phases of the trade. Apprenticeship, with its on-the-job work experiences, coupled with sound related instruction, has proved to be a basic source of sheet metal craftsmen.

This publication, prepared as a guide for instructors in the field of sheet metal work, should be helpful in developing course content for conducting day-to-day shop and laboratory classes. The guide is intended for administrators who must have information about course content, equipment and supplies, training schedules, qualifications of trainees, and similar items. Arrangement of the contents may be modified to meet local conditions under which training is to be offered.

With the greater use of air-conditioning facilities and of metal coverings for many building construction features, the need for sheet metal workers should continue strong. Preparation of entry-level workers in this apprenticeable occupation should lead to an increase in enrollments in apprentice training courses.

The basic content of this course will provide a foundation from which workers may move into the more demanding areas of sheet metal work.

Prepared under contractual arrangement with Oklahoma State University, the material has been reviewed by competent advisory groups. Recognition is given to Maurice Roney, Director, School of Industrial Education, for having supervised the development of the content.

Walter M. Arnold
Assistant Commissioner for
Vocational and Technical Education

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TRAINING COURSE FOR THE SHEET METAL WORKER

Purpose of the Guide

This training guide has been prepared to assist in planning and developing a course of training for workers in the sheet metal industry. It has been organized in a manner to be of maximum value to school administration personnel who are not themselves specialists in the occupation. Sufficient detail has been included, however, to provide an outline of instruction for the specialists who will be responsible for the operation of the training program.

The suggestions outlined in the training guide are not meant to delineate instruction in every detail. Supplemental material can be found in the suggested textbooks, references, and films. Further, the suggested course outline may not in all cases present topics in chronological order. The sequence of presentation, as well as the final selection of topics for special emphasis, should be determined by instructional specialists and will vary, depending on the needs and background of the trainee group.

Although this training guide has been developed primarily for planning Manpower Development and Training programs, it goes beyond the development of exercises to impart simple manipulative skills. By virtue of the related materials that are included, the trainee can be given a sound foundation in layout, a knowledge of efficient sequences of fabrication, and principles of simple product design. The materials included in the guide should be useful in technical high school programs, area vocational schools, and part-time apprenticeship programs.

Description of the Occupation

The sheet metal worker is involved in an industry that is centered around construction and manufacturing. Workers fabricate and install ducts which are used in ventilating, air conditioning, and other systems requiring movement of air. They also fabricate and install roofing, siding, flashing, venting, commercial stainless kitchen equipment, cabinets, partitions, store fronts, metal framework for advertising signs, and structures used for material movement and collection.

Generally, the sheet metal worker lays out and plans the job, taking the responsibility to determine the size and type of metal to be used. Many parts of a sheet metal assembly may be purchased in a prefabricated condition, effecting an overall saving if the sheet metal worker is aware of which parts to buy and which to fabricate locally. Beginning sheet metal workers should understand aspects of forming, cutting, bolting, riveting, cementing, punching, pressing, drilling, sawing, welding, brazing, and soldering. Workers also need to develop accuracy and speed in the layout process and master pattern construction.

The sheet metal worker uses galvanized sheet, cold rolled carbon steel, hot rolled carbon steel, copper, lead sheet, lead coated sheet, tin plate, nickel alloy, stainless steel, aluminum, and many other types of material of special formulas including several of the plastics.

Opportunities Within the Occupation

Within the next 5 years the sheet metal industry will require at least 25,000 workers to replace those who will leave the field through retirement, death, and inability to keep up with the increased demand for new and different skills. Also, the apprentice programs now in progress in the sheet metal field are not producing

the numbers of skilled tradesmen who will be needed as replacements. Some on-the-job training programs require four (4) years; however, this time may be materially reduced by attendance in a technical or vocational school.

Hourly wage rates for sheet metal apprentices generally start at 50 per cent of the journeyman rate and increase until the journeyman rate is reached. Union minimum hourly wage rates for sheet metal workers in July 1962 averaged $4.17, compared with $4.15 for all journeymen in the building trades, according to a national survey of building trades workers in 53 large cities. Among individual cities surveyed, the minimum ranged from $3.30 to $5.15.

Future opportunities for workers in the sheet metal industry look promising mainly because of the anticipated expansion in the new residential, commercial, and industrial construction. Despite the accelerated construction program in recent years, the industry has not been able to keep up with demand. Two factors which tend to keep the demand high are the population explosion, and the desire of the public to live in contemporary homes. It is quite probable that our cities and industries will require an ever-increasing program of construction and reconstruction.

Furthermore, the nature of the industry itself is changing, as are job requirements and job titles. "Warm air", as an identifying description, may disappear as tomorrow's industry achieves recognition of indoor environmental control. The day when environment control will be understood, accepted, and demanded is not far distant.

The activities of the small shop and local manufacturing are yielding to centralized manufacturing. The manufacturing industry is requiring more, faster and more complex services. This is not expected to reduce the total number of workers, but may place a different emphasis on their type of work.

Qualifications of Trainees

A high school education or its equivalent is desirable in order to progress rapidly in this occupation. Good physical condition and mechanical aptitude are important personal assets, since the sheet metal worker may be required to climb scaffolds or work in restricted enclosures. In general, the successful sheet metal worker must use, care for, and handle safely the tools, machines, equipment, and materials used in the trade.

Persons entering the training program should have completed at least one mathematics course of high school level. Persons with identified weaknesses in mechanical reasoning ability, manual dexterity, or other infirmities should be advised to consider other occupational training programs. A sense of spatial relations is necessary for successful progress in some of the more complex work in pattern development. Wherever possible in the selection of trainees, use of one of the standard tests of spatial relations may be helpful in selecting those persons with the best chance of success.

Suggestions for the Organization of Instruction

The total course presented in this training guide is intended to develop a marketable skill at the entry level, and at the same time to provide the trainee an orientation in the broad field of sheet metal work.

Shop practice, as well as the related classroom instruction, should be supplemented, where possible, by visual aids, models, and field trips; this is especially true where is is not possible to obtain certain special purpose machinery. Where this is the case, visits to industries may be required to provide the student

with at least an introduction to certain elements of the instruction which cannot be treated adequately in the training facilities.

Allocation of hours to each unit of instruction serves to indicate the relative emphasis on these units. Changes in the distribution of instruction time may be necessary, depending on the abliity and background of the group in training. Also, the ratio of classroom time to actual shop manipulations may need to be revised in individual situations. While this training guide was designed for a class of 20 persons, the ideal student-teacher ratio of somewhat less students may provide for more effective teaching. A great amount of individual instruction is required to teach the skills of the trade.

Length of Course and Course Units

The training course as outlined covers a period of 26 weeks with a total of 780 hours of related instruction and shop practice. The training is scheduled for 6 hours per day and 5 days per week.

Major Divisions of Instruction

Unit		Suggested related instruction hours	Suggested shop practice hours
I.	Mathematics and Blueprint Reading	20	20
II.	Drawing	40	60
III.	Job Planning	20	60
IV.	Pattern Development	20	80
V.	Fabrication	15	80
VI.	Sheet Metal Installation in Construction	15	115
VII.	Assembly	30	140
VIII.	Manufacturing	15	25
IX.	Maintenance and Safety Procedures	10	15
	Subtotal	185	595
			185
	Total hours		780

COURSE OUTLINE

Description

This training outline is designed to introduce to the trainee a background of fundamentals necessary for him to become a proficient entry level sheet metal worker. In order to provide trainees with salable skills, approximately three-fourths of the training time is devoted to shop practice.

Outline

The instructor, in opening the course, should orient the group to the occupational opportunities in the sheet metal field. Information contained in the opening pages of this guide may be used for this purpose. Topics to be covered should include a description of the work, employment opportunities, and information about the training as suggested by items contained in the course outline.

I. Mathematics and Blueprint Reading

A. Class - 20 hours
1. Geometry of sheet metal layout
2. Bluepring reading
   a. Symbols
   b. Single, multiple, and sectional view drawing
   c. Dimensioning practices
   d. Specifications

B. Laboratory - 20 hours
1. Problems on geometric construction
2. Problems involving bluepring reading

II. Drawing

A. Class - 40 hours
1. Development of freehand sketches, shading and perspective
2. Proper dimensioning
3. Use and care of drawing equipment

B. Laboratory - 60 hours
1. Freehand sketching
2. Mechanical drawing assignments

III. Job Planning

A. Class - 20 hours
1. Selection of materials (Design factors in the use of the following)
   a. Cold rolled steel
   b. Galvanized steel
   c. Copper
   d. Aluminum
   e. Stainless steel
   f. Plastic sheet
2. Procuring necessary measurements
3. Procedure for job layout
4. Design, safety rules, and regulations

B. Shop Laboratory - 60 hours
1. Complete drawings with an emphasis on efficiency of finished sheet metal products.

IV. Pattern Development

A. Class - 20 hours
1. Developing a layout from a bluepring
2. Use of templates for layouts
3. Procedures for the construction of:
   a. Cylinders
   b. Cones and frustums of a cone

3. Procedures for the construction of:
   a. Cylinders
   b. Cones and frustums of a cone
   c. Pyramids and frustums of a pyramid
   d. Intersections of cylinders, pyramids, cones, and irregular figures.
   e. Square to round fittings
   f. Square to rectangular and offset fittings
4. Calculations of allowances for laps, locks, and seams

B. Shop Laboratory - 80 hours
1. Construct a paper pattern of the following:
   a. Cylinder with grooved seam
   b. A cylinder fabricated by resistance spot welding which has 45° intersection of the same diameter.
   c. A rectangular container with straight sides
   d. A rectangular duct fabricated by the use of a Pittsburgh lock
   e. A rectangular elbow fabricated by the use of a Pittsburgh lock
   f. Change a square to a round
   g. An offset section of a rectangular duct.
   h. A standard funnel
   i. An offset funnel
   j. An irregular fitting requiring triangulation

V. Fabrication

A. Class - 15 hours
1. Procedures for cutting stock
   a. Hand operations
   b. Power operations
   c. Others (sawing, pneumatic panel cutter, oxyacetylene, metal inert arc, plasma arc, punching, and drilling)
2. Procedures for forming:
   a. Hand forming on stakes
   b. Slip roll forming
   c. Die forming (Acme, Pittsburgh, pressforming, drop forming, hydraulic forming explosive forming and magnetic pulse metal forming.
   d. Bar-folding operations
   e. Forming on the brake
   f. Crimping, grooving, beading, burring
   g. Wiring
   h. Flanging

B. Shop Practice - 80 hours
1. Assignment in cutting
   *a. Cutting straight scribed lines with combination snips
   *b. Cutting irregular lines with aviation snips
   *c. Use ring and circle shear to cut a flange
   *d. Use foot-operated squaring shear to cut rectangle
   *e. Using power plate shear to duplicate rectangular parts
   f. Punching a series of holes using the hollow punch, hand punch, etc.
   g. Drilling a series of holes without burning drill bit
2. Assignments in forming
   a. Hand forming on stakes
   b. Using slip roll to form cylinders
   c. Using lock forming machine to form Pittsburg lock
   d. Using the bar folder to form a grooved lock seam
   e. Wiring the edge of a cylinder
   f. Flanging operations

*Parts to be saved and used later during required fabrications

VI. Assembly

A. Class - - 30 hours
1. Riveting design and procedure
2. Soldering
3. Metal stitching
4. Acetylene welding and brazing
5. Resistance spot welding
6. Inert arc spot welding (consumable and nonconsumable)
7. Metal arc spot welding
8. Fastening (bolt, screws, adhesives, cold welding)

B. Shop Practice - 140 hours
1. Complete riveted joints using: flush rivets, round head rivets, pop rivets, and standard tinners' rivets
2. Solder lap seams on galvanized steel and copper
3. Solder lock seams and hems on aluminum and stainless steel.
4. Join sections of hot rolled steel sheet by the oxyacetylene process in both brazing and welding.
5. Join aluminum and stainless steel structures by oxyacetylene brazing and tungsten inert gas welding.
6. Join cold rolled carbon steel, stainless steel, and galvanized steel by the resistance spot welding method.
7. Join cold rolled carbon steel by the tungsten inert gas spot welding process.

VII. Sheet Metal Installation in Construction

A. Class - 15 hours
1. Roofing (use of seams, locks, lap joints)
2. Flashing and vent installation
3. Guttering
   a. Eave trough
   b. Moulded gutters
   c. Box gutters
   d. Roof gutters
   e. Conductor heads and pipe
4. Skylights
   a. Single pitch installation
   b. Double pitch installation
5. Ducts for heating and ventilating
   a. Design of size and shape
   b. Sound deadening
   c. Insulation
   d. Use of locks, clips, drives, and studs
6. Hotel and cafeteria equipment
   a. Cabinets
   b. Table tops
   c. Drain boards
7. Sheet metal finishes
   a. Care of manufactured finishes
   b. Preparation and application of finishes

B. Shop Practice - 115 hours
1. Guttering
   a. Work from blueprint to complete single pitch 5-12 chimney flashing. Scale $\frac{1}{4}$ original size.
   b. Work from blueprint to complete double pitch 4-12 chimney flashing. Scale $\frac{1}{4}$ original size.
   c. Install a corner section of gutter complete with conductor heads and downspout.
   d. Install a roof gutter on a 4-12 pitch roof complete with conductor heads and downspouts.

2. Skylights
   a. Make up corner section of a skylight to fit a flat, built-up roof
   b. Examine methods to join glass to sheet metal construction
3. Ducts for heating and ventilating
   a. Check air flow of various sizes and shapes of ducts.
   b. Examine methods for controlling noise level of various types of ducts
   c. Install various types of insulation on duct work
   d. Install sections of duct, examining various methods of joining and hanging
4. Hotel and cafeteria equipment
   a. Examine various methods of constructing cabinets
   b. Build cabinet complete with drawers, hinge assembly, and fixture mountings.
   c. Prepare a cabinet for priming and finish with a gloss enamel
   d. Experiment with air dry and baked synthetic finishes.

VIII. Manufacturing (quantity production)

A. Class - 15 hours
   1. Tubes and ducts
   2. Elbows
   3. Guttering
   4. Tanks and containers
   5. Residential and commercial fixtures
   6. Metal spinning
   7. Future trend in the manufacture of products by the sheet metal industry.

B. Shop Practice - 25 hours
   1. Explore the use of jigs and fixtures to aid in quantity production
   2. Design and build a simple fixture for the mass production of an outside yard light.
   3. Use the metal spinning lathe to produce various shapes

IX. Maintenance and Safety Procedures

A. Class - 10 hours
   1. Hand tools
   2. Power equipment
      a. Brake
      b. Punch press
      c. Drill press
      d. Nibbler and portable electric shear
      e. Oxyacetylene welding equipment
      f. Resistance welding equipment
      g. Metal arc welding equipment
      h. Inert gas welding equipment
      i. Turning machines
      j. Bar folder
      k. Lock forming
      l. Press brake
      m. Squaring shear

B. Shop Practice- 15 hours
   1. Examine and complete the sharpening of various cutting and pointed tools
   2. Examine various types of hacksaw blades for expected service, life, and use
   3. Regrind several different sizes of drill bits, noting angle of cutting edge and top clearance
   4. Examine the difference between high speed and carbon steel twist drills (hardness, use and cost)

5. Examine the cleaning equipment and maintenance procedures for oxyacetylene cutting and welding torches.
6. Write lists of safety and maintenance procedures for power equipment frequently enough to establish automatic habits.

TRAINING FACILITY CONSIDERATIONS

An attempt has been made in the layout of the physical plant (see Appendix C) to arrange equipment in a manner suitable for production practices. Several factors have been considered in arriving at the shop arrangement--such as: Space requirements per man in each work area, handling and fabricating sequence related to flow of materials, considerations of safety precautions, and a due regard for traffic problems in the handling of materials.

In the suggested floor plan storage of raw materials is adjacent to layout areas. This makes it possible for work to move from the planning area to the shear area where the final layout is reduced to size. Here the layout pattern is broken, folded, or punched as needed, and sent to the area for joining or locking. If required, the final fabrication is then sent to the spray booth which is near the exit door for priming or finishing.

In the event it is necessary to reduce the expenditures for shop equipment, considerable savings may be effected by removing from the suggested list of tools and equipment, some of the items marked with an asterisk (see Appendix D). While the machines so marked represent the least priority items, they are required equipment for an optimum facility. For example, the list includes two resistance spot welding machines which differ quite radically. The large machine, a 50 K.V.A. model, contains electronic controls and multiple adjustments to control heat, squeeze and hold cycles. When this machine is properly adjusted, quality welds may be expected, regardless of the skill of the operator. The small machine, a 10 K.V.A. model, is a simple mechanical device which may produce welds that will vary widely in quality, depending on the operator's skill. The 50 K.V.A. resistance spot welder will handle 10-gage members of mild steel and aluminum up to .051 inches thick. This is well beyond the capacity of the 10 K.V.A. resistance spot welding machine. Other machines marked with an asterisk may be considered by industry as necessary for efficient production, while for this training program the smaller, less complex, and lower cost machinery may suffice.

The specifications shown for the suggested list of machines, tools, and equipment are necessarily simplified, and are intended to be used primarily for estimating the cost of instructional facilities. Additional and more complete specifications will be required for purchase orders. In any case, the final determination as to the number, kinds and quality of items to be purchased should be made by experienced sheet metal teachers.

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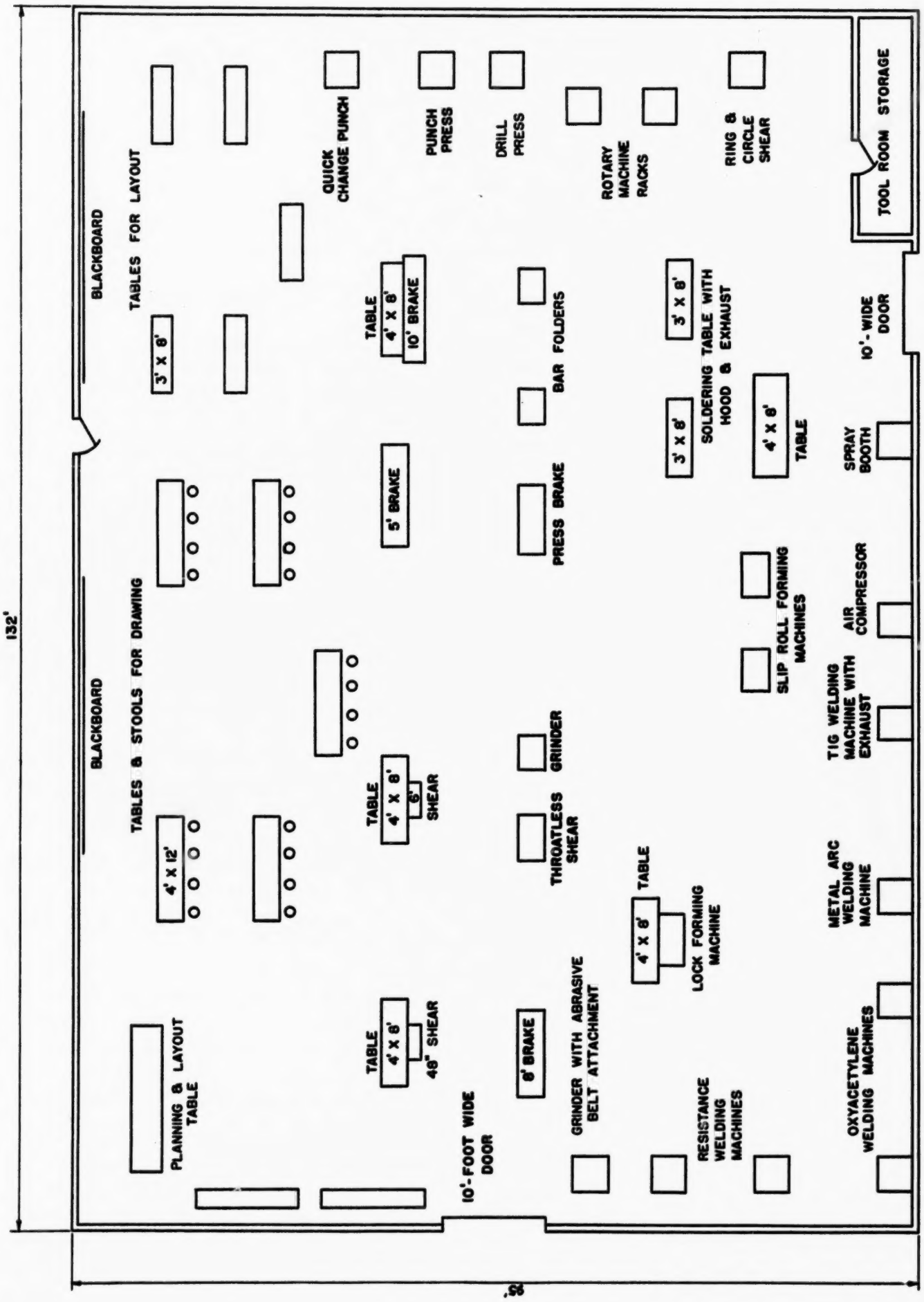

SHEET METAL SHOP FLOOR PLAN

APPENDIX D. SUGGESTED LIST OF MACHINES, TOOLS, AND EQUIPMENT FOR A CLASS OF 20 PERSONS

Unit	
1	Squaring shear, foot operated, bed width 48 inches, 18-gage capacity
*1	Squaring shear, power operated, bed width 6 ft., 14-gage capacity
*2	Unishear, motor driven, 16-gage capacity
*1	Ring and circle shear, 24-inch throat, 22-gage capacity
*1	Engel shopmaster or equal, bed size 36 X 120 inches, cutting capacity, 18-gage, notching capacity 22-gage
2	Throatless shear, 10-gage capacity
1	Brake, standard cornice, bed width 5 ft., 16-gage capacity
*1	Brake, standard cornice, bed width 8 ft., 16-gage capacity
*1	Brake, box and pan, bed width 10 ft., 16-gage capacity
*1	Punch, quich change, hand operated, 17 punches and dies, 5/32 to 2-inch capacity
1	Punch press, 10-ton capacity
1	Punch press, punch and die set, single and multiple units
*1	Nibbler, portable electric-powered, 14-gage capacity
1	Press brake, bed width 48 inches, 18-gage capacity
1	Drill press, 1/2-inch capacity chuck
4	Drill, electric hand, 1/4-inch capacity chuck
*2	Drill, electric hand, 1/2-inch capacity chuck
1	Air compressor, air delivery @ 100 psi - 15 cu. ft./ min.
2	Spray gun, external mix, 1-quart capacity
2	Air hose, 25-foot length, 1/4-inch internal diameter
2	Air moisture trap with pressure regulator, 0-150 psi
1	Spray booth with exhaust fan, minimum size, 4 X 4 X 8 ft.
20	Respirator for spray booth
2	Oxyacetylene, portable unit complete with welding and cutting tips
2	Oxyacetylene, face shields equipped with #3 lens
*2	Generator, motor-driven for metal arc welding, direct current, 250-ampere capacity
1	Power supply, AC-DC, gas and water controlled, 250-ampere capacity, complete with TIG spot-welding timer
1	Tungsten inert gas welding torch, 1/4" maximum electrode capacity
3	Arc welding helmets equipped with #10 lens
1	Inert arc spot-welding torch
1	Metal arc spot-welding torch, complete with power supply and timing device, maximum electrode size 3/32 inch
1	Resistance spot-welding machine, minimum throat depth 12 inches, minimum power 10 K.V.A.
*1	Resistance spot-welding machine, minimum throat depth 24 inches, minimum power 50 K.V.A.

* Items marked with an asterisk represent a certain grouping of machinery which may be deleted without destroying the usefulness of the training program. The complete list represents an optimum facility rather than either a minimum or an ideal facility.

Unit	
*1	Metal-stitching machine
1	Lock-forming machine, 22-gage capacity
2	Rotary racks, complete with the following: 1. Turning machine 2. Wiring machine 3. Beading machine 4. Crimping machine 5. Burring machine 6. Flanging machine
1	Grooving machine, 48-inch throat depth, 22-gage capacity
1	Double-seaming machine, 22-gage capacity
5	Tables, for drawing, 3X8 ft. top
5	Tables, for workbench and layout, 4 X 8 ft. top
5	Tables, for workbench and layout, 4 X 12 ft. top
2	Workbench, for soldering, 3 X 8 ft. top
2	Storage racks, vertical dividers to hold 10-foot-long sheets, 10 compartments
*1	Grinder, 1-hp. capacity, grinding wheel width 2 inches, double arbor
1	Grinder, 1/2 hp. capacity, grinding wheel width 1 inch, double arbor to power 2" flexible abrasive belt
1	Lathe, metal spinning, 1-hp. motor, 12-inch swing
2	Bar folder, bed width 26 inches, 22-gage capacity
2	Slip roll forming machine, 2-inch diameter rolls, working length of rolls 36 inches, 22-gage capacity
*1	Slip roll forming machine, 5-inch diameter rolls, 5-hp. motor, working length of rolls 72 inches, 11-gage capacity
4	Bench plate for assorted bench stakes
2	Bench stake set as follows: 1. Double seaming 2. Beakhorn 3. Bevel-edge square 4. Needle case 5. Hatchet
3	Universal stake holders and Universal stakes: set, complete as follows: 1. Double seaming 2. Beakhorn 3. Bevel-edged square 4. Needle case 5. Hatchet 6. Blowhorn 7. Bottom
4	Hollow mandrel stakes
5	Universal hand dolly
2	Punch set, solid, taper, 1/8, 1/4, 1/2, 3/4 inch
2	Punch set, hollow, 1/2, 3/4, 1 inch
10	Punch set (one prick, one center)
20	Needle-nose pliers, 2-inch nose
20	Flat-nose pliers
2	Shears, double-cutting hand-operated
20	Combination snips, 3-inch jaw

Unit	
10	Standard straight snips, 3-inch jaw
5	Circle snips, 2 1/2-inch cutting edge
20	Aviation snips, 10-inch length, 2-inch cutting edge right-hand cutting
20	Aviation snips, 10-inch length, 2-inch cutting edge left-hand cutting
2	Trojan snips, 12-inch length, 2 1/2-inch cutting edge
20	Scratch awls
20	Wing dividers, 10-inch
2	Beam trammel points
10	Soldering coppers, set as follows: 1. One-pound (one each, pointed and bottom) 2. Three-pound (one each, pointed and bottom) 3. Four-pound (one each, pointed and bottom) 4. Six-pound (pointed)
5	Furnace, gas-fired, complete with 2 burners, 2 valves, and pilot light
5	Hand groover set with groove widths as follows: 1. 1/8-inch 2. 7/32-inch 3. 5/16-inch 4. 7/16-inch
5	Rivet set, containing numbers 680 to 689, inclusive
10	Mallet, leather-faced, 2-inch diameter face.
10	Mallet, leather-faced, 4-inch diameter face
10	Mallet, plastic-faced, 1 1/2-inch diameter face
10	Hammer, setting, sheet metal
10	Hammer, raising, sheet metal
10	Hammer, riveting, sheet metal
5	Hammer, 3-lb., sledge
10	Square, roof-framing
20	Square, combination
5	Rule, circumference
20	Rule, 24-inch
2	Micrometer, 0-1-inch opening
5	U. S. standard sheet-metal gage
5	Vise, solid base, 3 1/2-inch jaw, 4-inch opening
5	Vise, swivel base, 3 1/2-inch jaw, 4-inch opening
20	"C" clamps, 8-inch opening
20	Vise grips
5	Chisel set, 1/2, 3/4, 1-inch blade
10	Screwdriver set, standard blade as follows:

Blade		Tip	
Length	Diameter	Thick	Width
3"	7/32"	.032"	7/32"
4"	1/4"	.037"	1/4"
6"	5/16"	.041"	5/16"
10"	3/8"	.050"	3/8"

Unit	
10	File, flat-bastard, 10-inch
10	File, smooth-mill, 10-inch
10	Screwdriver set, for Phillips head screws as follows: 1. No. 4 and smaller 2. No. 4 to 9, inclusive 3. No. 10 to 16, inclusive 4. No. 18 and larger
10	Tubular hacksaw frame, adjustable for 10-inch to 12-inch blades
1	Grinding wheel dresser
2	Abrasive bench stones, combination coarse, and fine grit
	Adjustable wrench set complete as follows: 1. 6-inch 2. 8-inch 3. 10-inch 4. 12-inch
4	Twist drill set, carbon steel, 1/16" to 1/4" by 1/64", 13 drills
4	Twist drill set, high-speed steel, 1/64" to 1/2", 32 drills
	Metal spinning tools, complete as follows: 1. Flat tool 2. Pointed tool 3. Cut-off tool 4. Beading tool
20	Drawing sets complete as follows: 5 1/2" compass, 3" extension bar, interchangeable pen, 4" combination spring bow pen and pencil, 4" spring bow divider, 4 1/2" ruling pen
20	Drawing outfit complete as follows: 48" T-square, triangular architect's scale, triangle 30" X 60", acrylic 8-inch, triangle 45" X 45" acrylic 6-inch, curve (irregular) 8-inch, pencil pointer, drawing pencil H. drawing pencil 3 H, drawing pencil 6 H, eraser, protractor (acrylic), drafting tape, drawing board brush
20	Drawing boards, steel edge
20	Stools, steel frame construction with 13" diameter wood seat

APPENDIX E. SUGGESTED LIST OF EXPENDABLE SUPPLIES

Quantity	Description
10	Cold rolled steel sheet, 18-gage, 36" x 96"
10	Cold rolled steel sheet, 20-gage, 36" x 96"
60	Cold rolled steel sheet, 22-gage, 36" x 96"
10	Cold rolled steel sheet, 26-gage, 36" x 96"
60	Cold rolled steel sheet, 28-gage, 36" x 96"
2	Zine sheets, 20-gage, 30" x 96"
60	Galvanized steel sheet, 22-gage, 36" x 96"
60	Galvanized steel sheet, 28-gage, 36" x 96"
20	Copper flat sheets, soft temper, 16-oz. (.022) 1.0 lbs per sq. ft. 24" x 48"
20	Copper flat sheets, cold rolled, 16-oz. (.022) 1.0 lbs per sq. ft. 24" x 48"
20	Aluminum flat sheets, 16-gage, (.051), 17.18 lbs per sheet, 36" x 96", half hard temper
20	Stainless steel sheet, type 304, polished one side, 36" x 96" sheets, 24-gage
40	Steel strip, hot rolled mild steel, 20 ft.-lengths 1/8" x 1/2", .213 lbs per ft.
40	Steel strip, hot rolled mild steel, 20 ft.-lengths 1/8" x 1", .425 lbs per ft.
1000 ft	Steel angle, hot rolled mild steel 1/8" x 1 1/4" x 1 1/4"
50	Tin plate, 20" x 28" sheets, 28-gage (D15)
100 lbs	Solder, 50% tin and 50% lead
500 ft	Galvanized wire, #8 gage
500 ft	Galvanized wire, #10 gage
5 gal	Machine oil, for general lubrication and rust prevention
50	Abrasive belts, 2" x 60", 100-grit
20 lbs	Solder, 60% tin and 40% lead
5 gal	Hydrochloric acid
20	1-pound blocks of Sal-Ammoniac
20	6-oz. tins of rosin paste
20 lbs	Soldering salts
5	Pint jars of aluminum soldering flux
5	Pint jars of aluminum brazing flux
10 lbs	Aluminum soldering rod
10 lbs	Aluminum brazing rod
10 lbs	Stainless steel solder
5	Flux for soldering stainless steel, (6 oz.)
1 gross	Flux and acid brushes
200	Steel stove bolts with square nuts, 3/16" diameter 1/2" long
8 lbs	Tinners' rivets, 8-oz.
8 lbs	Tinners' rivets, 1-lb.
8 lbs	Tinners' rivets, 2-lb.
4 gross	Pan head rivets, #6 size, 1/4-inch long
50 lbs	Arc welding electrodes, E-6024, 3/32"-diameter
50 lbs	Arc welding electrodes, E-6024, 1/8"-diameter
50 lbs	Mild steel, oxyacetylene welding rod, 1/16"-diameter
50 lbs	Mild steel, oxyacetylene welding rod, 1/8"-diameter
160 oz	Silver solder, 1150° melting temperature

Quantity	Description
4 lbs	Silver solder paste flux
20	Cartons epoxy glue, 8-oz. containers
5 gal.	Metal primer
10 gal.	Synthetic enamel
20 gal.	Lacquer thinner
2 gal.	Synthetic enamel reducer
5 gal.	Synthetic finish for galvanized metal, aluminum, or ternplate surfaces
5 gal.	Wrinkle finish
20	Hacksaw blades, 18 teeth per inch, .025 thickness
20	Hacksaw blades, 24 teeth per inch, .025 thickness
20	Hacksaw blades, 32 teeth per inch, .025 thickness

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State of New Jersey
Department of Education
Vocational Division

COMMERCIAL FOODS

MATHEMATICS - 1

Prepared by
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MEMORANDUM

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DATE: June 7, 1967

RE: (Author, Title, Publisher, Date) Blanche E. Dornfield; COMMERCIAL FOODS - MATHEMATICS 1 ; Vocational Division-Curriculum Laboratory ; 4th printing - July 1966

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(3) Utilization of Material:
Appropriate School Setting Related math at vocational High School level
Type of Program High School
Occupational Focus Occupational cluster
Geographic Adaptability No limits
Uses of Material Students reading
Users of Material Students

(4) Requirements for Using Material:
Teacher Competency Math specialist or commercial foods instructor
Student Selection Criteria High School age - medium aptitude and commercial food service goal
Time Allotment Three periods per week for one year

Supplemental Media --
Necessary ____)
Desirable X) (Check Which)

Describe None available

Source (agency)
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U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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Vocational Division

Department of Vocational-Technical Education
Graduate School of Education
Rutgers - The State University

C O M M E R C I A L F O O D S - M A T H E M A T I C S - I

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New Brunswick, New Jersey

Vocational Division - Curriculum Laboratory
New Brunswick, New Jersey

Fourth Printing, July, 1966

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COMMERCIAL FOODS

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MATHEMATICS I - FOR COMMERCIAL FOODS

Counting, computing and figuring were one of man's earliest accomplishments.

Even before you came to school your mother may have boasted to her neighbors that her child knew how to count.

When you came to school you were taught what is known as the four fundamental processes in mathematics -- addition, subtraction, multiplication, and division.

You learned how important it was to work carefully and thoughtfully because mathematics is known as an "exact science", which means that a problem is either right or wrong.

The first lessons of your mathematics course for Commercial Foods will be a review of these fundamental processes. Your work will also indicate whether you are careful and accurate.

Turn to the next page and start your "Pre-Test". This is not a speed test. Do your work carefully and try to make a good score.

The lessons that follow will show how the fundamental processes are used in all jobs of the foods trade.

UNIT I - WHOLE NUMBERS

Pre-Test No. 1

OBJECTIVE: To recall knowledge of whole numbers and to review the work with whole numbers.

RELATED INFORMATION:

In this lesson you will have an opportunity to review the fundamental processes of working with whole numbers. After you have successfully completed this lesson, you will be ready to proceed with the mathematics planned especially for Commercial Foods workers.

PROCEDURE:

1. Do all of the work on paper furnished by the instructor. Do not write on this sheet.

2. Copy all the problems onto your paper. Papers will be checked for legibility, neatness as well as accuracy.

   Check your answers carefully. This is not a speed test.

Exercise 1. Addition

Add the following numbers mentally - just put the answers on your paper.

1. 8 + 4 + 5 + 3 + 2 =
2. 9 + 6 + 7 + 4 + 1 =
3. 10 + 13 + 15 + 11 =
4. 7 + 12 + 3 + 15 =
5. 6 + 15 + 5 + 7 + 17 =

Exercise 2. Copy the following on your paper and add.

1.	2.	3.	4.	5.
3547	$18.95	42976	$178.24	475891
4365	15.16	72877	96.50	652322
6623	45.98	25734	57.95	698507
7832	6.50	86754	6.95	579243
8950	5.65		101.98	126759
4268				324576

Exercise 3. Subtraction

Subtract the following and put the answers on your paper. Do not copy the problem.

1. 18 - 7 = 2. 14 - 9 = 3. 15 - 8 = 4. 12 - 8 =

5. 17 - 5 =

Exercise 4. Copy the following on your paper and subtract.

1.	2.	3.	4.	5.
239	487	842	9457	2965
-128	-359	-456	-7068	-1372

Exercise 5. Multiplication

Multiply the following mentally and put only the answer on your paper.

1. 7 x 6 = 2. 3 x 7 = 3. 9 x 8 = 4. 5 x 9 =

5. 6 x 8 =

Exercise 6. Copy the following on your paper and multiply.

1.	2.	3.	4.	5.
488	3566	8495	6294	7384
x307	x 224	x 637	x 176	x4613

Exercise 7. Division

Divide the following and put only the answers on your paper.

1. 15 ÷ 3 2. 8 ÷ 2 3. 45 ÷ 9 4. 81 ÷ 9 5. 16 ÷ 4

Exercise 8. Copy the following on your paper and divide.

1. $14\overline{)2366}$ 2. $71\overline{)4615}$ 3. $86\overline{)63640}$ 4. $92\overline{)349671}$

5. $84\overline{)354028}$

UNIT I - WHOLE NUMBERS

Checking Daily Bills — Lesson No. 1

OBJECTIVE: To understand the importance of checking daily food orders and bills.

RELATED INFORMATION:

What would you think of a shopper who neglected to check the articles that were in his order? Also, what would you think of a person who neglected to check the prices of the goods that he had purchased? Surely, you would say that he was a very careless person.

The food worker must be more cautious than the shopper because:

a. he is purchasing food in much larger quantities.
b. he is responsible for the receipt of the goods.

PROCEDURE:

Daily orders are written in the "day book" or order book.

Be sure that the count, weight, or size of the package is the same as has been ordered.

Record the prices in the day book.

Check the total.

If there should be any mistakes in prices of quantities, call the dealer for corrections.

ASSIGNMENT:

1. Why should all deliveries be checked carefully?

2. The order book indicates that 150 half pints of milk were ordered, but 148 were received. When would you report the shortage? Why?

3. The total grocery bill is $17.66. After adding it several times, you find that your total is $17.76. What will you do?

4. Twenty-four dozen rolls were ordered. You were charged for twenty-two dozen. What would you do about this situation? Why?

5. A good business person reports all mistakes, whether it affects the dealer or the customer. Explain why this is a good practice?

6. Total the packet of orders that you have received. Find the total of each bill. Add the totals of each to arrive at the total of all. Your teacher will supply the orders.

UNIT I - WHOLE NUMBERS

Issuing Stock Lesson No. 2

OBJECTIVE: To learn how to keep accurate stock records.

RELATED INFORMATION:

The kitchen manager or the stock room clerk is responsible for issuing staples from the store room.

To keep the records uniform, a stock room form has been made.

PROCEDURE:

A.

1. Obtain a form from the file.

2. As each worker requests stock, record the material withdrawn from the stock room on the form.

3. Study the model form below and fill the form in with any supplies issued from the store room.

MODEL STOCK ROOM FORM

DATE	ARTICLE	SIZE	AMOUNT	TOTAL
Nov. 6	Tomatoes	#10	3	3
	Cornstarch	1 lb.	1 lb.	1 lb.
	Spaghetti	1-20 #	10 lb.	10 lb.

4. Fasten the form on a clip board and leave it there while you are acting as stock room clerk. Total all supplies issued before you pass the form on to another clerk. Sign your name to your record.

5. Record each item that is taken from the store room.

6. At the end of the day, total the quantities used.

7. Put the record in the file.

B. It is necessary to keep a special record of the ice cream sales. The store room clerk can prepare one of these before the lunch period.

1. Make out a form as follows.

2. List the items for sale, and the quantities available.

3. The person who sells the ice cream will keep the record.

Daily Ice Cream Record

Date	On Hand	Article	Sold	Total	Left
Nov. 6	84	Ice Cream Sandwich	~~////~~ ~~////~~ ~~////~~ ~~////~~	20	64
	36	Dixie Cups	~~////~~ ~~////~~ ~~////~~ ~~////~~ //	22	14
	60	Fudgcicles	~~////~~ ~~////~~ ~~////~~ ///	18	42

ASSIGNMENT:

1. Total the stock room slips for one month according to the following directions:

   a. List the various items used.

   b. Record the quantity of each item that has been used for the month.

   c. Total the quantity of each item that has been used.

Suggested Form

Monthly Store Room Record

DATE: Sept.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	Total
Peaches #10		4			1				8		3						6		1		2	25
Coffee		1		3					1		1				4			2	1	1	1	15
String Beans #10				5			1			6							4					16

NOTE: It is suggested that a form be made out to conform to the dates that school will be in session.

Food Service Records

Lesson No. 3

OBJECTIVE: To understand the application of addition in keeping food service records.

RELATED INFORMATION:

A progressive business must know the number of people that eat in their establishment every day.

Guest check pads provide one method of determining this record. Below is a sample of the check pad.

Guest Check

Table No. 15 3	Server J.W.	Guests 4

EXPLANATION:

No. means number of the check -- this is usually printed on the pad and the numbers are consecutive.

Table means the table number at which the guest has been served.

Server - some means of identifying the person serving.

Guests - the number of people served at this time.

PROCEDURE:

A. Table Service

1. Each check is numbered. If you spoil a check, do not destroy it. The hostess or cashier will direct you as to the way to handle checks that are "void".

2. Table Each waitress or server is assigned a certain number of tables. The number of the table is placed in the box on the check.

3. Server The hostess or manager will instruct you as to the way you mark this box. Some places use the name; some, initials; others use different means of identification.

4. Guests The number of guests in each party should be put in the box provided for this information.

B. Counter Service

The method of counting counter customers varies. We will consider the method that we have found helpful.

1. Put forty half-pints of milk on each serving tray. Record the number of trays set up.

2. Check the various desserts that have been prepared. Record the number of each.

3. Check the number of salads, sandwiches, and all other foods prepared for the counter.

4. Pile the dinner plates or platters in piles of twenty.

C. Ice Cream

The kitchen manager or the stock room clerk will prepare the service record for this station. See directions for keeping this record in Lesson 3.

The server should check the items sold. The cashier will put the money collected from ice cream in a separate register. At the end of the lunch periods these accounts will be checked. The cash and the server's record should agree.

ASSIGNMENT:

1. Get a packet of sales checks from the cafeteria. Figure the number of guests served.
   a. for one day
   b. for one week
   c. for one month

2. Get the register tape and count up the number of sales according to the letters that appear on the tape. "E" is used by the cashier to indicate the number of platters or Federal lunches sold. Count the "E's" and check them with the number of plates that were set up.

3. Consult the lunchroom records for two preceding years. Find the date that corresponds with the one that you are recording. Compare today's guest count with the previous records. Has business increased? decreased? Make a record of the information that you find.

4. Make a table like the sample. Observe - the days of the week that may be consistent with more business. Reasons?

Month	Monday	Tuesday	Wednesday	Thursday	Friday	Total
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						

UNIT I - WHOLE NUMBERS

Cash Register Operation — Lesson No. 4

OBJECTIVE: To learn the method of checking lunchroom receipts.

RELATED INFORMATION:

You, of course, realize the importance of accuracy, if you are operating a cash register. Carelessness here can cost your employer his profit. Overcharges can make a customer angry. (You may even be asked to make up shortages out of your pay). It isn't difficult to see that you need pin-point accuracy in this operation. While 95% in math in school is a good mark, it is not good enough for the cash register operator. She must make a mark of 100%. Nothing else will do.

Some of the causes of overs and shorts are listed. Read these are see if you may not be able to add others to the list.

1. distractions -- conversation with workers or customers.
2. not paying attention to business.
3. insufficient amount of change to begin the day's work.

PROCEDURE:

To total the receipts for the day.

1. remove the money from the cash drawer.

2. take out the change that was in the register.

3. pile the remaining change as follows:

   pennies in piles of tens
   nickels in piles of tens
   dimes in piles of tens
   quarters in piles of fours
   half dollars in piles of twos
   bills -- clip together with a slip of paper on which the amount is written.

Note: If there is extra change of any denomination, keep it aside and add it in later. Some establishments put this change in envelopes marked with the amount and description of the contents.

4. Total the money.

5. Check the money with the total on the cash register tape - the amounts should agree.

6. fill out a register blank with the following headings

Register Reading	Register Receipts	Over	Under

Cashier
Date

ASSIGNMENT:

1. How is the money to be piled?

2. Should the first and second column check? Why?

3. Jane's register report for one week was as follows:

Register Reading	Register Receipts
$26.36	$26.41
41.15	40.99
28.01	28.34
27.44	27.34
31.47	31.42

What was Jane's record for the five day period? Would you consider Jane an accurate cashier?

4. Explain how you would stack the following change:

7 half dollars	75 nickels
24 quarters	98 pennies
30 dimes	$22 in bills.

a. What is the total amount of money in the above?

b. The register tape showed a total of $39.35. Was the cashire over or under? How much?

5. If your register shows a tape for $249.87 and you have $250.16 in cash, how much over are you?

6. Monday's cash register receipts were $170.02. The tape showed $171.46. What was the shortage?

7. The receipts for one week amounted to $426.46. There was $75.00 in bills, $25.50 in half dollars; $220.75 in quarters, $59.60 in dimes, $45.00 in nickels, and the remainder in pennies.
   a. How many pennies are there?
   b. Make up the change in piles according to the directions for totaling the daily receipts.

8. If you were getting the money ready to deposit in the bank, it would be necessary to put the coins in wrappers, as follows:

half dollars	$10.00 to each wrapper
quarters	$10.00 to each wrapper
dimes	$ 5.00 to each wrapper
nickels	$ 2.00 to each wrapper
pennies	.50 to each wrapper

   a. How many rolls of each denomination would you have?

   b. Put any extra change in separate envelopes and mark with the coin and the amount.

Make out a slip like the model

	Number	Amount
Bills		
Halves		
Quarters		
Dimes		
Nickels		
Pennies		

Total -- should balance with the amount you started with -- $426.46.

UNIT I - WHOLE NUMBERS

Production Report — Lesson No. 5

OBJECTIVE: To learn how to prepare a production report.

RELATED INFORMATION:

The record of food prepared as well as what is sold and returned to the kitchen,provides a kitchen manager with a great deal of information.

PROCEDURE:

1. Each cook prepares a record of the different dishes made at his station.

2. After the meal, he counts or measures what food remains. This figure should balance with the quantity of food sold.

ASSIGNMENT:

1. The following is a cook's production report. Complete the last column.

Prepared	Returned	Sold
100 portions soup	10	
65 baked pork chops	0	
40 chicken croquettes	0	
100 portions mashed potatoes	15	
3 quarts gravy	1 pint	
12 pies	2	
6 layer cakes	1	
50 fruit cups	15	
30 servings rice custard	5	

2. The cook ordered 25 porterhouse steaks. Five were left at the end of the day. There was a record of 19 sold. Does this record balance? What is the difference? What might be some reasons for the discrepancy?

3. The production record showed that 75 portions of spaghetti were prepared. The server was able to get 70 from the pan. What was the difference? How might it be accounted for?

4. Sixty-five baked custards were prepared. The counter server accidentally dropped four. How many were actually available for sale?

5. The sandwich cook received 45 slices ham, 20 slices cheese, 40 slices ham bologna, for sandwiches. At the end of the day there were 5 slices ham, 10 slices cheese, and 15 slices bologna left. How many sandwiches of each kind were made, if one slice of each was used for a sandwich?

Counter Report Lesson No. 6

OBJECTIVE: To learn how to prepare a counter report.

RELATED INFORMATION:

A good counter worker is a sales person. Often he can increase sales by suggesting and encouraging customers to take extra items. This form of selling is very profitable to the management and such a worker is very valuable to any establishment.

With such variety of items at the cafeteria counter there is ample opportunity to make suggestions.

The counter report shows exactly how much has been sold at each station at a given interval of time.

PROCEDURE:

1. Obtain one of the counter report blanks.
2. List all of the food items on the menu.
3. Record the quantity of each as it is ready for the counter.
4. At the close of the serving period, record the quantity of left-overs in the column not sold.
5. Subtract from the number listed in the first column.
6. The result will be the quantity sold.
7. Multiply the number in column 3 by the unit selling price. Put the answer in column - total value.
8. Add all the numbers in column 5. This figure will be the total money value of the food sold.
9. The total money value of food sold should equal the cash receipts.

ASSIGNMENT: Complete the following Counter Report:

1.

Food Item	For Sale Servings	Not Sold	Sold	Unit Price	Total Value
Soup					
Tomato	60	10		.05	
Clam Chowder	50	5		.10	
Potato	30	10		.05	
Split Pea	60	10		.05	
Desserts					
Layer Cake	45	2		.15	
Tapioca Pud.	30	10		.10	
Apple Pie	50	30		.10	
Sandwiches					
Egg Salad	30	10		.20	
Ham	25	5		.20	
Cheese	20	10		.15	

2. Complete the following counter report:

Article	Number Sold	Unit Price	Total
Steak Sandwich	50	.75	
Hamburger & Roll	70	.40	
Frankfurter & Roll	60	.20	
Pie			
Apple	48	.20	
Pumpkin	40	.20	
Custard	13	.20	
Cherry	32	.20	
Cake			
Chocolate Layer	25	.15	
Cup	40	.07	

3. The cashier had $110.68. Was the register over or under? How much?

CAFETERIA
DAILY COUNTER REPORT

(Day of Week) Date 19

Food Items	Quantities For Sale	Quantities Not Sold	Quantities Sold	Unit Selling Price	Money Value of Sales	Food Items	Quantities For Sale	Quantities Not Sold	Quantities Sold	Unit Selling Price	Money Value of Sales
Soups	Bowls					Sandwiches					
Vegetable	50	10	40	10	$4.00	Ham	20	0	20	20	$4.00
Cream of Mushroom	35	0	35	15	5.25	Tuna Salad	15	1	14	20	2.80
						Peanut Butter	15	2	13	10	1.30
Hot Dishes						Salads					
Macaroni & Cheese	40	0	40	15	6.00	Fruit	12	0	12	25	3.00
Meat Loaf	50	0	50	10	5.00	Chef's	15	5	10	20	2.00
Vegetables						Desserts					
Peas & Carrots	35	5	30	07	2.10	Jello	36	0	36	05	1.80
Mashed Potatoes	100	0	100	05	5.00	Fruit Cup	20	5	15	07	1.05
						Cup Cake	36	0	36	10	3.60
Other Food Items						Butterscotch Pie	24	0	24	15	3.60
Federal Lunch	100	10	90	25	22.50						
										Total Money Value Food Sold	$72.00

Checked by

UNIT I - WHOLE NUMBERS

Food Service Report — Lesson No. 7

OBJECTIVE: To learn how multiplication is used in preparing daily food service reports.

RELATED INFORMATION:

You will be very much surprised to learn the number of lunches served in our school over a period of one month.

Records show that in schools alone there are millions of lunches sold to school children every day.

Try to think of the thousands of meals that are served in restaurants, luncheonettes, and various other eating places, and you will begin to understand what a tremendous job this feeding business is.

The habit of "eating out" has grown to such an extent that our business must keep accurate records of the number of meals served every day.

PROCEDURE:

1. Prepare a form like the sample -

Date	E	Value of E	A	Value of A

2. Use the cash register tapes to prepare your record. Tapes for each month are in marked envelopes in the cafeteria.

3. Count up the number of "E's" and "A's" on each tape.

4. Record the number in the correct column of the form.
   Explanation -- "E" represents the number of Federal lunches;
   "A" indicates adult lunches.

5. Multiply each number in column "E" by 25 cents. Put the answers in the column - "Value of E".

6. Multiply each number in the column "A" by 30 cents and put the answers in the column "Value of A".

7. Total each column.

8. To prove your work -- total of column "E" x .25 = the total of column "Value of "E".
   "A" x .30 = the total of column "Value of "A".

Sample

Date	E	Value of E	A	Value of A
Oct. 1	30	$ 7.50	22	$ 6.60
Oct. 2	42	10.50	16	4.80
Oct. 3	57	14.25	30	9.00
Total	129	$32.25	68	$20.40

Proof: 129 x .25 = $32.25
68 x 30 = 20.40

ASSIGNMENT:

1. What would be the total receipts for 607 lunches at 25 cents each?

2. In January, 560 adults purchased lunches at 30 cents each. How much cash was received?

3. If the average luncheon check in a commercial cafeteria was 76 cents, how much would be received from 625 guests?

4. A commercial restaurant owner separated his meal checks for Thursday evening dinner. There were:

   41 checks @ $2.50 each
   8 checks @ 3.75 each
   51 checks @ 1.25 each
   17 checks @ .75 each
   44 checks @ 1.50 each

   a. How many people were served?
   b. What was the total of the receipts for this meal?
   c. What was the average check for this meal?

UNIT I - WHOLE NUMBERS

Costing Recipes | Lesson No. 8

OBJECTIVE: To learn how to compute the cost of recipes.

To recognize the importance of knowing the cost of materials used in food preparation.

RELATED INFORMATION:

What would you think of a carpenter who built a house and didn't keep a record of the cost of materials that were used?

What would you think of a dressmaker who made a dress and considered just the cost of the cloth used?

I am sure that you would say that these workers would not be successful business people. Every item that is used should be listed and priced so that there is a true picture of the cost of the production of the house or the dress.

The food worker must know the cost of recipes by computing the costs of all the materials used.

It is necessary to make frequent checks of costing recipes because prices change.

ASSIGNMENT:

1. For this lesson you will use current prices. Consult the cafeteria records for these.
   Copy the following recipes. Look up the unit price of each item used. Consult day book, or inventory cards.
   Compute the cost of each recipe. This is materials cost only.

   A. Spanish Rice (50 servings)

   3 lb. bacon
   10 green peppers
   4 lb. rice
   2 lb. onions
   1 #10 can tomatoes
   1 oz. salt

B. Salmon and Macaroni Salad (50 servings)

3 1 lb. cans salmon
2 lb. green beans
2 qts. diced celery (weigh to determine the quantity needed)
1/4 lb. onions
3 lb. elbow macaroni
1 pt. salad dressing

C. Cottage Pudding (50 servings)

1 1/2 lb. sugar
1 oz. baking powder
4 eggs
1 pt. milk
1 1/2 lb. flour
1/2 lb. vegetable shortening

D. Tapioca Pudding (50 servings)

6 qts. milk
1 1/2 doz. eggs
1 lb. sugar
1 1/2 c. quick tapioca (quick cooking)
1 T. vanilla

2. Find the cost per serving of each of the recipes.

3. Ground beef costs 52 cents per lb. What does 30 lbs. cost?

4. Eggs are 45 cents per dozen. What does a crate of 30 dozen cost?

5. A restaurant prepared 80 servings of chicken to be sold at $1.25 per serving. 56 servings were sold. How much income was derived from this sale?

6. The chicken cost the restaurant operator 44 cents per serving, what was the value of the chicken that was not served?

UNIT I - WHOLE NUMBERS

Yield of Standard Recipes — Lesson No. 9

OBJECTIVE: To learn how to divide standard recipes.

To become familiar with the present trends in the use of smaller recipes.

RELATED INFORMATION:

Standard recipes are prepared to yield a definite quantity but there are times when a cook will need to change the yield of a recipe.

The newer trend in food preparation is for the cook to prepare food in smaller quantities. Every cook has his favorite recipes which have often been worked out in large quantities, so it will be a great help to know how to change these recipes and be able to break them down so that they will serve different numbers.

There also will be times when the recipe will need to be increased.

ASSIGNMENT: Change the following recipes to the quantities indicated in each column.

1.

Cake Batter	100 Portions	50 Portions	25 Portions
molasses	8c.		
brown sugar	8c.		
buttermilk	8c.		
melted butter	16T.		
eggs	32		
flour	8lb.		
ginger	4T.		
cinnamon	4T.		
baking soda	4oz.		

2.

Baked French Toast	24 Portions	12 Portions	48 Portions
bread	24 slices		
egg yolks	12		
granulated sugar	1 T.		
salt	1 T.		
milk	4 c.		

3. Baked Egg Sandwich Roll with Cheese Sauce

	36 Portions	24 Portions	6 Portions
hamburger rolls	36		
eggs	36		
fresh tomatoes	9		
melted butter or oil	3/4 c.		
salt	1 1/2 T.		
pepper	3/4 t.		
sauce			
milk	2 1/4 qts.		
butter	12 oz. oz.		
cheese	12 pz. pz.		

4. Select three recipes from one of the following:

Restaurant Management Magazine
Institutions Magazine
Woman's Day Magazine, Good Housekeeping and/or similar magazine
Copy the recipes and state the source.
Figure out each recipe to serve twelve, twenty-five

UNIT I - WHOLE NUMBERS

Use of Standard Serving Equipment — Lesson No. 10

OBJECTIVE:

1. To understand how standard measuring equipment is used to obtain uniform servings.

2. To understand how the use of standard measuring equipment provides business with a check on the production as well as the service of food.

RELATED INFORMATION:

Standard measuring equipment has taken the guess work out of food production.

The use of standard serving equipment also makes for satisfied customers. Would you feel that you were being treated fairly if you saw one person in the cafeteria line receive a large serving of food and then when you came along you received a much smaller portion?

Ladles, dippers, and ice cream scoops are some of the tools that are used to give the customer the quantity of food that he should receive for the money he is spending.

PROCEDURE:

1. Obtain several ladles from the kitchen. Fill each with water. Pour the measured water into a measuring cup. Record the amount that each dipper holds. Compare the amounts.

2. Look at the different sizes of ice cream scoops or dishers. On the spring inside the scoop, there is a number. The number indicates the number of servings per quart. Compare the size of the scoop with the number on the spring. Compare the number with the size of the scoop. What is your observation?

3. The slicing machine can be adjusted to yield thick or thin slices. Turn the gauge to the number that you would consider would give slices the desired thickness for a sandwich. A slice of meat or cheese should weigh about 1 - 1 1/2 oz. When you obtain this weight slice, make a note of the number on the machine dial that you should use. By using this number to slice the meat, every sandwich will be uniform.

4. For a salad plate, slightly thicker slices would be needed - the weight should be 2 - 3 oz. When you are able to obtain this weight, record the number so that your salad plate servings will be uniform.

5. Compare the two numbers used in 3 and 4.

ASSIGNMENT:

1. The salad girl prepared four quarts of egg salad mixture for sandwiches. She was instructed to use a #30 scoop of filling for each sandwich. How many sandwiches should she be able to obtain from the mixture?

2. How many quarts of cabbage salad should be made for 96 servings? A number 16 scoop will be used for each serving.

3. The sandwich girl is using a butter cutter that yields sixty cuts to the pound. How many pounds of butter will be needed for 300 servings?

4. The cook figured that each gallon of soup would yield 16- 1 cup ladles. How many gallons should be prepared for 80 servings?

5. One quart of gravy should yield 32 servings. How much gravy should the cook make for 128 servings?

6. A chef was directed to prepare 400 servings of hamburgers. Each was to weigh 4 ounces. How many pounds of meat should the chef order?

7. If you wanted to serve 120 guests, a number 12 scoop of potato salad, how many quarts of the salad would you prepare?

Yield of Standard Packs Lesson No. 11

OBJECTIVE: To practice computing quantities from various standard packs.

RELATED INFORMATION:

Food purchased for quantity production is packed in what is known as "institutional packs".

If the yield of a standard pack is known, accurate orders can be prepared.

PROCEDURE:

1. Canned goods are packed in various sized cans with a definite number of each size can to a case. Each can has a definite weight of contents. Look at the exhibit of cans of standard sizes. Note the weight or yield which is on the label.

2. Many foods are packed in packages which have a definite number of uniform portions. Meats such as cutlets, steaks, etc., fish fillets, and sticks are examples of this type of packaging.

3. Fresh fruit such as oranges, apples, melons, pears are packed in crates or boxes with a definite count to the package. Other fruits and fresh vegetables are packed in baskets or crates that have standardized weights.

4. Eggs are packed in cases, with a standard count, to the case.

5. Flour, sugar, potatoes are some of the materials packed in bags of standard weights.

6. Consult one of the following books:

   The School Cafeteria - Mary De Garmo Bryan
   Food Production, Marketing, Consumption - Stewart
   Restaurant Management - J. O. Dahl

Look up the following information

1. The weight of a basket of spinach, a crate of lettuce, a box of apricots (fresh), a till of tomatoes, a crate of eggs (small, medium, large). Make a record of your findings.

   Why has it been necessary to specify that these goods have a definite weight in each package? What would be the difference in these two directions -- 4 heads of cabbage -- 15 lbs. of cabbage?

ASSIGNMENT:

1. A restaurant used 20 gallons of salad oil in one week. The oil came packed_____gallons to the case.
   How many cases should be ordered for one month?

2. A school used 8,400 half-pints of milk in 21 days.
   What was the daily consumption?

3. There are approximately 20 slices of bread to a loaf, not including the crusts.
   How many loaves should be ordered for 100 sandwiches?

4. How many pounds of butter would be needed for 300 guests, if a cutter yielding 60 cuts per pound were used? for 360 guests with a 72 cut per pound?

5. There are 24 ice cream sandwiches in a package.
   How many packages should be ordered for 480 servings?

6. Fish sticks are packed in 5 lb. boxes of 150 fish sticks each.
   Three fish sticks are used for each serving.
   How many 5 lb. boxes should be ordered for 300 portions?

7. A manager wanted to use 4 oz. Swiss steaks for a luncheon.
   He found the steaks were packed 40 to the box at $11.60 per box.
   What was the cost per serving?

8. An institution pack of frozen vegetables will serve about 30 people.
   How many boxes would be used for 180 servings?

9. A restaurant used two No. 10 cans of peas for a meal.
   If peas are planned for six meals, how many cases should be ordered?

10. There are 176 oranges in a box that cost $5.28.
    What was the cost of one orange?

11. There are five medium size potatoes to one pound.
    How many pounds should be ordered for 500 servings?
    How many 100 pound bags would be ordered? 50 pound bags?
    25 pound bags?

12. If there are 30 dozen eggs to a case, how many guests can be served from one case, allowing 2 eggs for each serving?

Computing the Daily Average Check — Lesson No. 12

OBJECTIVE:

1. To learn how to figure the average amount of the guest checks.

2. To understand the importance of the amount of the "average check".

RELATED INFORMATION:

Every restaurant operator is in business for the purpose of making money.

At the end of the day, he totals the income from the day's business. Also, he will want to know how many customers he has had. With these two figures, he will be able to figure what the average check has been or what the average guest has spent.

The hotel dining room will probably have fewer guests than an automat, so we would expect that the average check for the hotel would be much larger.

PROCEDURE:

First, let us consider our school lunch room. Use the monthly report of the total income. Find the total number of students served. Divide the number who purchased food into the income. This figure will be the average check. (Records are available in the cafeteria)

ASSIGNMENT:

1. An industrial cafeteria for May 16 showed receipts of $314.25. There were 419 guests. What was the average check for the day?

2. The hotel dining room receipts for dinner were $164.25. The average check was $2.25. How many guests were served?

3. A restaurant took in $747.04. There were 322 guests. What was the average check?

4. Compare the average check from the various types of eating places that have been used in this lesson. What factors would cause the variations of the amounts of the average check?

5. A Y.M.C.A. cafeteria served 140 guests at breakfast.
   60 checks amounted to 75 cents each.
   30 checks amounted to 55 cents each.
   50 checks amounted to 45 cents each.

   What were the total receipts for the meal? What was the average check?

6. A lunch room manager found that an average of 25 persons bought cakes at 10 cents per cut. Each person remained 8 minutes to eat the cake. Would this be a profitable business? Reason?

7. A small luncheonette has set the following standard - 10 persons per hour for each of their 20 stools. If each person spent 30 cents, what would be the income for one hour?

8. What would the manager of the above restaurant take in, in the following periods: 1 1/2 hours at breakfast; 2 1/2 hours at lunch?

9. A restaurant manager discovered that he had to take in $265.00 per meal in order to meet expenses and make a living income. If he figured his average check amounted to 85 cents, how many customers must be served per meal?

UNIT I - WHOLE NUMBERS

Achievement Test No. 1

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1. The kitchen manager issued the following number of eggs; six to the meat cook, four dozen to the salad cook, and one and one-half dozen to the baker. How many dozens were issued? At 45 cents per dozen, what was the total cost of the eggs used?

2. From a ham that weighed 14 lbs., the cook was able to carve forty orders. The ham cost 47 cents per pound. What was the total cost of the ham? What was the cost per order?

3. The receipts from one month's business in a small restaurant amounted to $2,463.08. The expenses for food were $1,253.10. How much was left for other expenses?

4. There were 2603 school lunches served in one month. At twenty-five cents each, how much money was received for all of the lunches?

5. There are fifty peach halves to a No. 10 can. How many cans would you need for 150 servings, allowing two halves of peaches for each serving?

6. Lima beans cost 96 cents per No. 10 can. What would be the cost of one case of lima beans?

7. Portion cut, 5 oz. veal cutlets cost 55 cents each. The cutlets are packed 35 to the box. What would be the price for one box?

8. $467.12 + 20.84 + 103.09 + 4.26 =

9. 6037
   x 212

10. A restaurant record showed that receipts for one week were $4268.18. The average check for the week was $6.02. How many customers ate at the restaurant?

11. A menu advertised the following low calorie luncheon:

ITEM	AMOUNT	CALORIES
Tomato Juice	1/2 cup	50
Roast Beef (lean)	5 slices (2 1/2 x 1/4 in)	100
Radish Roses	3	9
Head Lettuce Wedge with 1 t. French Dressing	$\frac{1}{6}$ medium head	90
Bread with 1/2 t. Butter	1 slice	110
Grapes (seedless)	Medium bunch	75
Iced Tea (clear)	8 oz. glass	0
	Total	

If a woman planned a diet of 2400 calories per day, how many calories could she have for the remainder of the day?

UNIT II - FRACTIONS

Review - Terms | Lesson No. 1

OBJECTIVE: To learn how fractions are used in Commercial Foods.

RELATED INFORMATION:

You have completed the unit on whole numbers. Were you surprised to find that addition, subtraction, multiplication and division are so important to the foods trade?

Now you are ready to start Unit 2 which will first review your knowledge of working with fractions.

Later in this unit you will learn that fractions are also very important to the foods worker.

The following facts will refresh your memory on the terms used in the study of fractions.

PROCEDURE: A fraction is a part of a whole number. It is composed of two parts. The numerator which is the number written above the line, the denominator is written below the line and indicates the size.

In the fraction $\frac{2}{3}$ a whole thing or "1" has been divided into three parts and two parts have been taken.

"2" is the <u>numerator</u>

"3" is the <u>denominator</u>

1. What do the following mean -- $\frac{5}{6}$ $\frac{3}{4}$ $\frac{1}{8}$ $\frac{11}{12}$ $\frac{3}{23}$ $\frac{6}{64}$ $\frac{10}{20}$

2. Write the following as fractions:
   three sevenths, fifteen forty-fifths, four forty-seconds
   nine sixteenths, seven tenths.

QUESTIONS:

1. a. What is the number above the line called?
   b. What does this number mean?

2. a. What does the number below the line mean?
   b. What is the number below the line called?

QUESTIONS: (Cont'd)

3. How many months do we have in one year?
   How many months do we go to school?
   Write this number as a fraction.

4. There are ____ cents in a dollar. A boy spent 33 cents.
   Write this number as a fraction. How many cents remain?
   Write this number as a fraction.

5. A cake is cut into sixteen pieces. Each piece is one ____
   of the whole cake.

6. The following fruit is to be used to make four fruit salads.
   Write as a fraction, the fruit to be used for one salad.

4 Salads	1 Salad
2 slices pineapple	
1 banana	
1 orange	
$\frac{1}{2}$ cantaloupe	

   a.
7. What part of the school day is spent in shop?
   b.
   One hour of shop time is given to discussion.
   Write this number as a fraction of the total shop time of the
   total school day.

8. A loaf of bread has 20 slices. One slice is _____ of a loaf.

9. There are 12 eggs in one dozen. One egg equals ___ of a dozen.
   Two parts of a pear which had been cut into eight parts would be
   _____ of the pear.
   An orange had 16 segments. Three were used. Write this number
   as a fraction.
   _____ dimes make one dollar. Each dime is one ____ of the dollar.

UNIT II - FRACTIONS

Review - Types | Lesson No. 2

OBJECTIVE: To recall the different types of fractions.

RELATED INFORMATION:

There are three types of fractions:

a. The proper of common fraction ($\frac{2}{3}$)

b. The improper fraction ($\frac{3}{2}$)

c. The mixed number ($3\frac{1}{3}$)

We may change any improper fraction to a mixed number and any mixed number to an improper fraction.

This exercise will be used almost every day in the foods class.

ASSIGNMENT: Classify the following according to the three types of fractions:

1.

$\frac{1}{12}$	$\frac{12}{8}$
$3\frac{1}{2}$	$4\frac{1}{7}$
$\frac{4}{6}$	$\frac{3}{10}$
$7\frac{1}{8}$	$\frac{24}{5}$
$\frac{5}{2}$	$6\frac{2}{9}$

2. Change the mixed numbers in No. 1 to improper fractions.

3. Change the improper fractions in No. 1 to mixed numbers.

4. The following foods indicate the quantities as follows:

Baked Beans	15 1/2 oz.
Soup	6 1/4 cups
Corned Beef Hash	5 1/2 lbs.
Corned Beef Hash	5 7/8 lbs.
Mushrooms	1/3 cups
Devilled Ham	1 1/2 tablespoons
Cranberry Sauce	7 5/6 lbs.
Asparagus	6 7/16 lbs.

a. Label these quantities to which types of fractions they represent

b. Change the mixed numbers to improper fractions.

5. The following menu yields about 740 calories. Write the calorie value of each food as a fraction.

onion ring soup	20 calories
2 broiled lamb chops	260 calories
1 c. buttered broccoli	75 calories
1 medium baked potato	100 calories
chefs salad	45 calories
roll and butter	130 calories
black coffee	0 calories
fruit cup with lime sherbert	110 calories

6. A manager found a new recipe. The chef was directed to make a test of the recipe for flavor and acceptance. The recipe and the test recipe follows:

Ingredients	50 Portions	Fraction (Test Portion)
Cauliflower	9 lb.	1 lb.
Butter	12 T.	2 T.
Flour	5 T.	2 T.
Milk	12 c.	2 c.
Cheese (cheddar)	20 oz.	4 oz.
Cheese (Parmesan)	16 T.	4 T.
bread crumbs		

a. Use the numbers in the "50 Portion" column for the denominators of the fractions.

b. Use the number in the "Test Portion" for the numerators.

c. Classify the fractions.

UNIT II - FRACTIONS

Reduction **Lesson No. 3**

OBJECTIVE: To develop skill and accuracy in the reduction of fractions.

RELATED INFORMATION:

It is important that you be able to reduce and handle fractions as this work is the basis of a great part of the food trade work.

Practice in this exercise will be very helpful.

PROCEDURE:

A. To reduce the value of a fraction, the top and bottom numbers are divided by a number which will go into each evenly.
Example:

$$\frac{6}{9} \div \frac{3}{3} = \frac{2}{3}$$

When the resulting answer can no longer be divided on top and bottom by a number common to both, we then have the fraction reduced to its lowest term.

$$\frac{15}{45} \div \frac{5}{5} = \frac{3}{9} \div \frac{3}{3} = \frac{1}{3}$$

B. To reduce fractions like $\frac{28}{8}$ $\frac{14}{4}$ $\frac{7}{2}$ first divide the bottom number into the top, check the remainder, and reduce it as below.

1. $\frac{28}{8} = 8\overline{)28}$ $3\frac{4}{8} = 3\frac{1}{2}$
   $\frac{24}{4}$

2. $\frac{14}{4} = 4\overline{)14}$ $3\frac{2}{4} = 3\frac{1}{2}$
   $\frac{12}{2}$

3. $\frac{7}{2} = 2\overline{)7}$ $3\frac{1}{2} = 3\frac{1}{2}$
   $\frac{6}{1}$

C. The next step is to take a mixed number (a whole number and a fraction) and put it back into fraction form:

$$4\frac{5}{8} = 8 \times 4 = 32 + 5 = \frac{37}{8}$$

We multiply the bottom number (denominator) of the fraction by the whole number and add the top number (numerator) to it.

To reduce the improper fraction to a mixed number, we divide the denominator into the numerator, subtract, show the remainder.

Example:

$$\begin{array}{r} 4\frac{5}{8} \\ 8\overline{)\,37} \\ \underline{32} \\ 5 \end{array} \quad = \quad 4\frac{5}{8}$$

ASSIGNMENT:

1. Reduce the following fractions to lowest terms.

$\frac{2}{6}$ $\frac{4}{8}$ $\frac{16}{24}$ $\frac{8}{32}$ $\frac{10}{25}$ $\frac{20}{50}$ $\frac{21}{49}$ $\frac{12}{18}$ $\frac{14}{48}$ $\frac{45}{60}$

2. Change to improper fractions.

$5\frac{1}{2}$ $10\frac{3}{8}$ $5\frac{1}{6}$ $7\frac{6}{7}$ $8\frac{1}{3}$ $4\frac{5}{12}$ $3\frac{11}{24}$ $5\frac{4}{9}$ $9\frac{3}{9}$ $4\frac{6}{26}$

3. Write as a whole number or a mixed number.

$\frac{15}{2}$ $\frac{13}{5}$ $\frac{16}{4}$ $\frac{9}{5}$ $\frac{88}{8}$ $\frac{36}{10}$ $\frac{23}{7}$ $\frac{14}{3}$ $\frac{36}{6}$ $\frac{34}{11}$

4. Change each fraction to the denominator named.

$\frac{1}{3}$ to eighteenths

$\frac{7}{12}$ to forty-eighths

$\frac{1}{2}$ to eighths

$\frac{2}{3}$ to thirtieths

$\frac{2}{11}$ to forty-fourths

$\frac{2}{13}$ to twenty-sixths

5. $\frac{6}{16}$ lbs. butter = _____ lbs. butter

6. $\frac{21}{3}$ teaspoons sugar = _____ t. sugar

7. $\frac{17}{2}$ lbs. salt = _____ lbs. salt.

8. $\frac{13}{26}$ lbs. sugar = _____ lbs. sugar.

9. $5\frac{1}{2}$ lbs. chopped beef = _____ lbs. beef.

10. $\frac{32}{4}$ qts. milk = _____ qts. milk

11. $\frac{84}{12}$ cups milk = _____ cups milk

12. $\frac{120}{4}$ lbs. crisco = _____ lbs. crisco

13. $\frac{16}{8}$ lbs. flour = _____ lbs. flour

14. $\frac{340}{17}$ lbs. gelatine = _____ lbs. gelatine

15. $\frac{27}{2}$ lbs. tapioca = _____ lbs. tapioca

16. $\frac{23}{4}$ tablespoons baking powder = _____ tablespoons baking powder

17. $\frac{11}{4}$ teaspoons cream of tartar = _____ teaspoons cream of tartar

18. $\frac{637}{13}$ cans tuna = _____ 13 oz. cans tuna

19. $\frac{48}{4}$ lb. salmon = _____ 1 lb. cans salmon

20. Change $\frac{136}{16}$ to a mixed number.

UNIT II - FRACTIONS

Addition and Subtraction — Lesson No. 4

OBJECTIVE: To review work in addition and subtraction of fractions.
To learn how these processes are used in the food classes.

RELATED INFORMATION:

When we have a group of fractions that do not have a common denominator, we must have one before we can compare size or add or subtract them.

PROCEDURE:

1. To find the least (lowest) common denominator for a group of fractions - e.g. $\frac{1}{6}$ $\frac{3}{8}$ $\frac{2}{9}$ $\frac{3}{4}$

   a. Place the denominators of the group of fractions in a horizontal line with a hypen between them.

   b. Box them in as in short division.

   /6-8-9-4

   c. Check for common factors in one or more numbers. See if there is a number that can be divided evenly into several of these denominators. In this case 2 goes into 6-8-4.

   2/6-8-9-4

   d. Divide and bring down the quotients that were divisable an exact number of times.

   2/6-8-9-4
   3-4---2

   e. Bring down the denominators that were not divisible. Repeat until all the denominators are reduced to 1.

   2/6-8-9-4
   2/3-4-9-2
   2/3-2-9-1
   3/3-1-9-1
   3/1-1-3-1
   1-1-1-1

f. Multiply all numbers on the outside of the box.

$2 \times 2 = 4 \times 2 = 24 \times 3 = 72$

72 is the L.C.D. or least (lowest) common denominator.

2 Practice -- Find the least (lowest) common denominator for the following fractions:

a. $\frac{1}{3}$ $\frac{1}{4}$ $\frac{1}{7}$ $\frac{1}{2}$

b. $\frac{1}{5}$ $\frac{1}{3}$ $\frac{1}{6}$ $\frac{1}{2}$

c. $\frac{1}{7}$ $\frac{1}{5}$ $\frac{1}{3}$ $\frac{1}{6}$

d. $\frac{1}{2}$ $\frac{1}{3}$ $\frac{1}{4}$ $\frac{1}{5}$

3. Before fractions can be added, the bottom numbers or the denominators must all be the same. Therefore, find the L.C.D. Add the numerators and reduce the fractions if necessary.

Example: Add $\frac{3}{4}$ $\frac{1}{4}$ $\frac{1}{4}$ $\frac{3}{4}$ All these fractions have a common denominator.

Add $2\frac{1}{16} + 3\frac{3}{16} + 7\frac{5}{16} + 2\frac{1}{16}$ All denominators are the same.

Add the whole numbers.

$2 + 3 + 7 + 2 = 14$

Adding the whole numbers and the fraction $= 14\frac{5}{8}$

4. Practice - add the following:

a. $\frac{3}{8}$ $\frac{5}{8}$ $\frac{1}{8}$

b. $\frac{3}{4}$ $\frac{1}{2}$ $\frac{3}{8}$

c. $\frac{9}{16}$ $\frac{1}{4}$ $\frac{1}{8}$

d. $2\frac{1}{4}$ $5\frac{3}{4}$ 6

e. $7\frac{1}{8}$ $6\frac{3}{8}$ $9\frac{3}{8}$ $3\frac{1}{2}$

f. $2\frac{3}{16}$ $5\frac{3}{8}$

g. $7\frac{3}{64}$ $11\frac{5}{8}$ $2\frac{1}{4}$

h. $8\frac{11}{12}$ $5\frac{5}{8}$

i. $5\frac{1}{2}$ $3\frac{7}{12}$

j. $1\frac{2}{3}$ $5\frac{1}{8}$ $2\frac{9}{16}$

5. Subtraction of fractions like addition requires a L.C.D.
Example: subtract $\frac{3}{8}$ from $\frac{7}{8}$; $2\frac{3}{16}$ from $9\frac{11}{16}$

$$\begin{array}{r} \frac{7}{8} \\ -\ \frac{3}{8} \\ \hline \frac{4}{8} = \frac{1}{2} \end{array} \qquad \begin{array}{r} 9\frac{11}{16} \\ -\ 2\frac{3}{16} \\ \hline 7\frac{8}{16}\ \ \frac{1}{2} = 7\frac{1}{2} \end{array}$$

Practice:

a. $15\frac{2}{3}$
$$\begin{array}{r} -\ 7\frac{9}{16} \\ \hline \end{array}$$

b. $7\frac{15}{32}$
$$\begin{array}{r} -\ 6\ \frac{1}{8} \\ \hline \end{array}$$

c. $5\frac{7}{12}$
$$\begin{array}{r} -\ 3\frac{1}{2} \\ \hline \end{array}$$

d. $53\frac{3}{18}$
$$\begin{array}{r} -\ 19\frac{1}{9} \\ \hline \end{array}$$

e. $27\frac{4}{5}$
$$\begin{array}{r} -\ 19\frac{3}{4} \\ \hline \end{array}$$

ASSIGNMENT:

The following quantities of materials were used in the kitchen. Find the total of each.

a.	Flour	$2\frac{1}{8}$ c.	$4\frac{1}{4}$ c.	$1\frac{1}{16}$ c.	$3\frac{1}{4}$ c.
b.	Eggs	$\frac{1}{12}$ doz.	$2\frac{3}{12}$ doz.	$2\frac{1}{3}$ doz.	$3\frac{1}{6}$ doz.
c.	Butter	$\frac{1}{4}$ lb.	$2\frac{1}{8}$ lb.	$3\frac{1}{16}$ lb.	$1\frac{3}{4}$ lb.
d.	Milk	$1\frac{1}{3}$ qts.	$4\frac{1}{4}$ qts.	$5\frac{1}{8}$ qts.	$3\frac{1}{6}$ qts.

e. Four and one quarter pounds of vegetable fat were issued from the store room. Two and one-eighth pounds were used. What remained at the end of the meal?

f. There were $2\frac{2}{3}$ dozen oranges in the refrigerator. The salad cook used $1\frac{1}{4}$ dozen (one and one-fourth dozen). What was left?

g. $25\frac{2}{3}$ lbs. potatoes minus $10\frac{1}{4}$ lbs. = _____ lbs.

h. $7\frac{2}{5}$ gallons milk minus $4\frac{1}{4}$ gallons = _____ gallons

i. The kitchen manager has seventeen and one half dollars in the petty cash fund. The following expenditures were made: six and one half dollars, three dollars and one quarter, one dollar and twenty cents.
Write the amount of money as fractions.
Figure the expenditures and the amount of money that was left.

j. The inventory showed that there was $3\frac{5}{8}$ lbs. pepper on hand. The inventory at the end of the following month showed that there was $2\frac{3}{16}$ lbs. on hand. How much pepper was used?

UNIT II - FRACTIONS

Multiplication — Lesson No. 5

OBJECTIVE: To learn how the multiplication of fractions is used in the foods trades.

RELATED INFORMATION:

There are several types of problems in the multiplication of fractions. Most of the problems in the foods shop involve work with simple fractions. You will find the work in the foods shop more simple after this review.

PROCEDURE: Multiplication of simple fractions.

a. $\frac{3}{4} \times \frac{1}{2} \times \frac{3}{8}$

1. Look for cancellation from top to bottom - there is none.

$3 \times 1 \times 3 = 9$
$4 \times 2 \times 8 = 64$

2. Multiply the top numbers (numerators)
3. Multiply the bottom numbers (denominators)
4. Answer is $\frac{9}{64}$

b. $\frac{9}{16} \times \frac{2}{3} \times \frac{1}{2} \times \frac{5}{8}$

1. Cancel from top to bottom.

$\frac{\cancel{9}^{3}}{16} \times \frac{\cancel{2}^{1}}{\cancel{3}_{1}} \times \frac{1}{\cancel{2}_{1}} \times \frac{5}{8}$ (2 into 2) (3 into 9)

2. Multiply top $3 \times 1 \times 5 = 15$.
3. Multiply bottom $16 \times 1 \times 1 \times 8 = 128$.
4. Answer $\frac{15}{128}$

c. The next step you will want to review is the multiplication of a whole number by a mixed number.

1. $6 \times 2\frac{1}{2}$

a. Change mixed number to improper fraction.

$\frac{\cancel{6}^{3}}{1} \times \frac{5}{\cancel{2}_{1}} = 15$

b. Cancel.
c. Multiply top number.
d. Multiply bottom number.

2. Another method of putting the same problem down

$$\begin{array}{rcl} 6 & = & 6 \times 2 = 12 \\ \times\ 2\frac{1}{2} & = & +6 \times \frac{1}{2} = \frac{3}{15} \end{array}$$

Practice:

$$12 \times 4\frac{3}{4} = \frac{\cancel{12}^{3}}{1} \times \frac{19}{\cancel{4}_{1}} = 57$$

or

$$\begin{array}{r} 12 \\ \times\ 4\frac{3}{4} \\ \hline 48 \\ 9 \\ \hline 57 \end{array} \qquad \frac{3}{\cancel{4}_{1}} \times \frac{\cancel{12}^{3}}{1} = 9$$

$$15 \times 3\frac{5}{8} = \frac{15}{1} \times \frac{29}{8} = \frac{435}{8} = 54\frac{3}{8}$$

or

$$\begin{array}{r} 15\frac{5}{8} \\ \times\ 3 \\ \hline 45 \\ 9\frac{3}{8} \\ \hline 54\frac{3}{8} \end{array} \qquad \frac{5}{8} \times \frac{15}{1} = \frac{75}{8} = 9\frac{3}{8}$$

3.

a. $\frac{9}{10} \times \frac{3}{4} =$

b. $9\frac{1}{3} \times \frac{7}{12} =$

c. $3\frac{1}{2} \times 7\frac{1}{2} =$

d. $2\frac{4}{7} \times 4\frac{2}{3} =$

e. $16 \times \frac{5}{12} =$

f. $12\frac{1}{2} \times 8\frac{1}{4} =$

g. $8\frac{5}{16} \times 4\frac{1}{2} =$

h. $2\frac{5}{9} \times 8\frac{1}{36} =$

i. $4\frac{7}{9} \times 6\frac{2}{3} =$

j. $11\frac{2}{5} \times 9\frac{3}{4} =$

ASSIGNMENT:

1. One Minute French Dressing

Basic Recipe		$1\frac{1}{2}$ Times Recipe	$3\frac{1}{2}$ Times Recipe
Salt	$2\frac{1}{2}$ tablespoons		
Sugar	2 tablespoons		
Pepper	2 teaspoons		
Paprika	2 teaspoons		
Prepared Mustard	$1\frac{1}{2}$ tablespoons		
Vinegar	2 c.		
Worcestershire Sauce	1 tablespoon		
Oil	$1\frac{1}{2}$ quarts		

2. Use three of the following recipes:

   a. Indicate the source of the recipe that you use. (book, page; card, number)
   b. Copy the recipe.
   c. Figure the part of the recipe indicated by the fraction to the right.

   1. Chili Con Carne
   2. Cottage Pudding
   3. Oatmeal Cookies
   4. Barbecue Sauce
   5. Corn Soup

3. A restaurant sells 300 cups of coffee a day. How many cups would be sold in: $\frac{1}{3}$ of a day? $\frac{1}{12}$ of a day?

4. A 7 lb. leg of lamb yields

   10 - servings -- each $\frac{1}{4}$ lb.

   13 - servings -- each $\frac{3}{16}$ lb.

   20 - servings -- each $\frac{1}{8}$ lb.

   What could the chef figure from (a) five 7 lb. legs? (b) eight 7 lb. legs?

5. In making out an order for dishes, silver, and glassware for a commercial cafeteria that was to be equipped to serve 300 guests, the manager was advised to order the following:

No. Guests	Equipment	Quantity	Total
300	Dinner Plates	$1\frac{1}{2}$ times	
	Bread & Butters	$3\frac{1}{2}$ times	
	Sauce Dishes	$2\frac{1}{3}$ times	
	Sherbert Glasses	$4\frac{1}{4}$ times	
	Water Glasses	$2\frac{2}{3}$ times	
	Knives	$1\frac{1}{2}$ times	

UNIT II - FRACTIONS

Size Comparison | Lesson No. 6

OBJECTIVE: To understand the meaning of fractions as to size comparison. To learn how to apply this knowledge in the work of the foods trade.

RELATED INFORMATION:

Sometimes it is difficult for a worker to think in parts instead of a whole number. This is especially true when we are attempting to make a comparison of size. Part of the confusion that we may experience may be cleared up if we will always remember the meaning of "fraction" -- as part of one.

It would be quite different if you asked your father for a dollar and he gave you one-fourth of a dollar. You would know this immediately because you have been handling money for some time. However, when you were a child, numbers or parts of numbers made little difference to you.

In one of our earlier lessons we spoke of the need for uniform servings to keep a customer happy. Therefore, to accomplish this we must always divide that ONE into an equal number of parts that must be the same size.

PROCEDURE:

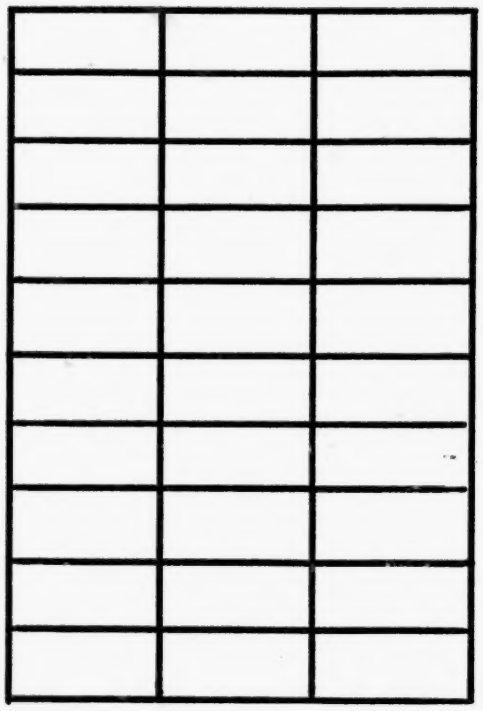
1. Study the accompanying diagrams. Count the number of parts into which each whole unit has been divided. Write the total of the number of parts for each diagram.

2. Write the fraction that would represent one part of the diagram.

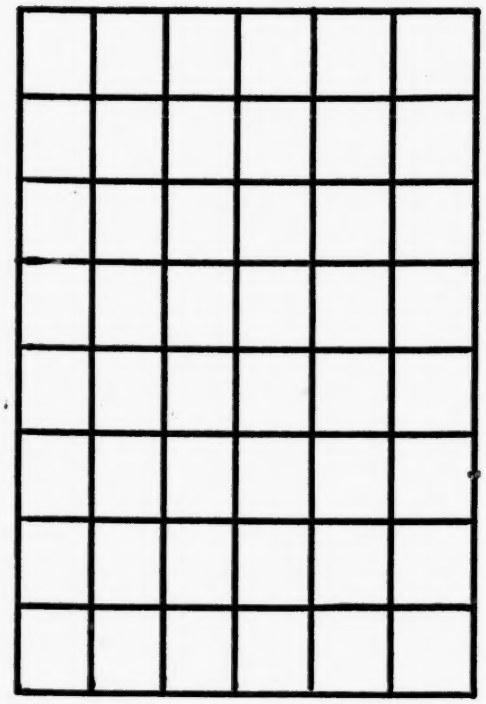
3. How do these pieces compare in size?

4. Do you think it would make any difference to a customer which piece he had been served? Explain your answer.

A



B



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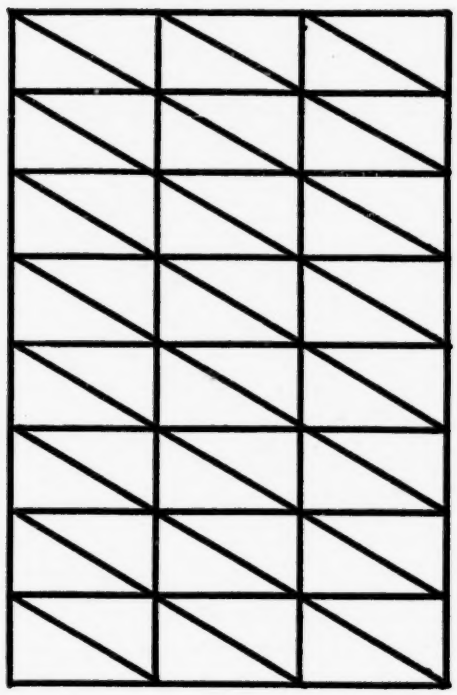
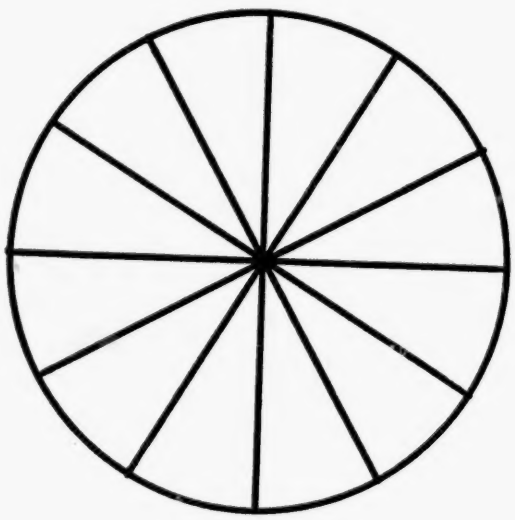
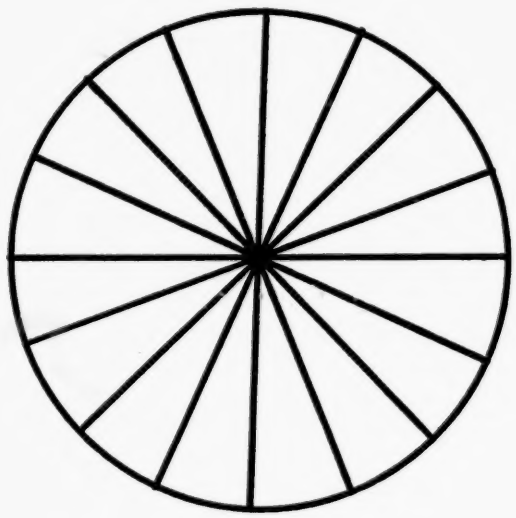




D



E

ASSIGNMENT:

1. Oranges are packed in boxes containing 150,288, 176 or 216 oranges. One orange from each box would be what fractional part of the box. Which would be the largest orange? the smallest?

2. A family of five uses a 25 pound bag of potatoes in ten days.

   a. What part of the bag is used each day?
      What part of the daily quantity consumed is the fractional allowance per person?

   b. Write as a fraction the quantity consumed daily by each person.

3. There are five tomatoes to one pound. Each tomato is to be sliced into five slices. Each salad has $\frac{3}{25}$ of the total number of slices or ____ slices on each salad.

   The salad maker was told to serve two slices on a sandwich. How did the number of slices of tomatoes on each item compare with the salad above?

4. $\frac{1}{18}$ = 1 part of a package of Mr. Bigs. There are _____ in one package.

5. 10,000 paper napkins are in one case.
   a. $\frac{1}{5}$ of the case = _____ napkins.
   b. $\frac{1}{8}$ of the case = _____ napkins.
   c. $\frac{1}{25}$ of the case = _____ napkins.
   d. $\frac{1}{20}$ of the case is used for each meal. The case of napkins will be used up in _____ meals.

6. A group borrowed five dozen forks for a picnic. Four forks were lost. What fraction of the total number borrowed was lost? What fraction of the total number was returned?

7. John wanted to buy one dozen oranges from a box that was marked 150 oranges to the box. Mary said she wanted a dozen from a box marked 176 oranges to the box because she would get a larger orange than John. Who got the larger orange? Prove it.

8. a. From a crate of 45 cantaloupe the salad maker was told to make 405 servings. What part of a melon would be used for one serving?
   b. If eight pieces were cut from each melon, would the serving be larger or smaller than the first way the melon was cut?

9. The charge for a #40 scoop of ice cream is seven cents; for a #12 scoop, fifteen cents.
   a. Why this difference in price?
   b. If you could afford either serving, which would you select?
   c. If a customer was watching calories, which serving should be selected?

10. There are 500 milk straws packed in each box.
100 students take two straws each.

a. What fraction of the box is used by the students?

b. If each student took one straw, what fraction of a box would each student use?

c. In one week 25 straws were dropped on the floor or were ruined and had to be thrown away. What fractional part of the box was lost?

11.

a. One box of 500 milk straws cost 25 cents.
What is the cost of one? Write this number as a fraction.

b. What would be the additional cost to the cafeteria if 250 straws were used daily? The straws are furnished to the customer as an added milk cost to the management.

c. At the cost per straw, how much money would be lost in forty weeks if 25 straws were ruined in a week.

d. Milk costs the cafeteria $6\frac{1}{4}$ cents per half pint. What is the added cost of furnishing two straws?

e. What part of a dollar does this added cost represent?

UNIT II - FRACTIONS

Computing Loss of Weight in Food Preparation — Lesson No. 7

OBJECTIVE: To learn the importance of considering the difference in the weights before and after food preparation or cooking.

RELATED INFORMATION:

Many people who have had little experience and training in food preparation do not take this loss into consideration in computing the cost of foods.

This can be one cause for a business failure.

If you know how to make these calculations, you can be a valuable worker to any establishment.

PROCEDURE:

A. 1. Prepare 10 lbs. of chopped beef for a meat loaf. Weigh all of the ingredients that you have used. Add them to the weight of the meat.

2. Before serving, weigh the cooked meat. Record the weight.

3. Weigh the fat that is in the pan.

4. Is there any difference between the first and second group of figures?

5. Use the weight of the fat that has accumulated in the pan as the numerator of the fraction, and the weight of the meat before it was put in the oven as the denominator. That fraction is the part of the meat that was lost during cooking.

B. 1. Stem, clean, and prepare seven pounds of spinach (fresh). Cook according to directions (no water to be used for cooking).

2. When the spinach is tender, drain it thoroughly. Do not throw the original weight of the vegetable as the denominator. The fraction indicates the loss in weight.

3. Weigh the cooked vegetable.

4. Use the figure from No. 2 as the numerator of the fraction, the original weight of the vegetable as the denominator. The fraction indicates the loss in weight.

ASSIGNMENT:

1. A turkey weighed 16 1/4 lbs. after cooking. The meat was removed from the bones. There was 7 1/4 lbs. solid meat that could be used for slicing. 1 lb. 7 oz. that could be used for salads and sandwiches. The skin weighed 6 oz. What was the weight of the bones?

2. A dessert cook prepared twelve quarts of cup cake mixture. How many cup cakes should this twelve quart batch yield if a 16 scoop is used to measure the mixture?
   The dessert cook made 184 cakes. What fractional part of the mixture was wasted?

3. The vegetable man put 35 lbs. of potatoes into the vegetable peeler. He did not sort the potatoes according to size. When he took the potatoes out of the machine he was instructed to weigh them. The weight was 30 lbs. What fraction of the load was lost through careless handling?

4. Two tablespoons of butter was scraped from the butter cutter that had been placed on the dish machine to be washed.
   What part of a pound of butter was being wasted?
   How many days will this waste continue before one pound of butter would be lost?
   Find out the current cost of one pound of butter.
   How much money was being lost daily?
   How many days would elapse before one dollar would be lost?

5. Two and one-half dozen bananas weighed 10 lbs. The weight of the fruit after removing the skin was 8 lbs. What fraction represents the loss in weight after removing the skins?

6. A watermelon weighed 25 lbs. The rind returned after serving weighed 2/5 of the original weight. What was the weight of the edible portion (E.P.)?

7. Consult the text book -- Production, Marketing and Consumption - Stewart
   for the following information:

   a. the number of quarts of cream needed for 1 lb. butter
   b. the quantity of milk and cream needed for 1 lb. cheese
   c. the weight of the bones from a beef carcass

8. Comment on the information you have gathered and discuss its application to this lesson in applied mathematics for foods trade.

Portioning Foods Lesson No. 8

OBJECTIVE: To appreciate the method of portioning foods so that the yield will be as planned and so that portions will be equal.

RELATED INFORMATION:

The need for equal portions cannot be emphasized too much. A little thought on pans, their size, shape, etc. will help you. Pans for the steam table, the sauce pans, soup pots and other utensils are constructed to hold specified quantities.

PROCEDURE:

1. Look at the marking on the outside of the stock pot. This pot holds _____ gallons.

   a. If it is half full of soup, there should be a yield of _____ gallons.
   b. The cook was instructed to make one-quarter of a pot of the soup. How many gallons should be prepared?

2. a. Measure the number of cups of water that will be needed to fill the coffee maker to the brim. _____ number of cups.
   b. Would you fill the coffee maker to this point? Why? Empty the coffee maker and measure the water so that it is three-quarter full. How many cups did you need to fill it to this point? Use the first number that you have for the denominator of the fraction, the last number as the contents of the coffee maker?

3. a. Measure the number of quarts of water that will be needed to fill the soup pot from the steam table to the very top.
   b. Record the number.
   c. Put eight quarts of water into the pot. What part of the total volume is eight quarts?
   d. One-fourth of a quart of soup is given on an "a la carte" order. What would be the yield from eight quarts of soup?
   e. 1/8 quart of soup is served as part of the luncheon menu. What would be the yield from eight quarts?

ASSIGNMENT I:

1. Make the following paper models:

   a. a circle the size of the pie tin
   b. a circle the size of the layer cake tin
   c. a rectangle the size of
      1. the largest cookie or baking sheet
      2. the rectangular pans, one of each size including a loaf or bread tin

2. Divide the circles so that 8, 9, 6, equal servings can be made. Each would be one _____, one _____, one _____, of the whole circle or pie or cake.

3. Measure the length and the width of the rectangular sheets of paper. Divide into 12, 24, 48, 36, 30 servings. Each serving would be what fractional part of the whole? Compare the size of each serving.

4. Divide the model of the loaf tin into slices that will be $\frac{3}{4}$ inch in width or thickness. How many slices have you made from the loaf?

5. Recipe cards are worked out for standard portions and will give this information, (a) recipe yield, (b) size of the pan to use. What advantage is this information to the worker?

6. Butter and margarine are frequently in solid pounds prints. Cut such a print into half, cut each into half again, cut each of these pieces into half again, each piece in half again. How many pieces are there? Each piece is what part of the pound?

ASSIGNMENT II:

1. A cup of soup holds $\frac{1}{4}$ cup, a bowl holds $\frac{1}{2}$ cup of soup, a shallow soup plate $\frac{1}{3}$ cup. Which is the largest serving? the smallest?

2. A portion of a layer cake divided into twelve pieces, is one _____ of the cake.

3. If each piece of cake in the former problem was sold for a quarter of a dollar, what would be the receipts from two cakes?

4. A pie cut into six cuts would give a customer one _____ of the pie.

5. Six cans of pie cherries will be needed for 48 (9 inch pies). What fraction of the case of cherries would be needed for four pies? (six cans of cherries to a case)

UNIT II - FRACTIONS

Achievement Test No. 2

---

1. The record showed that of 385, 500 eating places, one-third went out of business for varied reasons. How many establishments failed?

2. One pound of soup base will make five gallons of soup. How many gallons can be made from three-fifths of the jar?

3. 4 1/2 pounds of chicken was waste (bones, skin, etc.) The original weight of the chicken was 18 1/2 lbs. How much chicken meat was usable?

4. Add the following:

a.	b.	c.
$47\frac{7}{12}$	$4\frac{5}{8}$	$33\frac{1}{2}$
$8\frac{3}{4}$	$2\frac{3}{4}$	$9\frac{7}{8}$
$16\frac{1}{4}$		$3\frac{1}{4}$

5. Multiply the following:

a. $15 \times 1\frac{1}{3}$ b. $72 \times \frac{1}{4}$ c. $4\frac{1}{2} \times 50$

6. Take $\frac{1}{4}$ of the following recipe:

6 qts. milk
12 T. cornstarch
10 T. cocoa
$\frac{3}{4}$ c. sugar
2 t. vanilla

7. Take $1\frac{1}{2}$ times the following recipe:

2 lb. flour
4 t. baking powder
1 t. salt
3 c. sugar
$1\frac{1}{2}$ c. fat
$2\frac{1}{4}$ c. milk
1 t. flavoring

8. Divide

a. $\frac{3}{5} \div \frac{3}{10}$ b. $\frac{8}{25} \div \frac{36}{45}$ c. $12\frac{1}{2} \div \frac{5}{14}$

9. A restaurant owner found the money he took in from the week was spent as follows:

$\frac{1}{5}$ for food, $\frac{1}{8}$ for rent, $\frac{1}{4}$ for wages, $\frac{1}{10}$ for utilities $\frac{1}{20}$ for insurance.

a. What part of the income was spent?
b. What part of the receipts was left?

10. A student who is present every day for the school year is in school for 1080 hours.

540 hours	=	fractional part of year spent in shop
90 hours	=	fractional part of year spent in art
108 hours	=	fractional part of year spent in English
180 hours	=	fractional part of year spent in Phys. Ed.
162 hours	=	fractional part of year spent in other studies

UNIT III - DECIMALS

Review | Lesson No. 1

OBJECTIVE: To recall and review the use of decimals.

RELATED INFORMATION:

The division of integral unit into 10ths, 100ths, 1000ths, etc. is called decimal division. There are three ways of expressing a decimal division:

1. words - nine-tenths
2. common fraction - $\frac{9}{10}$ $\frac{9}{100}$ $\frac{9}{1000}$
3. decimals - .9, .09, .009

In other words, any fraction having 10,100, or 1000 or any multiple of ten for the denominator may be written without the denominator. In its place we have the decimal form and decimal point.

You recognize in No. 2 that the decimal may be written as a common fraction, so decimals are really fractions written in another way.

The following is a table that will help you to recall. Each number is based on its position in relation to the decimal point.

Decimal places are read as follows:

.0	- tenths
.00	- hundredths
.000	- thousandths
.0000	- ten-thousandths
.8	- eight tenths
.08	- eight hundredths
.008	- eight thousandths
.0008	- ten-thousandths

Note that the number to the right of the decimal point ends in ths; the number to the left in ds.

Example: Use the table - read the following:

7,385,651.789: Seven million, three hundred eighty five thousand, six hundred fifty one and seven hundred eighty-nine thousandths. The decimal point is read as "and".

PRACTICE:

A. Write the following numbers in words:

1.	135.678	6.	178.8937
2.	221.1156	7.	663.098
3.	3327.776	8.	732.8092
4.	54321.7898	9.	2144.928
5.	457.3486	10.	116.2492

B. Write the following words in numbers:

1. One thousand, two hundred forty-six and two thousand, one hundred nine thousandths.
2. Six million, eight hundred two thousand, one hundred ninety-two and three hundred seventy two thousandths.
3. Three thousand and five ten thousandths.
4. Twenty four and six one hundredths.
5. Eighty four thousand, three hundred two and forty-four hundredths.
6. Four hundred twenty eight, ten thousandths.
7. Thirty nine and twenty five thousandths.
8. Seven and fifteen hundredths.
9. Sixteen and seventy thousandths.
10. Fifty six thousandths.

ASSIGNMENT: 1. Study the following table. This is an example of a food analysis chart of the nutrients in canned foods. You will notice that the decimals are used in many parts of the chart. Answer the questions that follow the chart.

Food	Wt. Gm.	Approx. Measure	Calo-ries	Prot. Gm.	Fat Gm.	Cho. Gm.	Ca. Mg.	P. Mg.	Fe Mg.	Vit.A I.U.	Thia. Vit.B Mg.	Ribo-flavin Mg.	Niacin Nicotinic Acid Mg.	Ascorbic Acid Vit.C Mg.
Apricots	122	4 halves - 2 T. syrup	105	.6	.2	25.0	9.8	19.5	.85	2650	.022	.024	.42	5
Tomato Juice	182	6 oz.	38	1.5	.2	7.5	12.7	32.8	1.64	1575	.100	.051	1.40	27
Beans Cut Green	108	$\frac{1}{2}$cup	21	1.2	.1	3.8	36.7	22.7	1.30	320	.030	.039	.35	3
Salmon	113	$\frac{1}{2}$cup	168	24.2	7.9	.1	207.9	330.0	.68	.75	.024	.181	8.83	--

a. Which food in the above table is the best source of Vitamin C? _____
Which food in the above table is the poorest source of Vitamin C? _____

b. Which food in the above table yields the greatest number of calories? _____
Which food in the above table yields the smallest number of calories? _____

c. What food in the above table is a good source of Vitamin A? _____
What food in the above table is a poor source of Vitamin A? _____

d. What food in the above table has the largest amount of carbohydrate? _____
What food in the above table has the least amount of carbohydrate? _____

e. List the foods in the above table in order of importance in yield of calcium _____
List the food in the above table that is the best source of phosphorous _____
List the food in the above table that is the best source of iron _____

2. Prepare a chart like the model on the previous page. List the following foods on the chart:

Fresh orange juice	4	oz.
Cornflakes	1/2	cup
Whole milk	1	cup
White toast	2	slices
Butter	2	t.
Hard cooked egg	1	
Chopped cabbage	1/2	cup
Mayonnaise	1	T.
Fresh tomato	1	medium size
Whole wheat muffin	1	
Sliced canned pineapple	1	large slice
Ground beef	4	oz.
Potato baked	1	medium
Raw carrot sticks	2	oz.
Jello	4	oz.
Whipped cream	2	T.
Butter	2	t.
Whole milk	1	cup
Vanilla ice cream	4	oz.
Salted peanuts	2	oz.
Milk chocolate bar	1	(plain)
Coca cola	1	bottle

Consult one of the following text books for a food chart analysis:
Elements of Food and Nutrition -- Dowd and Dent.
Foods for Home and School -- Harris and Lacey.

3. List the food values for the foods that are listed in No. 2. This list of foods is representative of three meals that a teen-ager should be eating. Snacks have been provided for between meals.

BE CAREFUL IN RECORDING THE FIGURES.
YOU WILL USE THE CHART AGAIN IN ANOTHER LESSON.

4. To verify the occurrence of aluminum in foods, a manufacturing company has printed the following information. Aluminum can be found in foods as follows: whole wheat 3.45, raw carrots 3.80, green cabbage 22.70, apples 1.50. Write in words the quantity of aluminum that is present in each of the foods listed.

5. The minerals in the sample foods chart are _____, _____ and _____.

6. What food on your chart is the best source of phosphorous?

7. Which fruit on your chart is the best source of iron? How much iron does each fruit provide?

UNIT III - DECIMALS

Converting Fractions to Decimals — Lesson No. 2

OBJECTIVE: To review the method of converting fractions to decimals. To become acquainted with the application of this operation to the foods trade.

RELATED INFORMATION:

To change a decimal to a common fraction, use the figures in the quantity as a numerator and place for the denominator the figure <u>one</u> followed by as many zeros as there are figures to the right of the decimal point in the quantity.

A. Example: $.8 = \frac{8}{10}$ the 8 (quantity) is placed over 1 plus 1 zero because we have but 1 number after the decimal point

$.85 = \frac{85}{100}$ because we have 2 numbers after the decimal point, hence 2 zeros

Practice: Change the following to common fractions:

1. .325
2. .004
3. .0205
4. 9.3
5. .546

B. To change a common fraction to a decimal, we divide the denominator into the numerator and add a decimal point plus 2 zeros

Example: $\frac{3}{4} = 4\overline{)3.00}$ = .75

28
20
20

Practice: Change the following to decimals:

1. $\frac{1}{20}$	6. $\frac{3}{4}$	11. $\frac{3}{5}$
2. $\frac{2}{5}$	7. $\frac{3}{8}$	12. $\frac{4}{5}$
3. $\frac{1}{8}$	8. $\frac{5}{8}$	13. $\frac{1}{12}$
4. $\frac{1}{2}$	9. $\frac{7}{8}$	14. $\frac{1}{3}$
5. $\frac{1}{4}$	10. $\frac{1}{5}$	15. $\frac{2}{3}$

ASSIGNMENT:

1. A food establishment that spent $500.00 has an inventory valued at $125.00. Write this problem as a decimal. As a fraction.

2. A gallon of milk weighs 8.36 pounds.
   a. How many quarts in 41.80 lbs.
   b. How much will 41.80 lbs. cost at 21 cents per quart?

3. Change the following to decimal numbers:

$$8\frac{3}{8}, \qquad 27\frac{8}{16}, \qquad 15\frac{3}{20}$$

4. A manager divided his eight hour working day as follows:
   1 hour checking stock
   2 hours planning meals
   4 hours visiting markets, checking and comparing prices
   1 hour conference with the cooks

   Write these various periods as fractions. As decimals.

5. A dishwashing engineer found that $3\frac{1}{5}$ minutes were needed for complete cleaning of one rack of dishes. Write this figure as a decimal. How many racks could be cleaned in two hours?

6. Frozen shrimp are packed in 2.5 lb. packages (15, 20, 30 to the pound).

   a. What would be the count for a package of each size?

   b. At the current market price what would be the cost of each package?

   c. How many shrimp cocktails could be made from each package if
      3 shrimp from the 15 count package were used
      4 shrimp from the 20 count package were used
      6 shrimp from the 30 count package were used

   d. At 65¢ per cocktail, how much would a restaurant receive from the sale of a box of each size shrimp which were made into cocktails?

   e. Figure the loss or gain at the current market price.

7. After analysis of food costs, the manager found that it was necessary to "mark up" the selling price to cover the cost of labor, etc. Figure the costs from the following table:

	Food Cost	Mark Up	Selling Price
a.	.55	$\frac{2}{5}$	
b.	.81	$\frac{2}{3}$	
c.	.75	$\frac{1}{2}$	
d.	.25	$\frac{1}{5}$	
e.	.35	$\frac{4}{5}$	
f.	.66	$\frac{1}{6}$	

UNIT III - DECIMALS

Addition and Subtraction — Lesson No. 3

OBJECTIVE: To review the procedure in adding and subtracting decimals. To practice these operations in problems related to the foods trade.

RELATED INFORMATION:

In adding or subtracting numbers with decimals, there is just one rule to remember -- keep the decimals under each other and in a straight line.

Example: 18.03 + 41.9 + 207.31 (Addition)

```
  18.03
  41.90 -- note -- a zero may be used to fill in the column
+207.31
 267.24
```

Example: 31.309 - 19.56

```
  31.309
 -19.560--note - zero added
  11.749
```

Practice:

1. Copy the following and add.
   a. 9.028 + 116.05 + 5.945 + 75.07
   b. 3.5 + 111.721 + 4.005 + 17.205
   c. 2.1 + .003 + 103.5 + 17.205
   d. 6.215 + 3.97 + 178.2 + 156 + 3.001 + 10.2
   e. 5.0245 + 110.721 + 4.07 + 15.2036 + 7.5 + 14.08

2. Copy the following and subtract.
   a. 31.809 - 19.56
   b. 1053.16 - 1007.407
   c. 306.4 - 32.09
   d. 78.5137 - 59.306
   e. 205.06 - 140
   f. 402.09 - 325.387

ASSIGNMENT:

1. In Lesson 1 of this unit, you made a chart showing the analysis of various foods. Find the total of the following columns:

   a. protein grams
   b. fat grams
   c. carbohydrate grams
   d. calcium milligrams
   e. phosphorous milligrams
   f. iron milligrams
   g. thiamin
   h. riboflavin
   i. niacin

   Note: This exercise can be used in computing diets.

2. The following chart has been prepared to show the number of calories used per hour per pound of body weight for various activities. Figure the difference in the calorie requirement for each pair of activities.

Activity	Calories	Activity	Calories	Difference
a. walking upstairs	7.18	bycycling	1.10	?
b. dancing	1.95	eating	0.65	?
c. skating	2.10	swimming	3.25	?
d. sitting at rest	0.65	sleeping	0.43	?
e. running	3.70	sitting at work	0.7	?
f. dishwashing	0.93	vacuum cleaning	1.78	?
g. singing	0.79	sewing by hand	0.72	?

3. In the table below
   - A represents the price of the meal to the guest
   - B represents the cost of the entree (meat or meat substitute)
   - C represents the cost of other courses (salad, appetizer, etc.)
   - D represents the total food cost B + C
   - E represents all other expenses such as labor, heat, profit, light, etc. A-D

   Assignment: Fill in columns D and E

Price of Meal	Cost of Entree	Cost of Other	Total	Cost Allowed for Other Expenses
A	B	C	D	E
.60	.09	.15		
.80	.17	.15		
1.25	.35	.15		
.70	.13	.15		

NOTICE: that as the cost of the meal increases, the cost of the entree increases. That the cost of the other courses remains the same. How would you account for this situation?

4. Meat costs before and after cooking were as follows: Fill in C.

Raw A	Cooked B	Increase C
.24	.42	
.28	.49	
.32	.56	
.40	.70	

UNIT III - DECIMALS

Multiplication — Lesson No. 4

OBJECTIVE: To practice multiplication of decimals.
To discover how these processes are applied to work in the foods trade.

RELATED INFORMATION:

To multiply with decimals, the number of decimal places in both numbers are counted. The total is counted off in the answer. Count from right to left and then point off.

Example:

A. 8.24 x .95 2 places + 2 places = 4 places

```
 8.24
 x.95
 4120
7416
78280  point off 4 places    7.8280
                             7.828    the zero may be crossed off
```

B.

```
 .0036  4 places + 0 places = 4 places
  x72
   72
252
.2592  4 places
```

Practice: Multiply the following:

a.	7.03 x .09	d.	.95 x 8.25
b.	46.9 x 50.7	e.	87.5 x 8.24
c.	.25 x .06	f.	30.08 x .67

ASSIGNMENT:

1. A girl weighs 125 lbs. She irons for two hours. Each hour that she is working she uses 0.93 calories per pound. How many calories would she use for the entire period?

2. The circumference of a circle is 3.1416 x the diameter. Measure the diameter of the following and figure the circumference of each:
   a. a pie tin
   b. a layer cake tin
   c. a dinner plate
   d. a bread and butter plate
   e. a sauce dish
   f. an opening in the steam table I
      for the largest inset, for the smallest inset.

3. If the cost of preparing a bowl of soup is .0193, what would it cost to prepare 50 bowls. If the soup is sold for 15 cents per bowl, what is the profit on one bowl? on 50 bowls?

4. At $1.10 per hour, how much would a worker make in 43 hours?

5. Multiply the following:
   a. .185 x 17
   b. .0625 x 48
   c. .0875 x 74
   d. .1575 x 38
   e. .6125 x 67

6. Meat costs 0.125 per serving. What will be the cost of 62 servings?

7. How much will be made if it is sold for .625 per serving?
   a. per serving?
   b. on the total servings?

8. The cost of one plum is 0.0013 cents. What is the cost of 85 plums?

9. Pork chops cost .2375 each. What will be the cost of 145 chops?

10. a. A portion of pie costs 0.143 cents to prepare. What would 24 pieces or 3 pies cost?

    b. .057 was made on 1 piece. What would the profit be on the three pies?

UNIT III - DECIMALS

Division | Lesson No. 5

OBJECTIVE: To practice division of decimals in preparation for their use in the foods trade.

RELATED INFORMATION:

To divide a whole number into a decimal put the decimal point in the answer just above where it is inside the box.

Examples:

a. Dividing a whole number into a number containing a decimal:

6/6.96

First, place the decimal for the answer right above the decimal in the dividend. Then divide.

```
  1.16
6/6.96
```

b. Dividing a whole number into a whole number with the idea of getting a decimal in the answer:

5/17

```
   3.4
5/ 17.0   -  Place the decimal at the end of the dividend
  15         and add a zero. The decimal in the answer
   20        (quotient) should be directly above the
   20        decimal in the dividend.
```

c. Dividing a decimal number into a decimal number:

.038/.231762

Clear the decimal from the divisor. To do this, move the decimal to the right as far as you can, in this case 3 places.

.038/.231762

Then move the decimal in the dividend just as many places to the right as you moved it in the divisor, in this case 3 places. (Note that the zero in this divisor is no longer needed).

.038/231.762

Place the decimal in the answer directly above the decimal in the dividend.

```
        .
.038/231.762
```

Divide.

```
     6.099
38/231.762
   228 xx
     376
     342
      342
      342
```

Practice:

a. 3.036 divided by .06

b. 3.728 divided by 16

c. 10.044 divided by 36

d. 75.025 divided by 25

e. 82.50 divided by 1.25

f. .45 divided by 15

g. 1.44 divided by .8

h. 168.72 divided by 12

ASSIGNMENT: Find the cost of the following:

1.

Portions		Cost	Cost Per Unit Serving
a.	15	.50	
b.	45	$117.45	
c.	35	14.00	
d.	20	1.08	
e.	20	9.309	

2. Compute the yield (number of portions) from the following. Carry out to 3 decimal places.

Article	Total Cost	Cost Per Serving	Yield
a. cheese sandwich	$9.375	.075	
b. bread (banana)	2.70	.135 per loaf	
c. olives	3.90	.007	
d. peas (canned)	4.60	.0894	
e. pineapple (canned slices)	7.00	.1272	
f. beans (green)	3.85	.116	
g. cranberry sauce	6.50	.112	

3. $84.00 was received from 112 guests. What was the average check?

4. 12 shrimp cost 0.6552 cents. What was the cost of 1 shrimp?

5. Divide:

a. 1.7243 by .43

b. 475.13 by 1.18

c. 82.614 by .028

d. 41357 by .175

e. 580.5 by 21.5

6. Complete the following:

Total Cost	Per Unit Cost	Number of Units
a. $57.50	.0525	
b. 137.85	.2175	
c. 8.40	.0215	
d. 62.425	.0625	
e. 193.80	1.15	

UNIT III - DECIMALS

Short Processes — Lesson No. 6

OBJECTIVE: To develop skill and increase efficiency when working with decimals

RELATED INFORMATION:

Whenever we wish to multiply or divide by such numbers as 10, 100, 1000, etc., we may use a short process.

A. To multiply: the decimal point is moved to the right as many places as we have zeros

Example:

652.	x	10	=	6520.
52.	x	100	=	5200.
.0046	x	10	=	0.046
.0046	x	1000	=	004.6 or 4.6

B. To divide: move the decimal point one place to the left for each zero in the divisor.

Example:

625.	÷	10	=	62.5
7837	÷	100	=	78.37
19.536	÷	100	=	.19536
18.271	÷	1000	=	*.018271
15.623	÷	10000	=	.0015623

*Zeros must be prefixed as shown when necessary.

Practice: Multiply the following:

a.	3.32	x	10	f.	78.92	x	10
b.	56.8	x	100	g.	5.86	x	100
c.	32.1	x	1000	h.	78.9	x	10
d.	6.892	x	10	i.	221.56	x	100
e.	46.8	x	100	j.	3.35	x	10

Practice: divide the following:

a.	68.25	÷	10	f.	221.56	÷	100
b.	256.11	÷	100	g.	5.86	÷	100
c.	338.7	÷	10	h.	78.92	÷	10
d.	6.892	÷	100	i.	6.543	÷	10
e.	46.8	÷	10	j.	562.21	÷	10

ASSIGNMENT:

1. A camp director worked on a food allowance of 82 cents per child per day. There were 200 children at the camp. What was the total food allowance for the entire camp population? The total food allowance for the season was $8200.00. How many days of camp were there?

2. Figure the following total costs:
   a. 40 qts. milk@ 17.5 cents per qt.
   b. 200 loaves bread @ 13.5 cents per loaf
   c. 1000 servings of jelly @ .007 cents per serving.
   d. 180 eggs @ .04 each.

3. A budget of $4000.00 was allocated to the foods department for new equipment. .3 of the budget was planned for a new refrigerator. How much will the refrigerator cost? How much will be left for other equipment? Write this figure as a decimal.

4. a. At $36.00 for 200 servings of meat, what is the price per serving.
   b. At $3.20 for one theatre ticket, what is the cost of 200 tickets?
   c. 170 lbs. ham cost $136.00, what is the price per lb.?
   d. Text books cost $2.40 each, the total cost $57.60. How many text books were purchased?

5. If 100 cans of sardines cost $28.00, what is the cost of one can?

6. If a 100 lb. drum of pancake mix costs $18.00, what is the cost of one pound?

7. If 720 slices of melba toast cost $4.32, what is the cost of one slice?

8. Shoulder lamb chops cost .26 each. What will be the cost of 40 servings? One chop per serving.

9. One hundred, thirty-six, one ounce servings of apple jelly cost $1.15. What is the cost per serving?

10. The cost of one No. 10 can of tomato juice is .5166. It yields 32-3oz. servings. What would be the cost of one serving? of 50 servings?

11. What would be the cost for 2 ounces of tuna fish if 66 1/2 oz. cost $3.60? If two ounces of fish are used for each sandwich, what would be the cost for 100 sandwiches?

12. There are 30 dozen eggs in a case. At $13.50 per case, what would be the cost of one egg?

13. 110 eggs were used for a meal. What was the food cost for eggs for that meal?

14. A gallon of water weighs 8.35 pounds. Milk weighs 1.03 times as much as water. What is the weight of a gallon of milk? 40 qts.?

15. .5958 is the cost of one quart of salad dressing. What is the cost of one gallon?

UNIT III - DECIMALS

Computations | Lesson No. 7

OBJECTIVE: To be able to apply the use of decimals in the various computations in business procedures of the foods trades.

RELATED INFORMATION:

A successful foods operator must pay strict attention to money details.

In previous lessons, the cost of servings or portions of foods was stressed. It may have been surprising to you that a per serving cost was small. However, it is these small costs that an owner must watch. Also realize that you have been working with food costs, only. Later you will consider other costs that must be considered in carrying on a business.

Dollars and cents computations will involve all of the processes you have practiced earlier in your work in the Commercial Foods mathematics.

PROCEDURE: Recall all of the situations in which you have used dollars and cents since you have been in the foods class.

Breakage of china and glassware in restaurants results in losses totalling millions of dollars a year. Consult the cafeteria inventory for the price list of the various types of dishes (plate, cups, etc.). Breakage is costly.

ASSIGNMENT:

1. Use the price list of dishes and compute the loss if the following were broken in one month:
   - 4 dinner plates
   - 6 bread and butter plates
   - 1 salad plate
   - 2 tea pots
   - 3 sauce dishes

2. A restaurant purchased 100 lbs. of corned beef at 32 cents per lb. They sold 665 corned beef sandwiches at 20 cents each. The corned beef for each sandwich cost 12 cents and there was a three cent allowance for bread (no butter or salad dressing used). Did the restaurant gain or lose on this transaction? How much?

3. Three gallons of corn soup was scorched, and had to be thrown away. The management found that it cost 50 cents to make one gallon of soup. What was the total loss?

4. Each employee was given a meal allowance of one dollar per meal. Three employees took an extra serving of ice cream which could have been served or sold for 25 cents per serving. One employee took a 35 cent piece of pie and one took two frankfurters at 12 cents each and two rolls to go with the frankfurters, which cost 3 cents each. There were 12 employees. What was the cost to the management for the food that was allowed? What was the additional cost to the management for the extra food consumed? What was the total cost?

5. The porter found 4 forks, 2 knives, and 6 teaspoons in the refuse from the dining room. If these had been lost, what money value would have been lost -- knives cost $6.45 per dozen, forks $5.60 per dozen, teaspoons $1.10 per dozen.

6. An employee reported for work 10 minutes late. He worked 2 1/2 hours and then took a coffee break of 20 minutes. Later in the day he made a personal phone call on his employer's time, which took 14 minutes from his work. He was to work until 6:30 P.M. but he left his station at 6:24 P.M. How many minutes of company time did this worker use and lose? If the employee received $1.00 per hous, how much money did he collect for not working?

7. Consult the current issue of Restaurant Management magazine or Institutions Magazine. Report any topics in either magazine that will illustrate losses in business operation. Illustrate your report by showing actual figures used in the article.

8. Milk (bulk) cost $.175 per quart. Half pints (containers) cost .0625 per half pint. What would be the cost of one quart of the milk if half pints were used for food preparation? Would the management gain or lose by this procedure? Why would he prefer that the cooks use the bulk milk?

9. Milk costs $.0625 per half pint. What should the selling price be to clear 3 cents on each half pint?

10. a. If 30-40 half pints of milk were left over every day, what would be the criticism of the person placing the daily orders?

    b. What would the 30 cost the owner at the price previously stated?

UNIT III - DECIMALS

Relation of Decimals and Computations — Lesson No. 8

OBJECTIVE: To understand the relation of the use of decimals to the various computations in the foods department.

RELATED INFORMATION:

There is scarcely an operation in the food trade where dollars and cents can be eliminated.

From the beginning of business to the close, the consideration of money transactions is paramount.

All of the fundamental operations that were reviewed will be used in the following lessons.

Reminder: Watch the decimal point in all of the work that you will be doing.

PROCEDURE: Work the following problems which are representative of the type you will meet with in the trade.

1. 800 students spent 25 cents each. What was the total amount spent?

2. Find the total cost of the following:
   15 lbs. butter @ 60 cents per lb.
   12 heads lettuce @ 20 cents each
   15 bunches celery @ 15 cents each
   10 dozen rolls @ 24 cents per dozen
   30 lbs. watermelon @ 4 cents per lb.

3. 75 guests spent $36.00. What was the average check?

4. 70 Idaho potatoes cost $3.00. What should be added to the unit cost to bring up the selling price to ten cents each? Carry out the decimal to three places.

5. Meat cost is 65 cents per pound. It is sold at 95 cents per pound. What is the gain per pound? What would be the profit on 18 1/2 pounds?

6. It costs approximately $10.00 per formula to test and perfect a dish to a point of satisfaction. If 300 formulas were to be tested, what would be the cost of this service? How long would it take an operator to make up for this cost if he allowed 50 cents per day to his daily expense budget?

7. A 24 pound leg of veal yields approximately 38 portions. At 54 cents per serving, what would be the receipts from the sale of the veal?

8. $450.00 was received from 70 guests. What was the average check?

9. A foods worker worked 8 hours on Monday, 6.5 hours Tuesday, 7 hours Wednesday, 5 hours Thursday, and 8.5 hours on Friday. What were the total number of hours worked? At $1.25 per hour, what would the total wages be?

10. At 92 cents per pound for coffee, what would be the cost of one cup allowing 40 cups to each pound? Add .015 per serving for cream and .0014 for sugar. What should the selling price of one cup be in order to make a profit of 5 cents on each cup of coffee?

UNIT III - DECIMALS

Invoices | Lesson No. 9

OBJECTIVE: To learn to apply the information on decimals in working with invoices.

RELATED INFORMATION:

When goods are delivered to an establishment, a delivery slip or bill or invoice in left with each order. The goods are checked against the invoice for quantity and price. Invoices that accompany an order for staples or for any large quantity of goods may have added shipping charges, which increase the actual cost of the goods.

Also, check the invoice for the "brand" of goods to make sure that nothing of inferior quality is slipped into the order.

PROCEDURE:

1. Prepare an invoice or a bill for the following:

   a. 2 cases 24 No. 2 Tomato @ $2.75 per case
      4 cases 24 1 lb. cans @ 23.45 per case
      3 cases 48 1 lb. cans salmon+ @ 31.50 per case
   b. A charge of ten cents per case will be made for delivery. What would be the cost of delivery?
   c. What will be the total cost of the goods?

2. The following equipment items were purchased. What should be the total of the bill?

5 dozen 5 oz. glasses	@ $1.80 per dozen
6 dozen 12 oz. glasses	@ 3.60 per dozen
10 dozen teaspoons	@ 1.70 per dozen
12 dozen forks	@ 2.40 per dozen
6 dozen knives	@ 4.35 per dozen

3. Trays are listed as follows:

less than 5 dozen	$39.95 per dozen
for lots over 5 dozen	35.95 per dozen

   What is the per tray cost at each figure?
   A sample try set of four is offered for $12.00. Suppose some one put in an order for three of the sample sets, what would be the price per dozen? per tray?

4. a. An order was placed for 6 dozen dinner plates @ $9.56 per dozen and 8 dozen 6 inch bowls @ $4.94 per dozen. What should be the total of the invoice?

   b. On checking the order, two bowls were found to be have been broken in shipment. The dealer told the customer to deduct the price of the items from his bill. What will be the amount of the deduction?

5. The following statement or invoice was received from the milk dealer:

2467 half pints milk	@	.0625	$154.19
3-40 qt. cans bulk milk		.175 per qt.	20.04
10 qts. heavy cream	@	1.67 per qt.	16.70
3 qts. light cream	@	.92 per qt.	3.68
20 lbs. cottage cheese	@	.17 per lb.	3.40
			$198.01

Check this statement. If you find any errors, make a note of them. Check the total. If you should find any errors, what would you do?

6. A box of 216 oranges at $5.75 was ordered, but when the delivery was made it was a box of 176. The dealer said that the customer could have the box delivered for the same price although the larger oranges cost more per box. Would holding this box be a bargain? Why? Prove your answer. How much would be received for each box if the oranges were sold for 5 cents each?

7. Take the daily delivery slips for the milk for one month. Make out a chart as follows, using the headings -- H.C. (heavy cream) L.C. (light cream)

Date	1/2 Pts.	Qts. bulk	Qts. H.C.	Qts. L.C.	Pts. H.C.	Pts. L.C.	1/2 Pts. H.C.	1/2 Pts. L.C.	Cottage Cheese 8 oz.	Cottage Cheese 5 lbs.

8. Check the totals and check the charges with the statement from the milk company.

9. Make a similar chart for the ice cream. Copy the headings for your chart from the delivery slips. Check the bill from the ice cream company just as you did from the milk company.

UNIT III - DECIMALS

Receipts | Lesson No. 10

OBJECTIVE: To practice using decimals in figuring receipts.
To learn the application of decimals to the computation of receipts.

RELATED INFORMATION:

In the last lesson, the subject of moneys spent was considered. This lesson emphasizes moneys received.

The importance of being able to analyze costs and to figure them in dollars and cents has been discussed in an earlier lesson.

In this lesson we will consider sources and methods of handling receipts or moneys received.

PROCEDURE:

A. Consult the day book. Make a list of all the money received for each day for one month. Find the total receipts.

B. $1146.63, $1238.41, $942.08, $2001.66, $1805.06, $214.18
Add these receipts.

ASSIGNMENT:

1. The following is a report from a dining room that had a system of charges. Charges are considered as cash sales

Cash Sales	Charges	Total Sales
$ 82.27	4.12	
102.19	3.95	
62.45	2.17	
58.72	.86	
71.38	3.25	_____
Total	Total	Total

2. Many restaurants or eating places have various sources of income besides the regular dining room receipts. Copy and add the following:
   a. from the dining room $763.82, b. from the lunch counter $60.40, c. from the baked goods counter $49.23, d. from "take out orders" $154.29. What were the total receipts for the day?

3. An owner of a small restaurant devised the following method of computing the daily receipts. He sorted the daily slips in various denominations. One day his record read as follows:

Number of Tickets	Denominations	Total
54	.35	
75	.50	
24	.75	
21	1.00	
43	1.25	
10	1.50	
7	2.25	
3	2.50	
	Total	____

4. The owner gave the cashier $15.00 in change to start the day. When the cash was checked against the daily receipts, there was a total of $193.00. This included the money used for the cash drawer. Was the cashier over or under? How much?

5. The owner considered this an average day's business. What was the total number of guests served on the day in Problem 3? What was the average check?

6. Using the total sales as an average for a day's business, what would be the receipts for 20 days?

7. The following expenses were deducted from the receipts for 20 days:

   $1046.23 food supplies, $565.00 labor, $125.00 rent.

   What will remain from the month's receipts to take care of other expenses, savings, and a salary for the owner?

UNIT III - DECIMALS

Achievement Test No. 3

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1. Write the following as decimals:
   a. two hundred seven and eighty three thousandths
   b. seven tenths
   c. seventy two and ninety three thousandths
   d. six and five hundredths
   e. three hundred forty six millionths

2. Add the following:

   139.327 + .427 + 27.083 + 18.27 + 1.64

3. Subtract the following:
   a. 105.207 - 20.003
   b. 117.05 - 18.24
   c. 29.325 - 18.66
   d. 807.6 -135.2
   e. 21.4300 - 8.1291

4. Multiply the following:
   a. .875 x .36
   b. .002 x .014
   c. 32.25 x 2.376
   d. 6.42 x 50
   e. 48.37 x 25

5. Divide the following:
   a. 93.66 by 21
   b. 467.967 by 4.01
   c. 281.3232 by 3.76
   d. 468.312 by 316
   e. 350.96 by 214

6. What will be the cost of the following: 3 bags of potatoes @ $3.75 each, 32 lbs. butter @ .81 per lb., 2 - 100 lbs. sugar @ $5.75 each?

7. $467.14 + $201.36 + $420.01 + $296.43 + $819.63 represent the receipts for five days. If the expenses were $1546.23, for the same period, what remains?

8. A cook works 7 hours on Monday, 8 hours Tuesday, 4 hours and 45 minutes on Wednesday, 6 hours and 15 minutes on Thursday, 8 hours on Friday and 10 hours on Saturday. At $2.50 per hour, what would the cook earn?

9. Multiply the following by the short method:

a.	54.3	x	100
b.	221.46	x	10
c.	409.54	x	1000
d.	68.4	x	50
e.	201.3	x	100

10. Divide the following using the short method:

a.	802.5	by	100
b.	61.5	by	10
c.	611.50	by	10
d.	212	by	100
e.	41968.5	by	1000

11. Work out the following unit costs:

Total Cost	Number	Unit Cost
35.20	48	
3.96	176	
3.125	50	
50.00	40	
24.00	96	

UNIT IV - PERCENTAGE

Review | Lesson No. 1

OBJECTIVE: To recall the terms that apply to percentage.

RELATED INFORMATION:

Percentage is a name given to a group of rules or methods used in business transactions.

The term percent is used to indicate the number of hundredths. It means two decimal places and is expressed by the sign %.

You will find the word used frequently in papers, magazines, on the radio and TV.

PROCEDURE: In one dollar there are 100 cents.
One cent may be written in the following manner:

a. fraction $\frac{1}{100}$ b. as a decimal .01 c. or as 1%

3% would mean $\frac{3}{100}$ or .03

25% would mean $\frac{25}{100}$ or .25

50% would mean $\frac{50}{100}$ or .50

5% would mean $\frac{5}{100}$ or .05

Any percent above 100 is more than 1 whole unit.

110% equals $\frac{100}{100} + \frac{10}{100}$ or 1.10

200% equals $\frac{100}{100} + \frac{100}{100}$ or 2

125% equals $\frac{10}{100} + \frac{25}{100}$ or 1.25

There may be time when you will need to change a fraction into percent:

Example: fraction $\frac{7}{8}$ Use the denominator as the divisor.

The divisor:

```
      .875
   8/7.000
    64
     60
     56
      40
      40
```

Use the numerator as the dividend and add 3 zeros.

To get percent from the decimal .875, move the decimal point to the right 2 places -- 87.5%

ASSIGNMENT: Work out the following:

1.

	Fraction	Decimal	Percent
a.	$\frac{1}{2}$		
b.	$\frac{1}{8}$		
c.	$\frac{1}{5}$		
d.	$\frac{1}{10}$		
e.	$\frac{3}{4}$		

2. Change the decimals to %:
   a. .05
   b. .8
   c. .025
   d. .0625
   e. .055

3. Change these percents to decimals:

   a. 5%
   b. 75%
   c. $16\frac{2}{3}$ %
   d. 15%
   e. 18%

4. The salad maker is told to use 50% of the lettuce for salad. What fraction of the quantity is to be used?

5. 10% of forty teaspoons was found to have dented handles. How many were dented?

6. Of 5 dozen oranges, 10% was spoiled. How many oranges were spoiled?

7. a. 10% of a student's work was incorrect. What % was correct? There were 50 questions.
   b. How many were right?
   c. How many were wrong?

8. a. 50 cents is ____% of one dollar.
   b. 10% is what fraction of a dollar?
   c. 8% of 32 = _____.
   d. 25% of 400 = _____.

9. a. 11.05 is _____% of 85.
   b. 20% of 6.00 = _____.
   c. 40% of 4000 = _____.
   d. 7% of $842.00 = _____.
   e. $\frac{3}{4}$ of 100 = _____.
   f. 1% of $15.00 = _____.

10. An operator found that by assigning a worker to the job of sorting strawberries, he was able to save 5% of 25 quarts of berries that he had purchased each week. How many quarts would be saved in four weeks?

11. There were 7100 persons who ate in a restaurant in one month. The following month showed an increase of 30% in the number of guests. How many people ate there the second month?

UNIT IV - PERCENTAGE

Application | Lesson No. 2

OBJECTIVE: To learn how to apply knowledge of percentage to working problems in the foods trade.

RELATED INFORMATION:

A. You have been working with problems that have represented expenditures or receipts of food trade establishments.

A successful business man is also interested in knowing how to interpret these figures in percentage.

Many business concerns will have sales where discounts are given in order to sell goods.

You will see advertisements for "pre-inventory" sales and many others. The merchant offers goods at special prices, but he is still able to make a margin of profit.

This procedure can not be followed in the foods trades because this business deals with a product that must be used as soon as it is produced.

Recognizing this fact, you can see how important it is for the food merchant to be accurate, for if he is not, his business will not last long.

Labor cost and overhead expenses must be added to the cost of raw materials to arrive at a selling price. Location of the eating place will affect both of these figures, therefore the percentage of profit will vary.

ASSIGNMENT:

1.

a. Make a detailed list of all of the materials used for a special meal served in the school.

b. Compute the market price of the materials (use daily slips, stock purchase cards, etc.) to find the prices.

c. Add the following percentages to the food cost:
   1. 15% for labor
   2. 1% for overhead expenses
   3. 20% for miscellaneous expenses

   This would be the selling price.

d. If you were serving 30 guests, what would be the guest charge? Make the figure in the unit of 5 or 10, not an odd number as 6 or 9.

2. The materials in a meat loaf amount to 76 cents. Add 25% to this cost. What will be the selling price?

3. Figure the following:

	Food Cost Per Serving	% Profit	Selling Price
a. Macaroni and cheese	.035	15%	
b. Chocolate pudding	.0046	33 1/3%	
c. Swiss steak	.275	40%	
d. Ice cream	.105	75%	
e. Roll and butter	.0425	25%	
f. Fresh green beans	.0215	12 1/2%	

B. Use of Knowledge of Percentage in Proportion of Various Ingredients

Example: There are many foods either concentrated or dehydrated that are used in the preparation of foods. The worker must know how to interpret the directions on the packages.

Concentrated fruit juice - to reconstitute - read the directions for the brand being used.

ASSIGNMENT:

1. Read the directions on a can of concentrated soup. What percentage of water is added to reconstitute the soup?

2. a. Read the directions for reconstituting as dehydrated soup base. How many ounces of base are needed for 16 ounces of water?

   b. Repeat, using a bouillon cube.

3. A recipe for French Dressing requires 75% oil and 25% vinegar. If you were to make four cups of dressing, what quantity of each ingredient would you use?

4. To reconstitute powdered skim milk solids into liquid form, 25% powder is used to _____ % water?

5. One day the cook needed to make pastry flour from all-purpose flour and cornstarch. The directions called for 75% flour and 25% cornstarch. If 16 cups of the mixture were needed, how many cups of each would be used?

6. The law in our state permits the sale of milk of a water content not exceeding 87 1/2%. 3% butterfat is the minimum requirement. What percentage of other materials or milk solids are there?

7. A recipe calls for 3 lbs. fat. The cook was instructed to use 33 1/3% vegetable fat and 66 2/3% butter. How many pounds of each type of fat will be used?

8. Iced tea sold for 10 cents a serving. It cost 20% of the selling price. What did the cost of preparing one serving amount to?

9. The restaurant owner uses a quick method of computing the added cost to the basic food cost for a la carte dishes:

	Price of Table d'hote Dishes	% Increase	Price for A La Carte
a.	19 cents	40%	
b.	29 cents	40%	
c.	1.08	40%	
d.	35 cents	40%	

10. A restaurant with an income of $35.000.00 figured a 34% food cost. What was the food cost?

11. Mark up each of the following price meals to each of the percentages listed. The result will be the selling price.

Meal cost	.63,	.74,	.85,	$1.15
% Increase	45%	50%	32%	

The various percentages listed would represent establishments of varied localities and overhead.

12. a. Total the price of all the meats that were used in the school cafeteria for one month.

    b. Find the total cost of all food for that month.

    c. Find the % of the total used for meat.

    d. Find the % of the total used for milk.

UNIT IV - PERCENTAGE

Discounts | Lesson No. 3

OBJECTIVE: To discover the use of percentage in computing discounts. To learn how discounts can be applied to work in the food trades.

RELATED INFORMATION:

Although the food that is produced in the shop may not be sold at a discount, the manager can take advantage of discounts when purchasing the raw materials, in paying bills within prescribed times.

PROCEDURE:

1. The manager must analyze any offer of discount on purchases. Never buy on price alone. Remember quality will build lasting business.

2. Don't let the salesman rush you with the story that he is double parked or that he has another appointment in ten minutes. Watch offers of goods that may be given at a price under these conditions.

ASSIGNMENT:

1. The vegetable dealer called at 10 A.M. to sell corn at $3.00 per bag (100 ears). Earlier, the price had been $3.50. What would be the % of discount by taking advantage of this offer?

2. Most vendors offer various discounts on bills paid within specified times. What would be the total savings on the following bills? $462.17, $30.54, $2.79, $358.14 -
   a. a discount of 15% on each for payment in 10 days.
   b. 10% in 30 days.
   c. 5% in 90 days.

3. A salesman quoted $27.90 for six cases of canned corn. The customer inquired whether he could have a discount. The salesman agreed that since he was willing to purchase that quantity, he would give him $4.185 discount. What percentage would that equal?

4. The retail price of potatoes is .05 per lb. The restaurant purchases a bag of 100 lbs. at $3.00. What was the percentage of discount given for purchasing the larger amount?

5. Inventory showed that 40% of the coffee order was used in one month. If 60 lbs. had been ordered
   a. how many pounds had been used?
   b. What percentage of the original order remains?
   c. How many pounds?

6. A discount on purchases is frequently given to workers. How much would a worker save by the following purchases?

2 coffee cakes @ .65 each, $1\frac{1}{2}$ lbs. cooked ham @ $1.35 per lb.

1 qt. potato salad @ .45

A 15% discount is allowed on each item.

UNIT IV - PERCENTAGE

Gratuities Lesson No. 4

OBJECTIVE: To learn how to use percentage in figuring gratuities.

RELATED INFORMATION:

Many workers in the food industry depend upon tips or gratuities as part of their income.

An efficient worker in the service department is able to make considerable money on tips.

Some establishments request that guests do not tip but a percentage of the total amount that the worker sells to the guest is added to the worker's pay.

A comment was made in a former lesson that a food trade worker is a salesperson. Consider your tip or gratuity as a commission for your selling ability. The better salesperson you are, the greater the tip.

PROCEDURE AND ASSIGNMENT:

1. You are working in an establishment that adds 6% of the sales you make to your wages. Your business for one week amounted to $519.25. Your wages are $40.00. How much money will you receive for commission in addition to your wages?

2. A restaurant guest hesitates in giving his order, but the waitress is on the job! Before he has a chance to order a 65 cent hamburger, she makes the following suggestion, "The fried chicken has been very popular to-night and it is mighty good. Would you care to try it?" The customer accepted the suggestion and spent $1.95. At 15%, what would the tip amount to on each sale? What would be the difference for the larger check?

3. A 15% tip was received on the following sales slips. What was the total of the money received? $4.95, $2.60, $1.35, $1.25, $6.40, $3.85.

4. Wages amounted to $50.00. What percent of wages was sales commission if the commission amounted to $2.00.

5. A woman was asked to serve at a buffet supper. She was offered $10.00 for 2 1/2 hours. She said she couldn't do it unless she was paid 50% more than the offer. How much did she want for her work?

6. A worker lost three days pay at $7.00 per day.
   a. What percentage of his pay did he lose?
   b. What was his salary for six days?

7. A bakery salesperson sold $563.25 worth of baked goods for which a 5% commission is added to his pay. What will the commission amount to?

8. A waitress served a group whose bill amounted to $10.65. $1.60 was left as the tip. What was the % of the tip?

9. A waiter earned wages of $2140.00 for one year. His tips amounted to $1091.40. What was the % of his tips?

10. Four waitresses pooled their tips for the day. The total money in the box amounted to $48.50. They agreed to give the bus boy 1% of the total tips. Two waitresses worked for two meals and each received 25% of the remaining tips. How much did the other waitresses receive as their share?

    a. How much did the bus boy receive?
    b. How much did each of the first two waitresses receive?
    c. How much did each of the second two waitresses receive?

UNIT IV - PERCENTAGE

Achievement Test No. 4

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1. What is the difference between the terms hundred and hundredths?

2. Write 37 1/2% as a fraction. a decimal.

3. Figure the profit on $5000.00 at 150% and at 1.5%

4. If you earn $200.00 per month and spend $15 for uniforms, $7.50 for shoes, $3.50 for hose and $5.00 for other wearing apparel, what percent of your wages was spent for these items? What percent of your wages do you have left? How many dollars will this equal?

5. A business has expenses of $6454.57. The receipts were $10,410.59. What percentage of profit was made?

6. The cost of preparing a serving of apple pie is .08. What should the selling price be in order to make a profit of 75%?

7.
   a. What % of 50 is 5?
   b. What % of 35 is 7?
   c. What % of 48 is 12?
   d. What % of 30 is 3?
   e. What % of 90 is 45?

8. A worker was advised to budget his salary as follows: 10% savings, 25% food, 5% clothing, 10% shelter, 10% entertainment, 15% travel expenses, 10% church, 5% charities, 10% investments. If he earned $325.00 per month, how much would he use for each expense?

9. The selling price of the meals listed below is 40% more than the food cost. Find the food cost. 95 cents, 65 cents, 50 cents, $1.25, 85 cents.

10. 216 oranges cost $6.25. What should the selling price of one orange be to show a profit of 33 1/3% on each orange?

UNIT V - MEASUREMENTS

Review | Lesson No. 1

OBJECTIVE: To recall the terms necessary to the study of the tables of measurements as applied to the work in the commercial foods.

RELATED INFORMATION:

A. Unit of Measure
To measure the quantity of any object, it is necessary to decide on a method of measuring. Whatever is selected is known as a unit of measure.

B. The objects used as units of measure must meet certain specifications of size or volume, which have been established by law. This type of equipment is known as standard equipment.

C. All recipes and formulae are developed by using standard measurements and standard measuring equipment.

ASSIGNMENT:

1. Collect the following equipment from the cafeteria: measuring cup, set of measuring spoons, quart measure, gallon measure, (These articles are examples of standard measuring equipment).

2. Take a coffee cup, a soup spoon and a teaspoon from the dining room. (These articles are not standard measuring equipment).

3. Compare and contrast the articles that you have collected, as to appearance, size.
Fill the measuring cup with water. Pour the water into the coffee cup. Will the coffee cup hold all of the water? Examine the markings on the measuring cup. What do the marks show?

   Test the quantity of water that the standard tablespoon will hold with that of the soup spoon.
Repeat, using the standard teaspoon and the regular teaspoon.

   Fill the quart measure, using the standard measuring cup. How many cups of water were needed to fill the measure? How did the number of markings on the quart measure compare with the number of cups that were needed to fill it?

   What would your conclusions be regarding the use of standard measuring equipment?

D. To save time in quantity food preparation, many ingredients are weighed.
The units of measure used for this work are grams, ounces, pounds.

ASSIGNMENT: Examine the gram scales.
Examine the scales registering ounces and pounds.
Examine a portion scales.

1. Weigh one gram of flour.

2. Weigh one ounce of flour.

3. Weigh one pound of flour.

4. Compare the quantities of one gram of flour with one ounce of flour. Measure each unit of weight with a standard measuring spoon. How many tablespoons in one gram of flour? one ounce?

E. Some materials are measured according to other standard units such as, peck, bushel. You will find that these units must have specific weights.
For example, a bushel of green peppers weighs 25 pounds.
By consulting tables of specifications, you will be able to learn the various weights required for certain fruits, vegetables and other packs.
Specifying weights for certain packs has been found to give a more accurate measurement.

ASSIGNMENT: Consult your text book for a "A Chart of Comparative Weights and Amounts of Fresh Foods".

Select three examples for class discussion.

F. Temperatures: The standard unit for measuring temperature is the degree. A small o to the upper right of the figure is used to designate the degree. (80°)

The standard piece of equipment for measuring temperature is the thermometer. There are two main types of thermometers - the Fahrenheit and the Centigrade.

F. is used to represent the Fahrenheit thermometer on which 32° records the freezing point, and 212°, the boiling point of water.

C. is used to represent the Centigrade thermometer, where the freezing temperature is shown by 0 and the boiling point is 100.

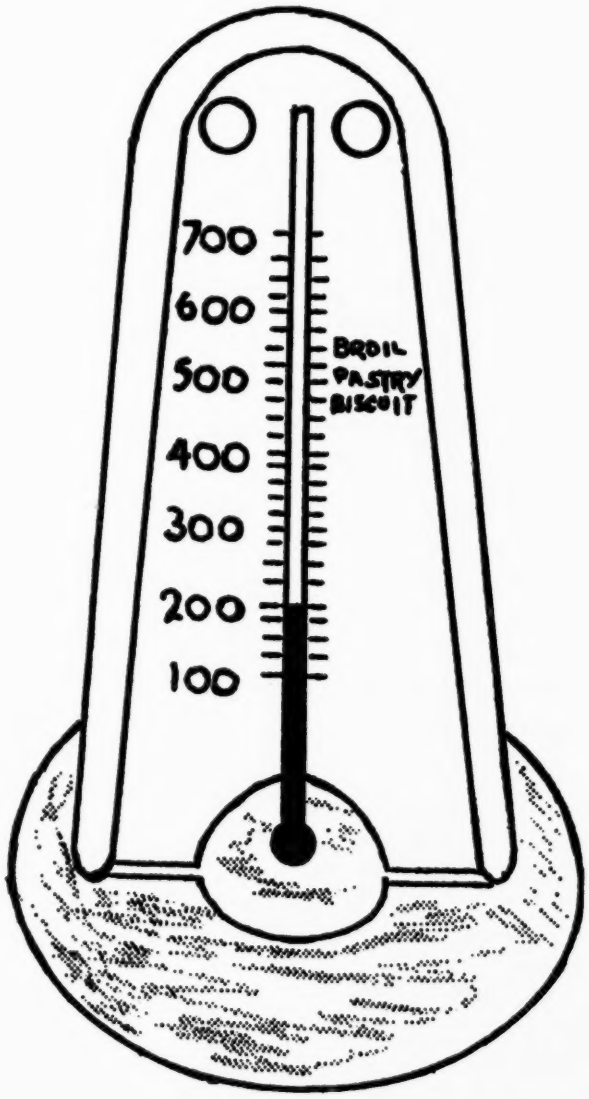
Although the Fahrenheit thermometer is used almost exclusively in the kitchen, it would be well for you to examine a centigrade thermometer.

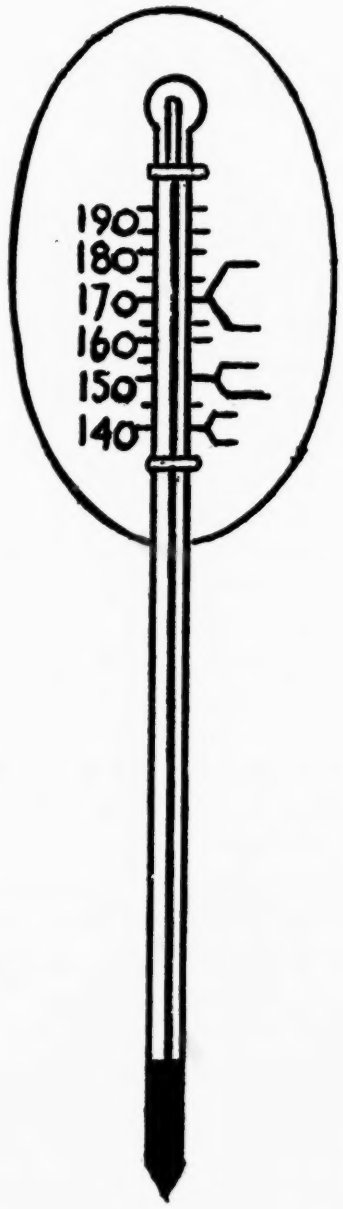
Various thermometers are used for different purposes in the kitchen. All are worked out on the Fahrenheit scale.

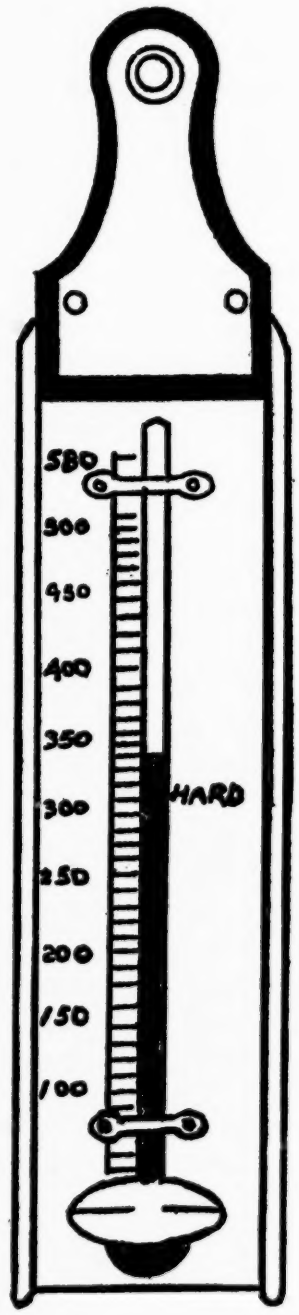
a. candy thermometer, fat thermometer
b. the oven thermometer
c. refrigeration thermometer

Many pieces of equipment are constructed with thermostats - instruments that control temperatures. The scale of degrees or temperatures register the same as on a thermometer. This instrument has the advantage of not only registering temperatures, but controlling them. However, a thermometer is needed to check the thermostat should it get out of order.

Thermostatically controlled equipment is becoming a necessary part of every foods establishment. It takes the guess-work out of food preparation, is a safety control, and also helps to save food from over-cooking, thus controlling the quality of the finished product.







OVEN THERMOMETER

Used for testing temperatures of oven heat.

MEAT THERMOMETER

Used to determine the internal temperatures of meats.

CANDY AND FAT THERMOMETER

Used for testing temperatures of sugar syrups, candy and deep fat frying

Collect the various types of thermometers from the kitchen so that you will be able to recognize each.

Notice the scales on each thermometer differ. Also note that certain thermometers will register much higher temperatures than others.

There is another instrument used to determine temperatures, when steam is used for cooking, called a pressure gauge. Gauges are marked in various ways to indicate pressures as well as temperatures.

<u>Warning</u> Always be certain of the directions for operating any equipment where steam is used, as it can be dangerous ! ! !

ASSIGNMENT:

Inspect the cafeteria equipment to learn the different types of thermometers or thermostats that are used.

If there are no pieces of equipment available to illustrate the use of pressure gauge, you may be able to see it on the heating equipment in the school or you may see it when you visit the Hotel Show or a commercial kitchen.

G. Measurement of time is also very important to the trade. Tested recipes indicate the time for cooking as part of their directions.

Seconds, minutes, and hours are the units used in the preparation of foods.

Days, weeks, months, years are the additional units used in computing various phases of business operations.

H. There is another unit of measurement that foods students will want to understand - the calorie. This is a unit of heat or energy derived from the foods consumed.

ASSIGNMENT:

Consult your text book for "Daily Food Needs".

Find the number of calories that a person your age requires daily.

Find the number of calories that a man doing heavy work needs daily.

Find the number of calories that a woman doing light work needs daily.

Find the number of calories that a child one year old needs daily.

Compare the number of calories need for each of the examples. How do you account for the difference in the number of calories that each person requires?

REVIEW:

1. a. Define the meaning of standard equipment.
   b. Why should standard equipment be used?

2. The units of measuring materials by weight are ____, ____, ____

3. You may purchase 10 pounds of potatoes or 1 bushel of potatoes. What two units of measurements are represented here?

4. The boiling point of water is _____F. _____C.

5. _____ represents the internal temperature for 10-12 pound turkey. (Consult the meat thermometer).

6. Which is more advantageous to the customer? To order a bushel of spinach or 35 pounds of spinach. Give the reason for your answer.

7. What should the internal temperature of a 12-15 lb. standing roast of beef be to produce a rare roast?
(Consult the meat thermometer).
How many minutes per pound should the meat be cooked to produce a rare roast?
What would be the total time for a roast of the weight listed to be cooked?
If the meat is put in a pre-heated oven at 9:45 A.M., at what time should the meat be ready to serve?

8. How do the temperatures in Problem 7 compare with those of Problem No. 5?

UNIT V - MEASUREMENTS

Reading
Thermometers

Lesson No. 2

OBJECTIVE: To learn how to read the various thermometers used in the commercial foods kitchen.
To be able to interpret the mathematics of the thermometer in the preparation of foods.

RELATED INFORMATION:

Accurate measurements, care in combining ingredients and use of standard recipes, as well as quality ingredients are some of the requisites of a uniform product. However, if the product is not cooked properly, it will not be acceptable.

Various thermometers are helpful and indispensable in food preparation.

PROCEDURE:

A. Using the candy thermometer. This instrument will be used in making cake icings, fillings, jelly, as well as in making various confections.

1. Examine the candy thermometer and make a record of the various temperatures, as well as the descriptive adjective that corresponds to each temperature.
   Note: The higher the temperature of a sugar mixture, the more brittle the finished product. This continues until all of the moisture is driven off and the mixture becomes a black mass of carbon which, of course, will not be usable in the foods trade.

   Icings are usually cooked to the "fondant" stage or "soft". Find the temperature that corresponds to this description.

2. Take one cup sugar and $\frac{1}{3}$ cup water. Stir until the ingredients are well mixed. Put the thermometer into the syrup. Heat on a low flame until the mixture reaches 238°F. At what temperature did the mixture remain for some time, before reaching the required temperature?

3. Continue to cook the syrup, checking the temperatures at the various stages described on the thermometer.

   CAUTION: REMEMBER THAT THIS MIXTURE IS VERY HOT. PROTECT YOUR HANDS AND DO NOT ALLOW ANY OF IT TO TOUCH YOUR SKIN. USE A HEAVY DRY POT HOLDER AND HAVE A DRY CLOTH ON WHICH TO PLACE THE THERMOMETER WHEN IT IS REMOVED FROM THE SYRUP. LET THE THERMOMETER COOL BEFORE PLACING IN WATER.

4. What finally happens when the syrup is cooked beyond the "brittle" stage?

5. Did this change take place slowly or rapidly? What did you learn from this exercise about the changes that take place in sugar cookery?

B. The Deep Fat Thermometer

1. Compare the lowest and highest temperatures on this thermometer with that of the candy thermometer.

2. Consult a cook book and find the recommended temperatures for frying the following in deep fat: chicken croquettes, fillet of flounder, crullers, French fried potatoes.

   Put the required fat into a frying kettle, put on a low flame and place the deep fat thermometer into the kettle. When the temperature of the fat reaches the required temperature, frying starts. Check the length of time required for the fat to reach each of the desired temperatures.

   Experiment by frying one of the foods listed. After the first batch has been fried, check the temperature of the fat. What has happened? What was the cause of this? What must happen before more food is fried? List the number of minutes or seconds for the fat to recover the temperature.

   PRECAUTION: HOT FAT CAN CAUSE PAINFUL BURNS.
   HOT FAT CAN ALSO CAUSE FIRES.
   WORK CAREFULLY.

   When the fat becomes too hot, what two conditions exist? Fat temperatures that are too high spoil the flavor of foods as well as take the "life" out of the fat. Fat that is not hot enough is soaked up by the food. This results in a greasy, indigestible product.

   These two points should impress you with the importance of frying foods at the right temperatures.

   Newer and more improved equipment for deep fat frying has thermostatically controlled temperatures.

C. The Meat Thermometer is inserted into the thickest part of the piece of meat and the meat is cooked until the internal temperature of the meat reaches the desired degree.

   Inspect the markings on the meat thermometer and notice that various kinds of meats require different temperatures.

   Which requires a higher internal temperature - rare roast beef or fresh pork?

D. Oven Thermometer and Thermostat. Most ovens are equipped with a thermostat which controls and regulates oven temperatures. A portable oven thermometer is usually available to check the thermostat.

Set the thermostat on the bake oven to 400F. Set a portable oven thermometer on the center of the shelf of the oven. In 15 minutes, check the thermometer to see if it and the thermostat agree.

Write the figures that represent the various temperatures that are described on the thermometer, e.g., what figure corresponds to the word "moderate". Why would it be more accurate to give the figure for the temperature especially when writing recipes?

E. The Refrigerator Thermometer. Many refrigerators are equipped with regulators so that temperatures can be controlled. There are also portable thermometers which can be used to determine the temperature of the refrigerator.

Using a portable refrigerator, check the temperature in the morning before the day's work begins, again at noon, and again at the end of the day. What have you learned about the effect of opening the refrigerator door on the temperature? 35° - 40° is the desirable temperature for keeping food cold. 50°F. is conducive to bacteria growth and is not desirable.

Set the thermometer in the freezer or in the ice cream cabinet. Record the temperature after 30 minutes have elapsed. How does the temperature compare with that of the refrigerator?

F. Dishwashing Machine Thermometer. Board of Health recommends that the temperature of water for dish washing in a machine be 140°F., for rinsing 180°F.

Check the temperature of the water at the beginning of the dish cleaning period and at the end. Record your findings.

ASSIGNMENT:

1. Check the temperature required for soft icing.

2. How do the internal temperatures for the following compare:

   a. roast beef - medium
   b. roast beef - well done
   c. fresh pork
   d. roast leg of lamb

3. Why are the terms like "hot oven", "moderate oven" inaccurate? What would be the exact temperatures for these terms?

4. If you were using an oven equipped with a thermostat, at what temperature would you set it for "hot"? "slow"?

5. Which is higher, the boiling point of water or 236°F.? How much?

6. A reading of the refrigerator the first thing in the morning was 38°F. At noon it was 52°F. How would you account for the higher temperature?

7. A piece of meat weighing 16 lbs. before cooking lost 1 lb. 3 oz. when cooked at 325°F. At 400°F. in the same length of time an identical piece lost 2 lbs. 1 oz. What would be your deduction as to the effect of higher temperatures on meat shrinkage? What would be the cooked weight of the two pieces of meat?

UNIT V - MEASUREMENTS

Using Scales

Lesson No. 3

OBJECTIVE: To learn the importance of accuracy in using various types of weighing scales as used in the foods trade.

RELATED INFORMATION:

Various types of scales are used in the foods trades.

1. Platform scales - at the point of delivery to weigh cases, barrels, etc.

2. Kitchen scales - used for weighing ingredients and small packages.

3. Portion scales - used to weigh portions of food - especially in diet kitchens.

4. Computing scales - convenient when figuring portion costs.

PROCEDURE: The scales that are used in a food establishment can be used as a check on deliveries. It is always wise to check all deliveries.

Platform Scales

Balance the scales before weighing ingredients.
Always report any variation - shortage or overage immediately.
This work is usually taken care of by the store room clerk.

Kitchen Scales - used for weighing ingredients.

This is a time saving method as well as an assurance of obtaining more uniform results with a quantity recipe.

ASSIGNMENT:

A.

1. If a platform scale is available, weigh a bag of sugar or a bag of flour (100 lbs.). Balance the scale and after checking the weight on the delivery slip, find out if it agrees.

2. Weigh a case of eggs - check for size (small, medium, large). Does the weight agree with the prescribed weight?

3. Repeat No. 2 using a basket of spinach, crate of lettuce (note the kind of lettuce), case of #10's standard tomatoes, barrel of dish machine powder.

   Check to see if the figures agree with those on the specification list. You will find information charts of "Comparative Weights" in your institutional books.

B. <u>Kitchen Scales</u> Procedure - balance the scales.

1. Weigh a nine inch mixing bowl, a six inch mixing bowl. Mark the weight of each bowl.

2. Put enough flour into each bowl to make one pound of flour. What must you remember when you are weighing the flour? Can you suggest two methods of doing this?

3. a. Weigh 1 lb. carrots (A.P.) as purchased, tops, etc.
   b. Remove the tops. Weigh again. What is the difference?
   c. Suppose you bought 2 dozen bunches of carrots. What would be the waste?
   d. Multiply this by the cost per pound to determine the money that you would be losing.

4. Sort enough potatoes of uniform size to make 25 lbs. Put them into the paring machine. Eye them after being pared. Weigh the potatoes again. Any difference? Mark down any loss. Cost of one pound. Cost of lost weight.

5. a. Weigh an uncooked smoked ham, leg of lamb or standing rib roast of beef. Record the weight and check with the dealer's bill.

   b. Cook the meat. Weigh again after cooking. Record the weight. Figure the number of pounds or ounces or both of shrinkage.

   c. Bone the meat. Weigh the bones and other trimmings. More loss!

   d. Weigh the boned meat.

   e. Multiply the number pounds of loss by the cost per pound. Add this to the bill that was rendered for the meat as delivered. What is the present cost per pound?

6. a. Weigh six head of iceberg lettuce.

   b. Weigh six head of Boston lettuce.

   c. If you are purchasing the lettuce by weight, which would be the better buy?

   d. Trim the leaves from both types of lettuce that cannot be used for salads. Weigh the trimmings. Any loss?

UNIT V - MEASUREMENTS

Purchasing by Weight vs. Count — Lesson No. 4

OBJECTIVE: To ascertain the value of purchasing by weight or count.

RELATED INFORMATION:

Institutional purchasing is usually done on the basis of weights rather than by count.

You will be better able to appraise the two methods of purchasing with some experience in figuring cost and then make a comparison.

ASSIGNMENT:

1. Check the weight of a case of small, a case of medium, and a case of large eggs.
   a. How many dozen are in each case?
   b. Compare the current market price per case for each size egg.
   c. What is the price per egg of each size?

2. On which case would the restaurateur make more money - selling a case of medium or a case of large eggs. The eggs are to be used on an a la carte breakfast menu. Consult a menu from your locality for the price of a single or two eggs.

3. A box of 150 apples (for table - fancy) sells for $7.50. The weight is 48 lbs.
   a. What is the cost per apple?
   b. What is the cost per lb.?
   c. What would be the approximate number of apples in one pound?
   d. If the apples were sold at 10 cents each, what would be received for the box of apples?

4. Corn per bag of 100 ears costs $4.00, or it may be purchased for 65 cents per dozen. Show by figuring which is the better buy.

5. Which would be the better buy?
   a. 1 crate of 27 cantaloupe @ $5.40 per crate
   b. 1 crate of 36 cantaloupe @ $7.92 per crate
   c. Figure the cost per cantaloupe of each size.
   d. What would be the cost per serving if eight servings were made from each of the 27 cantaloupes?
   e. What would be the cost per serving if six servings were made from each of the 36 cantaloupes?
   f. Each serving is to be offered to the customer for 15 cents per serving. What would be the profit from each box?
   g. Which is the better buy? Why?

6. Check the weight of a stalk of bananas, a hand of bananas. Consult the market price of each unit.

   a. What will determine the number of bananas in one pound? Weigh out one pound and figure the cost of each banana.

   b. Since you cannot sell bananas by weight to a restaurant customer, add 25% of the cost of one banana to arrive at the selling price. What will be the charge for one banana?

7. Look up the following units - the weight of
   a. till of tomatoes
   b. lug of tomatoes

   If the price of a till were $2.50 and the price of a lug were $5.75, which would be the better buy? Why?

8. Fresh plums are packed in baskets with the following description - "4 x 5"

   a. Find out what this description means.

   b. Find out how many baskets there are to a box or a crate.

   c. Figure how many plums this carte would yield.

   d. At $11.50 per box or crate, what would be the cost per serving if three plums are given to a customer?

   e. How many servings can be made from this pack?

UNIT V - MEASUREMENTS

Tables | Lesson No. 5

OBJECTIVE: To recall the various tables of measurements especially those used in the foods trades.

RELATED INFORMATION:

The following tables that you learned in the lower grades of school will be used for many of the jobs that you will do in foods work.

PROCEDURE: Review of the various tables and parts of the tables that will be needed for foods work.

A. Table of Liquid Measure

3t. (teaspoons	=	1 T. (tablespoon)
16 T.	=	1 c. (cup
2 c.	=	1 pint (pt.)
4 c.	=	1 quart (qt.)
4 qts.	=	1 gallon (gal.)

B. Table of Dry Measure

3 t.	=	1 T.
16 T.	=	1 c.
16 ounces (oz.)	=	1 pound (pd.)
2 c.	=	1 lb. sugar
2 c.	=	1 lb. fat
4 c.	=	1 lb. flour

Note: The measurements listed are the ones that you will need to memorize. There are other tables of Equivalents in your foods text books. You will use these when computing costs of recipes.

C. <u>Table of Weights</u>

28.35 grams (gr.)	=	1 oz.
16 oz.	=	1 lb.
2 c.	=	1 lb. fat or sugar
4 c.	=	1 lb. flour

D. <u>Table of Temperatures</u>

0 degrees Fahrenheit	=	0°F.
32°F.	=	freezing
212°F.	=	boiling point

E. <u>Table of Time</u>

60 seconds (sec.)	=	1 minute
60 minutes	=	1 hour (hr.)
24 hours	=	1 day
30 days	=	1 month
12 months	=	1 year (yr.)

F. <u>Size of Cans in which Food is Purchased for Food Establishments</u>

1. Learn to recognize each size can.

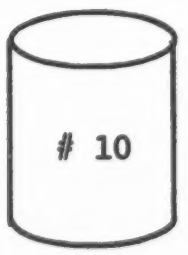
   a. Use the model cans to learn sizes.

   b. Cans of various sizes may be found in the cafeteria store room. Select a variety, check weights and contents and compare with the weights and contents on the standards.

$2\frac{1}{2}$ cups
20 ounces
24 to the case

7 cups
3 lbs. 8 oz.
12 to case

$3\frac{1}{2}$ cups
28 ounces
24 to the case



13 cups
6 lbs. 10 oz.
6 to case

ASSIGNMENT:

1. Cut a one pound print of butter or margarine or lard in half:

   a. Each piece will be what part of a pound?
   b. Each piece will be how many ounces?
   c. Each piece will be how many cups?
   d. Each piece will be how many tablespoons?

2. a. One pound of fat = _____ cups.
   One half-pound of fat = _____ cups.

3. a. One cup of fat = _____ tablespoons.
   b. One pound of fat = _____ tablespoons.

4. One tablespoon of butter = _____ teaspoons.

5. How many standard measuring cups will one gallon of soup yield?

6. a. Which weighs more, one pound of sugar or one pound of flour?
   b. How many cups in one pound of sugar? one pound of flour?

7. The temperature of the ice cream cabinet registered minus 10 degrees F. Is this above or below freezing? On what do you base your answer?

8. A turkey weighing $18\frac{3}{4}$ lbs. was to be cooked 12 minutes per pound. In how many hours and minutes should the turkey be cooked?
   If the turkey were put into a preheated over at 9 A.M., at what time should it be taken out if cooked according to the above directions?

9. A No. 10 can yields ____ cups, a No. $2\frac{1}{2}$ can ____ cups, and a number 5 can ____ cups.
   If one can of each size was used to make a fruit punch, how many quarts of punch would you have?

10. a. $\frac{3}{4}$ cup flour = ____ T. flour.
    b. $1\frac{1}{2}$ quarts of vinegar = ____ cups of vinegar
    c. 2 cups flour = ____ oz. flour
    d. ___ degrees F. = boiling point of water.
    e. 3 cups of flour = ____ T. = ____ oz. = ____ lb.= ____

UNIT V - MEASUREMENTS

Achievement Test No. 5

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1. Define the term "unit of measure".

2. What type equipment does one need in order to use the "units of measure"?

3. How does a "gram" compare with an "ounce"? Select one food from the table of food composition to illustrate. Weigh one gram of flour and 1 ounce of flour. Measure, using a tablespoon. Compare.

4. a. Name the various thermometers used in the food trade.
   b. The unit of measure on a thermometer is called a _____.
   c. A _____ regulates temperatures, a _____ registers temperatures.
   d. Why are thermometers necessary for the foods trade?

5. a. What is a calorie?
   b. What is this the unit of measure for?
   c. Why do people "count calories"?

6. Two No. 10 cans of peas weighed the same. When the cans were opened, one had 8 oz. more peas than the other. What term is used to describe the weight after the liquid is removed?

7. Potatoes 30 lbs. A.P. (as purchased) were peeled and eyed. There was a loss of 3 lbs. 6 oz. What was the edible portion (E.P.)?

8. 25 lbs. of fat was put into the frying kettle. At the end of the day 19 lbs. remained. How many pounds of fat was used? If it costs 15 cents per pound to get potatoes ready for frying and the fat cost 19 cents per pound, what would be the cost of frying the 20 pounds of potatoes that were used on that day?

9. How many 3-ounce portions would the above potatoes yield?

10. Compare the cost of the following (cost per egg):
    a. 1 dozen small eggs at 45 cents per dozen
    b. 1 dozen medium eggs at 55 cents per dozen
    c. 1 dozen large eggs at 65 cents per dozen

UNIT VI - ACCOUNTS

Wages | Lesson No. 1

OBJECTIVE: To learn how to apply the principles of mathematics in computing a worker's wages based on different time units.

RELATED INFORMATION:

Constant repetition has been made to making money throughout your work in related mathematics. In this lesson you will think of the money that you will make.

The amount of money that you will make will depend upon many things, such as, ambition, attendance, application, and experience.

We will consider wages only in this lesson. Tips were discussed in an earlier lesson.

Wages in a food establishment are based on the kind of job that you have, the experience and the responsibility connected with the job. A beginner cannot expect the same rate of pay as a worker who has been on the payroll for years.

It costs your employer money to train you, so for a time you are a "liability" to the establishment not an "asset".

Wages may be paid on different units of time: hour, day, week, month, year. Find out during your interview just what unit of time will be used to figure your pay.

ASSIGNMENT:

1. Find out what the rate per hour is in your locality for restaurant workers. At eight hours per day, 5 day week, what would your wages be at this hourly rate?

2. The store room clerk was paid $60.00 per week. He worked 6 days, 8 hours per day. What was his rate of pay per hour?

3. The kitchen manager received a salary of $250.00 per month. She worked 6 days per week, 8 hours per day.
   a. What is her rate of pay per day (30 days to the month)?
   b. Pay per week (4 weeks to the month)?
   c. Pay per hour?

4. The chef was paid $150.00 per week. He worked 50 weeks. What did he receive for that period of time?

5. A hostess was hired at $150.00 per month. At the end of three months, she was promised a 5% increase.
   a. What would her wages be?
   b. In six months there was to be a 10% increase of the existing salary and the following year she was to receive a 20% increase. What would her salary be per month at this time?

6. There are certain deductions authorized to be taken from your wages:
   a. Social Security and Withholding Tax are deductions authorized by the Federal Government.
   b. Other deductions such as - hospitalization, savings plans, government bonds, are more or less voluntary.
   c. Sample form for your study of the Government deductions will be provided.
   d. Investigate the laws pertaining to unemployment insurance.
   e. The money received after the various deductions is known as "net pay" but it is often termed "take home pay".

7. The dish machine operator is paid $1.10 per hour. What would his wages be for the week if his time card read as follows?
   NOTE: This station often requires a person to work a "split shift".

Monday	7:30 A.M.	to	10:45 A.M.
	11:30 A.M.	to	3:15 P.M.
	5:00 P.M.	to	8:00 P.M.
Tuesday	8:45 A.M.	to	10:45 A.M.
	12:15 P.M.	to	3:15 P.M.
	5:30 P.M.	to	7:30 P.M.
Wednesday	7:45 A.M.	to	10:45 A.M.
	11:45 A.M.	to	2:15 P.M.
	5:30 P.M.	to	7:30 P.M.
Thursday	8:00 A.M.	to	10:40 A.M.
	12:00 M.	to	3:00 P.M.
	5:00 P.M.	to	8:00 P.M.
Friday	8:30 A.M.	to	10:15 A.M.
	11:45 A.M.	to	2:15 P.M.
	5:30 P.M.	to	7:45 P.M.
Saturday	9:00 A.M.	to	12:30 P.M.
	1:30 P.M.	to	4:30 P.M.

8. Compute the following: 35 hours @ $1.00 per hour.

Deductions

Withholding tax	$4.35
Social Security	.35
Hospitalization	.90

What is the net pay?

9. In No. 8 what % of the whole pay was deducted?

10. Salary $575.00
Deductions 20%
Net Pay _____?

UNIT VI - ACCOUNTS

Financial Records Lesson No. 2

OBJECTIVE: To understand various financial accounts necessary for the operation of food trade establishments.

RELATED INFORMATION:

Studies made by the Department of Commerce as well as by private groups show that many small food trade establishments fail because of either inadequate records or none at all.

Records can be very simple. They need not be longer or more involved than the following questions.

1. How much business am I doing?
2. How much net profit did I earn?
3. What were my food costs?
4. What were my other expenses?
5. What is my investment in my establishment?
6. What are the trends in my sales, expenses and profits- or how am I progressing from year to year?
7. How much stock do I have?
8. How much money do I owe - wholesale dealers and others?
9. How much cash do I have on hand and in the bank?
10. How does my establishment compare with others of the same type?

If a business man can answer these questions, he knows if everything is right or wrong. He knows if there are any unfavorable conditions and is in a position to take care of them.

ASSIGNMENT:

1. What evidence is available to show that poor records are the rule rather than the exception?

2. What are the results of poor records?

3. Express the following statement in another way, "What are the trends in my sales, expenses and profit?"

4. What do you understand by "net profit"?

5. What value is it to an operator to compare his establishment with others of the same type?

UNIT VI - ACCOUNTS

Receipts From Sales — Lesson No. 3

OBJECTIVE: To learn how to keep records of moneys received from various sources in the food establishment.

RELATED INFORMATION:

Would you take a job without knowing how much money the job would pay?

What would you think of a food shop owner who had no idea of how much money he received every day?

PROCEDURE: The cash register is one way that a business man can get a fairly accurate account of the money he has taken in each day.

1. The receipts minus the amount of cash or change in the cash drawer at the start of the day's business should equal the amount of money taken in and balance with the cash register tape.

2. There should be a method of determining total receipts from various sources, viz. from goods sold over the counter such as baked goods, candy, tobacco, etc.

3. It is important that this information be broken down into different classifications since some of the items may be in on a consignment or commission basis.

4. The record of daily sales should be entered into a simple cash book. The operator will then be able to make comparisons with receipts of other years, same month and day.

ASSIGNMENT:

1. What does the term consignment mean? What are some materials that might be sold in a restaurant on this basis? Why would an operator need to know whether this business was yielding a profit?

2. Below is a sample of receipts for one week's business and one method of grouping them.

Meals	Beverages	Candy	Tobacco	Miscellaneous
$425.46	$ 14.37	$ 4.80	$ 5.80	$ 4.20
369.54	9.23	5.07	7.64	4.07
521.06	15.46	3.25	14.21	5.10
471.28	5.04	2.09	6.75	4.01
415.48	10.25	4.25	10.65	4.15
469.53	11.35	5.26	11.25	5.68

Copy the above figures and total each column.

3. If the owner receives 15% commission on the sale of tobacco and candy, what is the actual total that he can add to his own receipts?

4. Refer to the cafeteria records for the current year and the previous year. Check the total receipts for the year. Compare the total monthly receipts of each year. Also check the number of sales made on the days or the periods that you compare? How may any differences be explained?

5. A business man finds that his cash receipts were as follows: $74.96, $207.32, $112.52, $102.43, $97.32, $106.53

   a. What are the total receipts for the week?
   b. If he allows a 45% of each day's receipts for food cost, how much money may he allot for food each day?
   c. What would be the total food allowance?

UNIT VI - ACCOUNTS

Orders and Requisitions — Lesson No. 4

OBJECTIVE: To learn how to work out orders and requisitions.

RELATED INFORMATION:

Care in food purchasing can mean success or failure in this business.

Price is not the only consideration when purchasing food materials, quality should be the first consideration.

Also, the buyer must consider his needs. Stock piled up in the store room represents money. This is really a liability not an asset.

PROCEDURE: Purchasing food materials.

1. Select several dealers.
2. Have a list of materials ready that you will want to purchase.
3. Watch so-called "inducement prices".
4. Be well informed on the specifications you will want your purchases to meet.

ASSIGNMENT:

A.

1. Perishables (fruits, vegetables, meats are purchased semi-weekly). The following sources should be consulted before purchasing:

   a. Market reports.
   b. Visit wholesale markets to see what is available.
   c. Build menus around foods that are "in season" or are good buys.

2. Make a list of foods that are ordered every week.

3. Compare present cost with the cost of different seasons, e.g., Florida oranges (February - May). How do the prices compare? You may consult the prices in the day book.

4. Lettuce is $2.50 per dozen heads.
   Cabbage is $2.25 per bag.

   a. Find out how many lbs. are in a bag of cabbage.
   b. A head of lettuce weighs approximately one pound.
   c. How would the cost of the two vegetables compare in price per lb.?
   d. How could a restaurant operator use these two items to advantage?
   e. Consult the market price of the following greens: chicory, escarole.
   f. How do the prices compare with the price of lettuce?
   g. How may the restaurant operator take advantage of this?

Staples are materials that can be stored for some time without spoilage. Ordering staples varies with the size of the establishment. In some operations the order for staples is made on an annual basis. This method is rather difficult and it means the outlay of a great deal of money, so most restaurants order staples on the average of once a month.

ASSIGNMENT:
B.

1. An operator has prepared the following order. Check these price quotations on case lots from two wholesale houses. Lists are available in the cafeteria.

ARTICLE	QUALITY	UNIT COST	TOTAL
2 cs. 6/10 cut green beans	choice		
3 cs. 6/10 peas #4 sift	choice		
5 cs. 6/10 tomatoes	standard		
1 cs. 6/10 apricots, peeled halves medium syrup	choice		
1 cs. 6/10 pear halves Bartlett 35/40 medium syrup	choice		
1-100 lb. bag all purpose flour	Gold Medal or equal		
1-100 lb. bag granulated sugar			

<u>Furnishings and Equipment</u> The cost of equipment and furnishings is listed as a capital expense (original cost). As new equipment is developed and as furnishings and equipment become obsolete and wear out, new will have to be purchased.

ASSIGNMENT:
C.

1. A restaurant owner decided to redecorate the dining room.
   Painting cost $350.00
   Draperies - 40 yards of material @ $1.25 per yard
   Cost of making draperies $25.00
   New hardware for hanging curtains $5.75

   a. What would be the total cost of the draperies?
   b. If the owner decided that he would also purchase new floor covering for $285.00, what would be the cost for all the new decorations?
   c. He planned to charge 1/3 of the cost of this work to the current year's expenses. What would this amount to?

2. New Equipment. Deep fat fried foods are becoming very popular. An operator decided he would investigate the cost of a new frying machine. He found the price of the machine to be $575.00. If the fry kettle could be used for ten years, how much would he charge to his expense account for each year?

3. Paper Goods. Frequently the vast amount of paper goods that is used is often forgotten. Figuring the cost of this item will enlighten you as to the money that is involved in this item.

   Annual cost of paper goods amounted to $413.74. If a restaurant operates 302 days per year, what would be the daily cost of paper goods?

4. Laundry is another expense that can cause a leak in profits.

   The average charge for laundry was $58.55 per week. What was the cost for fifty weeks?

5. Heat, light, water, telephone, rent, licenses, taxes, cleaning supplies, stationery are among items listed as operating expenses.

   Look through the annual requisition for cleaning and paper supplies. List the expenditures that were made for these items.

UNIT VI - ACCOUNTS

Inventories Lesson No. 5

OBJECTIVE: To become familiar with computing inventories.

RELATED INFORMATION:

An inventory is a list of items on hand. The inventory count should be taken periodically.

ASSIGNMENT:

1. Prepare an inventory sheet with the following headings:
   Item Unit Cost Value
   List all of the canned goods on hand in alphabetical order.
   Put in the unit price. Take this from the requisition sheet.

2. Figure the value of the following items. Make an inventory sheet for this.

2 cs. 6/10 cherries Royal Anne	@ $10.50 per case
4 cs. 6/10 peas	@ $ 6.30 per case
1 cs. 6/10 sauerkraut	@ $ 3.75 per case
1 cs. 12/66 oz. tuna flakes	@ $11.50 per case
1 cs. 12/26 oz. jello	@ $ 3.85 per case
2 M. paper doilies	@ $ 2.25 per M
1/2 cs.-10 M. napkins	@ $ 7.40 per case
2 1/2 cs. 12/5 grapefruit juice	@ $ 3.65 per case

3. Find out the total value of the above inventory.

4. If you were a manager, what items would you order on the basis of the quantities listed on the inventory?

5. Make out an inventory sheet like the sample and list all of the supplies in the store room. Make classes of goods, such as, canned vegetables, canned fruits, paper goods, etc., in alphabetical order.

6. Fill out the unit cost.

7. Figure the value of the inventory.

8. Consult the inventory of the previous month to find the unit cost.

9. Subtract the total found in No. 7 from the total of the previous month.

10. Add the figure representing the expenditures on the inventory to the other food costs to arrive at the total food costs for the month. What is the total?

OBJECTIVE: To learn how to use different types of business records.

RELATED INFORMATION:
A foods trades business should make records of various types of business deals. To do this special forms may be used.

PROCEDURE: Prepare a form like the sample which is called an "Analysis of Cash Payments".

ANALYSIS OF CASH PAYMENTS

	(Month)		(Year)								
Date	Cash Paid	Food Purchases	Salaries & Wages	Laundry	Supplies	Repairs	Heat Light	Water	Rent	Tel.	Other
1		160.06				45.00			115.00		
2		-		8.75						35.00	
3		125.25	205.46								
4		-			5.88						
5		114.63					75.00				
6											
7		74.88									
8			101.23		5.40	2.69					15.00
9		43.27									
10											
11											
12											
Total											

ASSIGNMENT:
1. Compute the totals of each column. The total of the cross column when added together should equal the total of cash paid.

2. A cash disbursement book provides a record of cash expenditures. Below is a sample of one method of preparing a disbursement book. Total the disbursements.

CASH DISBURSEMENTS RECORD BOOK

(Year)		Firm		
(Month		Sexton	120.46	Check No. 47
		Mary Jones	25.57	Cash
		Consolidated Laundry	18.50	Cash
		Freight Forwarding	17.82	Check No. 48

3. Prepare a cash disbursement sheet for the following. Total the expenditures.

Cunningham Brothers	$22.50	check No. 214
Louis Ender	54.00	check No. 187
Gildersleeve	141.51	check No. 213
Bull Markets	49.76	cash
Dairylea	182.00	check No. 212
Ambrose	61.10	check No. 211
Sunshine Biscuit Co.	23.17	cash

4. What benefit would these records be to a business concern?

5. What problem would you feel that a small business operator would encounter in working out these forms?

UNIT VI - ACCOUNTS

Business Forms - Profit and Loss Statement — Lesson No. 7

OBJECTIVE: To learn the importance of a profit and loss statement and how to prepare a balance sheet.

RELATED INFORMATION:

In any business two financial statements are necessary:

1. a profit and loss statement and
2. a balance sheet.

A. The profit and loss statement summarizes business as follows:

Sales of food, less cost of food sold = gross margin.
Gross margin, less total operating expenses = net profit.

A typical profit and loss statement for one month may read as follows:

Sales			% of Sales
Sales		$2,000.00	100
Food cost			
Inventory beginning	$ 200.00		
Food Purchases for the month	850.00		
Total	$1050.00		
Less final inventory	150.00		
		900.00	45
Gross Margin		$1,100.00	55
Operating Expenses			
Salaries and Wages	600.00		30
Rent	140.00		7
Laundry	20.00		1
Paper and cleaning supplies	20.00		1
Utilities	60.00		3
Replacements, repairs, and maintenance	40.00		2
Depreciation	40.00		2
Advertising	10.00		0.5
Taxes and Insurance	40.00		2
Miscellaneous	30.00		1.5
Total		$1,000.00	50
Net Profit		100.00	5

B. An annual report would be a sum total of the twelve monthly reports.

The balance sheet is a statement of the assets - or those things owned by the business. The liabilities are those amounts owed by the business. Assets minus liabilities - Net Worth.

An annual report may be something like the following:

Current Assets		
Cash	$900.00	
Food inventory	150.00	
Deposits with Public Utility Co.	25.00	
Total Current Assets		$1075.00
Fixed Assets comprise articles and equipment that are more or less stationery and can be used for some time. The value of fixed assets may be as follows:		
Large equipment (kitchen)	$2500.00	
Dining room fixtures and furnishing	1500.00	
Small kitchen equipment	200.00	
China, glass, silver, linens	500.00	
Miscellaneous furniture and equipment	200.00	
Total Fixed Assets		4900.00
Total Assets		5975.00
Current Liabilities		
Accounts payable	$ 600.00	
Installment accounts or notes	1100.00	
Total Liabilities		1700.00
Net Worth		
Owner's capital June 1	4175.00	
Net profit for June	100.00	4275.00
		$5975.00

ASSIGNMENT:

1. What is the difference between gross margin and net profit?

2. Prepare a balance sheet for the following:

Foods Sales	$3418.24
Cost of Food	1210.15
Gross Margin	_____
Operating Expenses	
Salaries and wages	$ 521.42
Employees meals	74.16
Laundry	58.60
Sundry supplies and expenses	46.08
Repairs	17.25
Heat, light, power, water, telephone	52.18
Insurance	17.00
Rent	150.00
Depreciation - furniture and fixtures	22.00
Legal service	18.00
Interest expense	9.00
Payroll taxes	28.00
Miscellaneous expenses	15.42

3. What was the net profit on the above statement?

4. It is good practice to break down the different food products purchased. Make ten columns and use the following as the headings:
   Meats, Poultry, Fish, Fruit, Vegetables, Butter, Milk and Cream, Ice Cream, Groceries, Other Food Purchases.
   Consult the day book from the cafeteria and enter into each column the amount spent daily for each food group listed.

5. a. Total the amounts in each of the columns. This represents the money spent for each group for the month.
   b. List the foods according to cost 1. the most expensive, 10. the least expensive.
   c. Which foods should be sold at the highest prices?
   d. Consult a commercial restaurant menu to verify your conclusions regarding selling prices.

6. a. The United States Treasury Department, Internal Revenue Service - from Bulletin F. shows the following table of depreciation values on equipment and furnishings for restaurants. This is a partial list that owners use in figuring depreciation for income tax calculations.

	AVERAGE USEFUL LIFE (YEARS)
Chairs	10
Kitchen equipment	10
Silverware	5
Tables	15
Trays	10

b. Consult the equipment inventory for the cafeteria. List the cost of each of the above items. (The total value of each item listed)

(1) How would you arrive at the amount of deduction you would be entitled to?

(2) Figure the allowance for depreciation on the following pieces of kitchen equipment: range, refrigerator, bake oven.

7. The gross profit for a business was as follows:
January, $602.54, February, $1143.56, March, $1076.84
April, $2103.24, May, $2174.88, June, $1891.44,
July, $2278.42, August, $976.44, September, $2264.80,
October, $1902.15, November, $1536.48, December, $2521.46.
What was the gross profit for the year?

8. Expenditures were as follows:
January, $496.32, February, $920.16, March, $843.01,
April, $1094.15, May, $1438.54, June, $1007.68,
July, $1461.25, August, $903.56, September, $1115.49,
October, $1013.88, November, $1245.63, December, $1098.21.
What were the total expenditures for the twelve months?

9. What was the net profit?

UNIT VI - ACCOUNTS

Reconciliation of Bank Balance — Lesson No. 8

OBJECTIVE: To learn how to prepare a reconciliation of a bank balance.

RELATED INFORMATION:

Cash is the one asset in any business that can be converted quickly into other items. It is also the one that can disappear quickly and some times it is difficult to know where it has gone and what it was used for.

Cash available for use may be classified as:

a. "cash on hand"
b. "cash in the bank"

Cash on hand would be the money you actually had available either in the cash register or safe. Since it is not a safe business practice to keep too much cash on hand, the cash that is not needed is put in the bank. That sum would represent the cash in the bank.

When money or checks are put in the bank, the person depositing the money, makes out a deposit slip. The bank clerk will check the slip and then enter the deposit into the depositor's bank book.

Usually at the end of each month, the bank sends out a statement to each depositor.

The amount shown on the bank statement of a checking account may not be the same as the amount of money that is available for use for these reasons.

1. If deposits are made daily, the statement of any particular date rarely includes the deposit of that date, because the deposit would not be posted by the bank until the following day.

2. Checks drawn against the account a few days before the statement was made may not agree with the balance, because all of the checks may not have cleared and been charged to the account.

In Lesson 6 you learned how to make up a "Cash Disbursements Record Book" and you also learned how to prepare an "Analysis of Cash Payments".

PROCEDURE:

1. Review the two forms used in Lesson 6.

2. Make up a simple form like the sample.

RECONCILIATION OF BANK STATEMENT

Date - June			Expenditures	Deposits
Balance				$ 568.45
Additional deposits				119.50
				402.15
				110.00
		Total		$1200.10
Outstanding Checks				
Check No.	Date			
163	6/27		$ 96.45	
164	6/28		102.15	
158	6/20		54.82	
		Total	$253.42	
		Balance Available		$ 946.68

The bank charged $2.15 for handling the account, so be sure to subtract that amount from your balance.

3. All cancelled checks accompany the bank statement. Check these first against the check book as well as the statement- to safeguard that the amounts were not changed. A colored pencil could be used to show the cancelled checks that have been returned. It would follow that items not checked off would be outstanding.

ASSIGNMENT:

1. Cash available may be classified as _____ and _____.

2. Discuss this statement, It is not a safe business practice to keep too much cash on hand.

3. What are the advantages of paying bills by check?

4. Explain why the bank statement may not agree
   a. with the deposits
   b. with outstanding checks.

5. A bank statement shows the following:

Balance April 30 - $3426.09.

Deposits - $142.08, $107.43, $211.58, $40.96, $124.88, $136.21, $145.00
(deposits made for the month of May)

Cancelled checks - $181.21, $40.23, $156.09, $212.15, $87.28, $415.98
(expenditures during the month of May)

Outstanding checks - $408.15, $11.57, $21.76, $87.59

Deposits made after the statement has been made up - $114.28, $109.21, $324.68

Bank charge $2.76

Prepare the reconciliation for this bank statement. The statement was received from the bank on May 30.

6. How much cash would this business have in the bank account?

7. When would the outstanding checks appear on a bank statement?

UNIT VI - ACCOUNTS

Achievement Test No. 6

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1. Make out the following payroll:
   2 workers 40 hours each @ $1.10 per hour
   3 workers 35 hours each @ $1.65 per hour
   2 workers 40 hours each .75 per hour

2. A worker received $75.28 and 40% commission on his salary.
   a. What was the commission?
   b. What will be the total amount that the worker will receive?

3. What is the difference between gross profit and net profit?

4. The receipts for one day in a restaurant were $702.64.
   a. Figure the gross profit.
   Use the following percentages as a basis for computing the problem
   (1) 45% food cost _____ = $ food cost
   (2) 10% labor _____ = $ for labor
   (3) ? % for other expenses and profit ? $ _____

5. $205.76, $119.48, $316.07, $291.21, $368.14, $407.89, $118.54, are the total receipts for each day. What were the total receipts for the week?

6. a. $102.46, $80.02, $157.43, $109.18, $175.07, $318.02, were the daily expenditures for the above restaurant. What were the total expenditures?
   b. Was there a profit or loss? How much?

7. The following bills were received by a restaurant operator who was preparing to open a new restaurant:

canned goods and staples	$1743.08
kitchen equipment, machines, etc.	5419.95
kitchen equipment, tools and utensils	461.89
dining room equipment	
tables	420.00
chairs	420.00
draperies	186.00
dishes	502.57
glassware	180.75
silver	326.00

What were the total expenditures?

8. a. Tables cost $14.00 each. How many tables were purchased?

   b. If four chairs were used for each table, how many chairs were purchased?

   c. What was the cost of each chair?

9. The inventory on March 1 was valued at $308.15. Staples which amounted to $57.92 were purchased. At the end of the month the inventory amounted to $184.68. How many dollars were spent from this account for the month?

10. True or False?

    a. A profit and loss statement should be prepared by any business at definite intervals.

    b. Business often fails because of poor records.

    c. A restaurant owner or buyer for the business should receive salesmen at any time.

    d. The check stub and the cancelled check are evidence that bills have been paid.

    e. New workers are assets to a business.

    f. Disbursement means money received.

    g. The cash register tape can be used as a check of the restaurant receipts.

    h. The value of the inventory represents money saved.

    i. A good business operator tries to control all types of waste.

    j. Employees who waste time deserve good pay.

COMMERCIAL FOODS

Related Mathematics I — General Review

1. Which fraction is the largest - $\frac{1}{4}$ $\frac{1}{3}$ $\frac{1}{8}$

2. a. If a nine inch layer cake was cut into eight pieces, each piece would be one _____ of the cake.
   b. How much money would be received if the entire cake was sold at 25 cents per cut?

3. The cost of producing the cake was 40 cents. Was the cake sold at a profit or loss? How much?

4. A caterer submitted the following figure or estimate for a wedding reception: $35.00 for a wedding cake, $1.25 per guest for fancy sandwiches, petits fours and coffee, plus 15% gratuity. What would be the cost of the reception for 200 guests?

5. Find the cost of preparing 60 fruit cups @ .056 each.

6. The weight of a leg of lamb before cooking was 7 lbs. 2 oz. After cooking, it weighed 5 lbs. 6 oz. What was the loss of weight during cooking?

7. Change the following measurements to their equivalent weights: a. 4 tablespoons butter, b. 6 tablespoons flour, c. 1 1/2 cups sugar, d. 8 cups fat, e. 1 quart milk.

8. What % of a worker's pay is deducted for: a. social security, b. withholding tax and c. unemployment insurance benefits? Consult government publication for rates.

9. A man works 40 hours at $2.75 per hour. a. How much does he earn? b. Figure out <u>each</u> deduction, using the rates from Problem 8. c. What is his "take home" pay?

10. A restaurant bought a new appliance that cost $475.00. $105.00 credit was applied for turning in a piece of used equipment.
    a. What was the cash cost for the new appliance?
    b. By paying cash, 5% of the purchase price was deducted. How much would this deduction amount to?

11. According to the inventory on Jan. 1, there were 35 #10 cans of peas on hand. On Jan. 31, there were 15 on hand. a. How many #10 cans were used? b. At $0.56 1/4 per can, what was the value of the peas that were used? d. What is the value of the stock on hand Jan. 31?

12. The cost of a standard recipe yielding 50 portions is $2.975. What is the cost per portion?

13. The daily receipts in a restaurant were as follows: $138.46, $209.21, $186.23, $146.19, $168.70, $203.27. What was the total?

14. 23% of the total receipts in Problem 12 was used for food, 2% for rent. a. What amount was used for each? b. How much money was left?

15. The restaurant in Problem 13, served 743 customers. What was the average amount of each check?

16. If 30 servings can be obtained from one No. 10 can of peas, how many cans will be required for 180 servings?

17. 100 tea bags cost 65 cents. What is the cost of one tea bag.

18. 5% of a box of 125 tomatoes was spoiled. How many tomatoes were unfit for use?

19. A seashore restaurant took in $6245.35 in July. The following November, the receipts were 60% of those received in July. How much money was taken in during November?

20. How many gallons of brick ice cream cut 8 to the quart should be purchased to serve 256 portions?

21. A restaurant famous for popovers figured that the average served per guest is 3. How many dozen popovers should be made for 80 guests?

22. How many ounces in 10 lb. 8 oz. veal. How many 3 ounce portions will this quantity serve?

23. How many half-pint cartons of milk will 5 gallons of milk yield?

24. What fraction of a case of canned goods is each of the following?
    a. 3-#10 cans, b. 4-#5 cans, c. 24-#1 cans,
    d. 2-#10 cans, e. 8-#5 cans

25. Sardines are usually packed $100/\frac{1}{4}$ cans to a case. In one month, 30 cans were used.
    a. Write this number as a fraction.
    b. Write the number representing the number of cans left as a fraction.

26. a. 3 cups flour equals what fractional part of one pound?
    b. 2 cups milk equals what fractional part of one quart?
    c. 4 eggs equals what fractional part of one dozen?
    d. 10 tablespoons equals what fractional part of one cup?
    e. 1 quart equals what fractional part of one gallon?

27. A cook worked 6 hours, 45 minutes on Monday; 7 hours, 30 minutes on Tuesday, 8 hours on Wednesday; 5 hours on Thursday; and 6 hours, 40 minutes on Friday. What was the total time worked?

28. At $3.20 per hour, how much did the cook earn?

29. A waitress received $40.00 as wages. Tips amounted to three-tenths of her wages. a. How much did she make in tips? b. What were her total earnings?

30. Add the following: $32.53, $410.68, $1.87, $0.43, $16.19, $217.03, $411.00, $17.65, $225.02.

31. Divide 7645 by 63.

32. A honeydew melon cost 59 cents. It was cut into 12 pieces which were sold at 15 cents each.
    a. How much was received from the sale of the melon?
    b. Was there a profit or a loss? How much?

33. A restaurant owner received a bill for $563.12 for canned goods. He paid the bill in 10 days in order to take advantage of a 15% discount.
    a. What was the discount?
    b. How much did he have to pay for the canned goods after deducting the discount?

34. If coffee costs 88 cents per pound and yields 40 cups, what is the cost of one cup?

35. Find the total number of calories that the following luncheon will yield: 2 slices of white bread @ 65 calories each; 2 ounces luncheon meat @ 165 calories; 1 cup malted milk @ 280 calories.

36. If a person were on a 2000 calorie daily allowance, how many calories would remain for the other two meals?

37. The following bills were received for one week; meats $356.89, fruits and vegetables $112.38, dairy products $206.54, gorceries and staples $187.41, bakery products $87.28, fish and seafood $193.48. What is the total of the bills?

38. The owner of the above establishment found that $912.15 remained after paying the bills. What was the total of the receipts for this period?

39. The meat salesman quoted $1.10 per pound for club steaks. Later, he offered the restaurant a special price of 99 cents per pound if the owner would purchase 6 boxes of 40 pounds each.
    a. What would have been the cost of this quantity of meat at the first quotation?
    b. What was the cost at the second figure quoted?
    c. How much would be saved by buying the large quantity?

40. At 17 1/2 cents per pound, what is the cost of 1,200 loaves of bread? Each loaf weighs 2 pounds 4 ounces.

41. What is the cost per loaf of the bread in the preceding problem? Carry out the figure to five decimal places.

42. The pastry cook prepared the following products, which were sold as follows:

    50 servings Jello @ 10 cents each
    10 pumpkin pies - 6 cuts per pie at 25 cents per cut
    5 layer cakes - 10 cuts per cake at 25 cents per cut
    20 baked apples at 15 cents each
    75 servings pudding at 20 cents per serving
    5 dozen cream puffs at 35 cents for each cream puff

    What were the total receipts from this production station?

43. The dessert cook worked 8 hours at $1.50 per hour and the materials used for the various desserts cost $29.32.
    a. What was the total cost of the labor?
    b. What was the difference between the receipts and the cost of production?

44. Write in words the following decimals:

    a. .25 d. .6
    b. .01 e. 1.35
    c. .131

45. a. Subtract 1423.018 from 7186.241
    b. Divide 40738 by 212

46. Multiply 21468 by 107

47. 12 gallons of soup were served for dinner in an industrial cafeteria. How many bowls or 1 cup servings were served?

48. A restaurant used 3 cases of eggs in 4 days. How many dozen eggs were used?

49. How many pounds of tomatoes averaging 5 to a pound should be ordered for 250 servings? 1/2 tomato will be used for each serving.

50. A business paid 6% of its income for taxes and 5% interest on a mortgage. The income was $10,246.83. What was the amount for each expense?

STATE OF NEW JERSEY
DEPARTMENT OF EDUCATION
VOCATIONAL DIVISION

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OUR FIRST FOODS BOOK

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VOCATIONAL DIVISION - CURRICULUM LABORATORY
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Vocational Division

OUR FIRST FOODS BOOK

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JULY 1960

TO THE TEACHER

This book has been written for use in individual and group projects. It is intended that the lessons will be further clarified by demonstrations and visual aids.

The purpose of this manual is twofold: to acquaint the students with the equipment and utensils found in a kitchen; and to teach the pupils how to prepare simple meals, which will lay a foundation of knowledge for these homemakers of tomorrow.

In view of the particular needs of the students for whom this has been written, special attention has been given to the pronunciation and explanation of words used throughout the units. Since it is very important to establish a vocabulary of terms that are essential in a cooking class, new words are written in syllables and explained in each lesson, and repeated in alphabetical order in the glossary for reference use.

The material has been compiled in organizational sequence, but the lessons do not necessarily have to be taught in succession. The units are intended for a one-year course in cooking, the class being held for one hour a day, five days a week.

Included in this manual is a check list for recording class activities that have been accomplished, and a page on which the students may enter any cooking projects they have performed at home. This has been done as an incentive to each pupil, and also to give the student a feeling of achievement for the projects completed. A copy of the check list should be of great assistance to the teacher, when the students return for more advanced work in cooking.

I would like to express my sincere thanks to Miss Dorothy Brevoort, Supervisor of Vocational Homemaking in the State of New Jersey, for her cooperation and assistance; and to Mrs. Berminna Solem, former teacher at the New Jersey School for the Deaf, who is responsibile for all the excellent sketches.

Mary Margaret Pieslak
July, 1960

FOREWORD

Even though our way of life has changed considerably down through the ages, the need to prepare a woman for her most important role in life as wife, mother, and homemaker, is still the responsibility of our homes, churches, and schools.

To the homemaker, the good health of her family and herself is a constant concern. Therefore the planning, preparation, and serving of wholesome, tasty, and attractive meals becomes necessary.

This book and those to follow it will find a long-felt need for a clear and concise text on Foods. Although it has been prepared for a special purpose, its simplicity and thoroughness should make it a real aid to all girls beginning the important and fascinating subject of Foods.

I am certain that the use of and the resultant benefits from this text will indeed indicate to the author that her time and efforts have been sincerely appreciated by the students and staff of the New Jersey School for the Deaf.

C. M. Jochem, Superintendent
New Jersey School for the Deaf

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UNIT I - THINGS TO KNOW BEFORE YOU START COOKING

When You Come to Class Each Day **Lesson 1**

Objective: To learn what you must do when you come into this class.

Information:

Rules are very important. Your mothers have rules that you must obey. There are rules for the games you play. Rules teach us how to do things the right way. It is the same with cooking. The rules you will learn are going to help to make you better cooks.

Now you will learn what to do at the beginning of each class.

1. Put on your uniform. Be sure it is neat and clean.
2. Hang your dress on a hanger so that it will stay clean and tidy.
3. Comb your hair before you come into the classroom. You must never comb your hair near food.
4. Get out your notebook and pencil.
5. Sit down on your chair.
6. Listen carefully to all instructions.

Vocabulary:

objective	-	ŏb jĕk'tĭv -- what we are going to learn
information	-	ĭn fŏr mā'shŭn -- the things you must know in the lesson
uniforms	-	ū'nĭ fôrms -- dresses that look alike and are worn by each girl in class
tidy	-	tī'dĭ -- neat
instruction	-	ĭn strŭk'shŭn -- a telling of what you are to do
vocabulary	-	vō kăb'ū lĕr ĭ -- words and their meanings that you will learn
assignment	-	ă sīn'mĕnt -- work to be studied

Assignment:

1. Why do we have rules to follow?

2. Why do you wear a uniform in cooking class?

3. Why should you never touch your hair when you are cooking?

4. Why must you watch the teacher and pay attention at all times in class?

UNIT I - THINGS TO KNOW BEFORE YOU START COOKING

A Good Cook Is Clean and Neat **Lesson 2**

Objective: To learn to be neat in your appearance and in your work.

Information: You would not want to eat food that is dirty. To make sure our food is clean, we must keep ourselves, and everything we use spic and span.

Now you will learn many ways to be clean and neat in your cooking.

1. Always wash your hands before you start to prepare any food.
2. When you must cough or sneeze, turn your head away from food.
3. Always wash your hands after using a handkerchief.
4. Do not touch your hair while cooking.
5. Keep your books away from all food.
6. Keep your work space wiped clean while you are working.
7. Open and close cabinets with clean, dry hands.
8. Open and close doors and drawers quietly.
9. Get out the utensils and food needed before you start to cook.
10. Put all utensils and food away in their proper place.
11. Be sure each unit is swept and in perfect order at the end of each class.

Vocabulary:

appearance	-	ă pēr′ăns -- the way you look
spic and span	-	spĭk ănd spăn -- neat and clean
prepare	-	prē pâr′ -- to get ready
work space	-	wûrk spās -- the counter on which you will prepared your food
cabinets	-	kăb ĭ nĕts -- closets with shelves in them where you will keep your food and utensils
utensils	-	ū tĕn′sĭls -- tools used in the kitchen
proper	-	prŏp′ər -- right, correct
unit	-	ū′nĭt -- one part of the classroom

Assignment:

1. Why is it important to be very clean in the kitchen?

2. How will you keep your work space clean while you are preparing food?

3. Why do you cover your mouth and turn your head away from food when you cough?

4. Why do you keep your books away from food?

5. What will happen if you do not have your utensils and food ready before you start to cook?

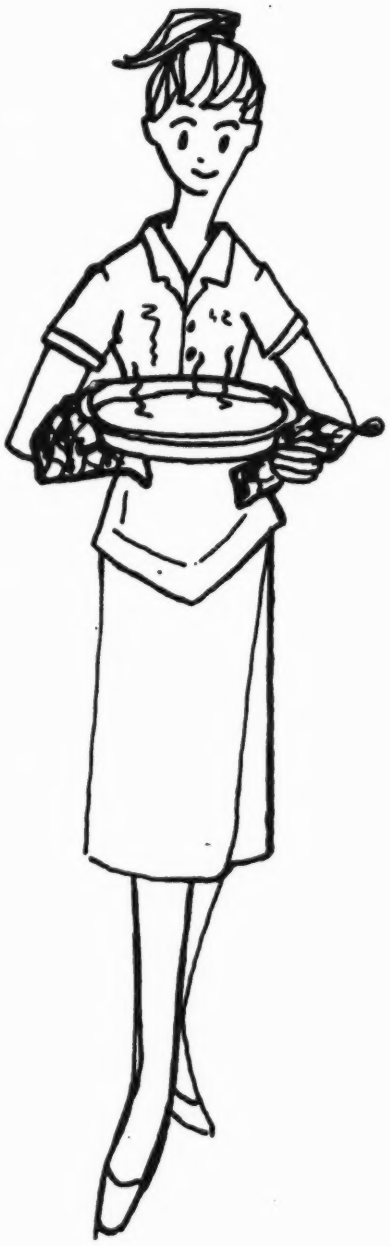
UNIT I - THINGS TO KNOW BEFORE YOU START COOKING

Safety Rules **Lesson 3**

Objective: To learn to work safely.

Information: The kitchen is a safe place if the cook is careful. If you are careless, you may hurt yourself or someone else. Always keep safety in mind. Then our kitchen will be a safe place to work in.

Here are some safety rules you must remember.



1. Be sure no one is in your way when you are carrying any food.
2. Never walk backwards. Always turn and look to be sure your path is clear.
3. Look before you reach for something on a high shelf.
4. Use a dry pot holder to pick up hot dishes.
5. Do not put hot pans on your work space.
6. Be sure your hands are dry before lifting a hot pan from the stove.
7. Keep all pot handles turned toward the inside of the stove, so you won't knock the pots over.
8. Do not leave oven doors open.
9. Lift pot covers away from you.
10. Stir hot foods with a wooden spoon because the handle stays cool.
11. Wipe up things that spill on the floor at once.
12. Always cut away from you.
13. Watch your fingers when cutting.
14. Do not put sharp knives in the dishpan with other dishes or utensils.
15. Keep cabinet doors closed so you don't bump into them.

Vocabulary:

safety	-	sāf'tĭ -- carefulness for yourself and others so that no one will get hurt
backwards	-	băk'wĕrdz -- with your back first
pot holder	-	pŏt hōl'dĕr -- many small pieces of cloth sewed together with which you pick up hot pots
stir	-	stûr -- mix or move with a spoon
handle	-	hăn 'dəl -- the part of the pot that you hold when you pick up the pot
spill	-	spĭl -- to drop food or liquid

Assignment:

1. Why is safety so important in the kitchen?

2. Why must you look before you walk in the kitchen?

3. Why do you keep pot handles away from the edge of the stove?

4. Why must your hands be dry before lifting a hot pan from the stove?

5. Why must your pot holder be dry when you pick up hot dishes?

6. Is it all right to use a dish towel instead of a pot holder? Why?

7. Why should you wipe up any spilled food at once?

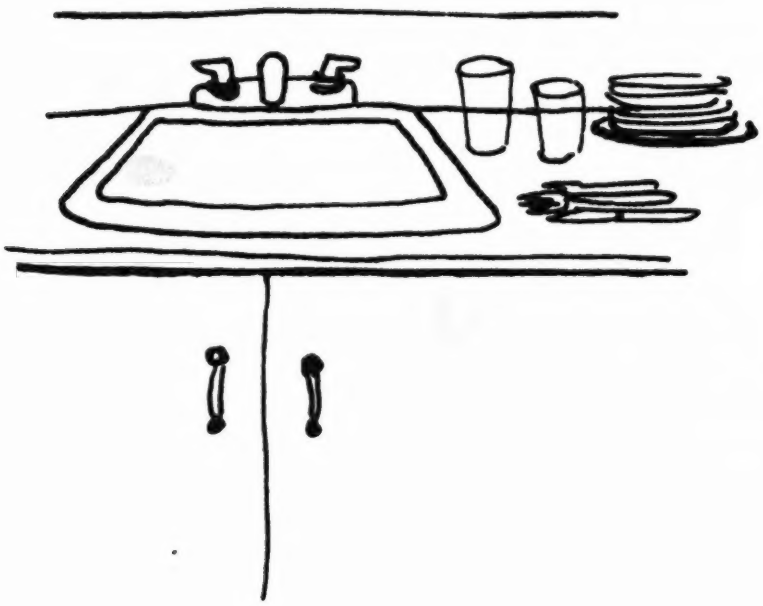
8. When you are cooking at home, why is it important to wear clothes that are not loose and have no big pockets or bows?

Dishwashing Rules **Lesson 4**

Objective: To learn the right way to wash dishes.

Information: You have probably washed dishes many times at home. Dishwashing will be easier, and we can save much time if we know how to wash dishes.

Now you will learn the right way to wash dishes.



1. Scrape food off dishes with a rubber food scraper.

2. Soak soiled dishes at once. Soak dishes that were used for milk, eggs, or flour in cold water. Soak all other dishes in hot water.

3. Rinse each dish under the faucet.

4. Stack the dishes neatly to one side of the dishpan.

5. Wash and rinse only a few dishes at a time so that you will not break any.

6. Wash dishes in this order:

   a. Glassware
   b. Silverware
   c. China
   d. Small cooking utensils
   e. Large cooking utensils

7. Wash, rinse, and dry the dishpan.

Vocabulary:

scrape	-	skrāp -- to clean off
soak	-	sōk -- to keep wet
soiled	-	soil'd -- dirty
rinse	-	rĭns -- to wash in clean water
stack	-	stăk -- to put the dishes one on top of the other in a neat way
glassware	-	glás' wâr -- all the glasses you use when you eat
silverware	-	sĭl'vĕr wâr -- all the knives, forks, and spoons you use when you eat
china	-	chī'nā -- all the dishes you use when you eat
order	-	ôr'dĕr -- the way one thing follows another

Assignment:

1. Why do you scrape the dishes before you wash them?

2. What dishes are soaked in cold water?

3. Why do you wash only a few dishes at a time?

4. Why do you wash glassware first?

5. Give the order in which we wash dishes.

6. Why must you wash, rinse, and dry the dishpan?

Kitchen Aids **Lesson 5**

Objective: To learn the things that will help us to keep our kitchen clean.

Information: We have products and tools that make washing and cleaning in our kitchen much easier for us. Years ago people had to work harder and longer to do their cleaning jobs. We want to know all the products that will help us to keep our kitchen clean in the best and fastest way.

Here are some products you will use.

1. Soap powder or detergent

   Put soap or detergent in the dishpan.
   Turn hot water on the soap powder to make suds.

2. Steel wool

   Wet steel wool and rub it on stained utensils.

3. Cleanser

   A little cleanser cleans a whole sink bright and shiny.

4. Brushes

   Long handled brushes help to clean bottles and graters.

5. Water

   Lots of hot water to rinse clean dishes makes them easier to dry. See them shine!

6. Dish cloths and dish towels

   Always use clean dish cloths and dish towels to be sure your dishes are clean and bright.

7. Baking soda

Baking soda in warm water to wipe out your refrigerator will keep it clean and fresh

8. Silver polish

Silver polish keeps your silverware looking like new.

Vocabulary:

product - prŏd'ŭkt -- something that is made

detergent - dē tûr'jĕnt -- a product that is like soap and is used for washing

stained - stānd -- soiled or dirty

Assignment:

1. How do you get good suds in your dishpan?

2. When do you use baking soda in cleaning?

3. When do you rinse dishes with hot water?

4. Make a list of the kitchen aids you have at home.

UNIT I - THINGS TO KNOW BEFORE YOU START COOKING

Following a Recipe **Lesson 6**

Objective: To learn how to follow a recipe.

Information: Now we are going to prepare food. After we make our food, we are going to eat it. We all like food that tastes good. Be very careful to follow your recipe exactly. Know what you are doing. Do not guess. Then we will all enjoy eating our food.

Now you will learn how to follow a recipe.

1. Read through the whole recipe before you start to prepare the food.
2. Be sure you understand all the words and measurements in the recipe.
3. Read the list of ingredients on the left side first, then the right side. Do not read across the line.
4. Get out all the utensils and food needed.
5. Remember to use exact measurements.
6. Follow each direction in order.
7. Keep your work space neat while you are working.
8. Be sure to serve hot foods while they are hot, and cold foods while they are cold.

Vocabulary:

recipe	-	rĕs'ĭ pē -- the way to make something to eat.
taste	-	tāst -- the feeling you get when food is in the mouth. The taste may be sweet, or sour, or bitter, or salty.
exactly	-	ĕg zăkt'lĭ -- perfectly or just right
measurement	-	mĕzh'ĕr mĕnt -- a way of finding the size or amount of anything
ingredients	-	ĭn grē'dĭ ĕnts -- foods used in a recipe
direction	-	dĭ rĕk'shŭn -- a telling how to do something

Assignment:

1. Why must you read through the whole recipe before you start to prepare food?

2. Why do you read down the left column of ingredients first?

3. How does it help you to get out all the utensils and food needed before you start to make something?

4. Why do you always use exact measurements?

5. Why must you follow each direction in order?

UNIT II - USE AND CARE OF EQUIPMENT

The Sink **Lesson 1**

Objective: To learn how to use and take care of the sink.

Information: We use the sink more than anything else in the kitchen. It is used before we cook, while we are cooking, and after we cook. We must follow some rules so that our sink will look tidy at all times.

Now we will learn how to use and take care of the sink.

1. While preparing food, wash, dry, and put away utensils that will not be needed again.
2. Soak pans as you finish with them.
3. Keep part of the sink free of soiled dishes.
4. Keep sharp-edged tools away from other utensils.
5. Do not pour any grease into the sink.
6. Take out any garbage that is in the drain.
7. Close faucets while washing the sink.
8. Clean sink with hot water and cleanser.
9. Be sure faucets and soap dish are clean.
10. Rinse sink well with hot water and wipe dry.
11. Wipe up any water which has spilled around the sink, so that you will not slip.

Vocabulary:

equipment	-	ē kwĭp'mĕnt -- the big things you need, like the stove and refrigerator
grease	-	grēs -- any oil or fat
garbage	-	gär'bĭj -- any food or part of food that is not to be eaten
faucets	-	fô'sĕts -- what you use to turn the water on or off in the sink
cleanser	-	klĕnz'ẽr -- the powder used to clean the sink
drain in the sink	-	drān -- the pipe through which the water goes down

Assignment:

1. How does it help you to soak the pans when you finish using them?

2. Why do you keep part of the sink free from soiled dishes?

3. What will happen if you pour grease into your sink?

4. Why must you clean the drain in the sink?

6. Why do you use cleanser in your sink?

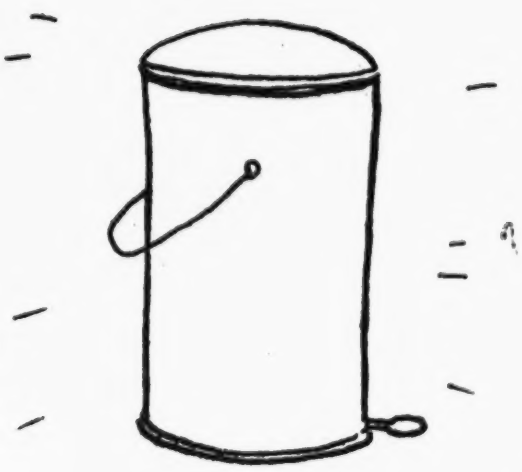
UNIT II - USE AND CARE OF EQUIPMENT

The Garbage Can **Lesson 2**

Objective: To learn how to use and care for the garbage can.

Information: The garbage can must be kept just as clean as all our other equipment. We do not like to see flies or bugs in the kitchen. If garbage is not taken care of, flies and bugs will come around.

Now you will learn how to use and care for the garbage can.



1. Open a paper bag and set it in the garbage can. This makes cleaning easier.

2. Keep the cover of the garbage can closed.

3. Drain all liquid off the garbage before putting it in the garbage can.

4. Do not put any broken glass or tin cans in the garbage can. Someone can get cut.

5. Garbage must be emptied every day. Close the paper bag and take it out of the garbage can.

6. Wash the inside of the garbage can with hot soapy water. Rinse and dry. Put in a clean paper bag.

7. Keep the outside of the garbage can as clean as the inside.

Vocabulary:

to drain	-	drān -- to pour off liquid
liquid	-	lĭk'wĭd -- anything that flows or pours
to empty	-	ĕmp'tĭ -- to take everything out of

Assignment:

1. Why do you put a paper bag in the garbage can?

2. Why must you keep the garbage can closed?

3. Why don't you put liquid in the garbage can?

4. Why is it important to keep broken glass and tin cans out of the garbage can?

5. Why must you keep the inside and outside of the garbage can clean?

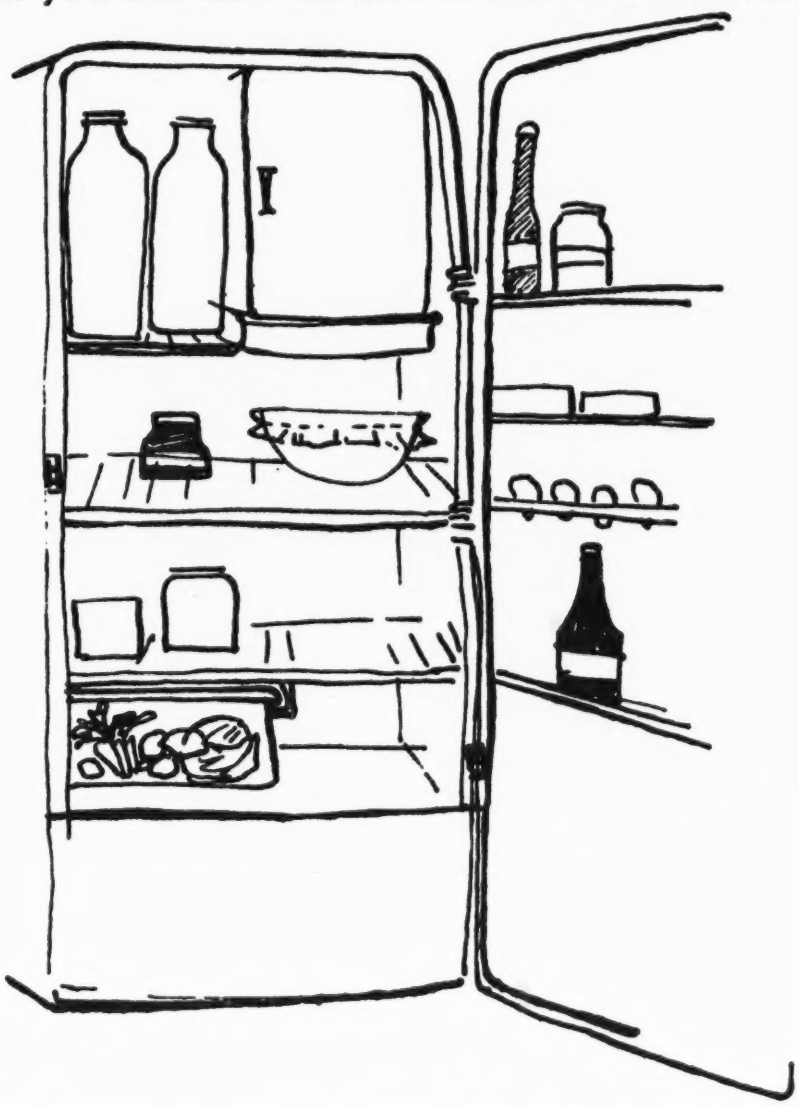
UNIT II - USE AND CARE OF EQUIPMENT

The Refrigerator **Lesson 3**

Objective: To learn how to use and take care of the refrigerator.

Information: Our refrigerator works for us. It saves us time and money by saving our food. We must use it in the right way and take good care of it. If we do this, our refrigerator will work for many, many years.

Now you will find out how to use and care for the refrigerator.



1. Keep the refrigerator door closed. Open it only when you have to get food, and close it again right away.

2. Do not put hot foods in the refrigerator.

3. Cover all foods. This keeps the food from getting dry.

4. Keep milk and meat in the coldest part of the refrigerator. The coldest part is near the freezer.

5. Leave room between food. This lets the cold air go around the food.

6. Put only clean food in the refrigerator.

7. Be sure all jars, containers, and bottles are clean and dry.

8. Wipe up any spilled food at once.

9. Defrost, wash, and clean the refrigerator once a week.

    a. Turn off the switch in the refrigerator.

    b. Take out the ice cubes by running cold water on the trays.

    c. Take all food out of the refrigerator.

    d. Remove all shelves and containers.

    e. Wash the inside of the refrigerator, the racks, and containers with warm water. Add 1 teaspoon of baking soda to the warm water.

    f. Wipe everything dry.

    g. Turn on switch in refrigerator.

    h. Refill ice cube trays and put back in place.

    i. Return racks, containers, and food to refrigerator.

    j. Clean outside of refrigerator with a little cleanser or cleaning wax.

Vocabulary:

refrigerator	-	rē frij'ĕr ā tĕr -- a box to keep things cold
freezer	-	frēz'ĕr -- a box that keeps food so cold that the food becomes hard
container	-	kŏn tān'ĕr -- anything that is used to hold something
defrost	-	dē frŏst'-- to take away frost or ice
switch	-	swĭch -- the thing you use to turn the refrigerator on or off
add to	-	ăd -- put with

Assignment:

1. Why should foods be cool before you put them in the refrigerator?

2. What happens to uncovered food in the refrigerator?

3. Why do you leave room between the food?

4. How does it help you when all jars, containers, and bottles are clean and dry?

5. Why do you defrost the refrigerator?

6. How do you take ice cubes out of the ice tray?

7. What do you put in the warm water when you clean the refrigerator? Why?

8. How do you clean the outside of the refrigerator?

UNIT II - USE AND CARE OF EQUIPMENT

The Gas Stove **Lesson 4**

Objective: To learn how to use and care for the gas stove.

Information: Our gas stove is automatic. We do not have to use a match for the burners or the oven. At home, some of you may have to use a match with your gas stove. We must be very careful when we are near the stove. We know our safety rules and must always keep them in m

Now you will learn how to use and care for the gas stove.

1. There are pilot lights near the top burners and in the ovens. These pilot lights must be on, or you cannot turn on the stove.

2. To turn on the oven or burner of an automatic gas range, you just turn the knob for the oven or the burner you want to use.

3. To light the burner of a gas stove that needs a match:

   a. Take out match and close match box.

   b. Strike the match away from you.

   c. Hold the match near the burner you want to light.

d. Turn the knob for that burner on full.

e. Wet the burned match before you throw it away.

f. After it is lit, adjust the flame so that it stays under the pan. If the flame comes around the pan, the food heats more slowly, you waste gas, and the pan will get dark.

4. To light the oven of a gas stove that needs a match (where there are two knobs, one to turn on the oven and one temperature control knob):

a. Set the temperature control knob to the temperature you want.

b. Open the oven door in case there is any gas in the oven.

c. Strike the match away from you.

d. Hold the match near the hole in the bottom of the oven. This hole is marked "light here."

e. Turn the oven knob on full.

f. Be sure oven is lit.

g. Close oven door.

5. To light the oven of a gas stove that needs a match (where one knob turns on the oven and is also the temperature control knob):

a. Open the oven door in case there is any gas in the oven.

b. Strike the match away from you.

c. Hold the match near the hole in the bottom of the oven, marked "light here."

d. Press the oven-temperature knob in, and turn it on full.

e. Be sure oven is lit.

f. Close oven door.

g. Set the oven-temperature knob to the temperature you want.

6. To light the oven of a gas stove that needs a match (where there is no temperature control knob):

a. Open the oven door in case there is any gas in the oven.

b. Strike the match away from you.

c. Hold the match near the lighting hole in the broiler.

d. Turn the oven knob on full.

e. Be sure oven is lit.

f. Close oven and broiler doors.

g. In this type of oven, you must use a thermometer. You change the temperature by turning the oven knob higher or lower.

7. A gas flame should be blue, not yellow.
A blue flame is hotter than a yellow one.

8. Lower the flame when food starts to boil.

9. Turn the gas off if any food boils over.

10. Turn off the gas as soon as the cooking is finished.

11. To remove a cover from a pan on the stove, lift the cover away from you.

12. Do not lean against the stove. You may turn the gas on.

13. Do not reach across an empty lighted burner.

14. Be sure the stove is cool before you clean it.

15. Wash the inside and outside of the stove with warm, soapy water, and rinse with clean warm water.

16. Use steel wool to clean stains.

17. After cleaning, light the burners and oven to dry them.

Vocabulary:

automatic	- ô tō măt'ĭk -- a stove that lights by turning a knob. You do not need a match, as the stove has pilot lights.
pilot light	- pī'lŭt līt -- the small flame that is always lit so that a burner can be turned on.
burner	- bûr'nĕr -- the part on the top of the stove where the flame comes
knob	- nŏb -- a handle to turn
to adjust	- ă jŭst'-- change to make right

temperature	-	tĕm′pĕr ȧ tŭr -- how hot or cold
control	-	kŏn trōl′-- a way to keep the temperature just as you want it.
to boil	-	boil -- to make the liquid hot enough so that you see bubbles on the top.
remove	-	rē mōōv′-- to take away
thermometer	-	thĕr mŏm′ē tĕr -- a tool for telling how hot or cold it is

Assignment:

1. What do we mean by a gas stove?

2. Do you use a match to light an automatic gas stove?

3. What are pilot lights?

4. Why do you close the match box before you strike the match?

5. Why do you strike a match away from you?

6. Why must you wet a match before you throw it away?

7. What happens when the flame comes around the pan?

8. What is the temperature control knob?

9. Why do you open the oven door before you strike the match?

10. Why do you strike the match before you turn on the gas?

11. Why should a gas flame be blue?

12. Why do you lower the flame when food starts to boil?

13. What do you do if food boils over on the stove? Why?

14. Why do you lift the cover of a pan on the stove away from you?

15. What kind of stove do you have at home?

UNIT II - USE AND CARE OF EQUIPMENT

The Electric Stove **Lesson 5**

Objective: To learn how to use and care for the electric stove.

Information: We know all about the gas stove. An electric stove is different. Not all electric stoves look the same. Some look like a gas stove. Sometimes, electric burners are built in your work space, and the oven is built in your wall. When the oven is built in the wall, you do not have to bend over to use it.

Now you will learn how to use and take care of the electric stove.

1. The surface units, which are the burners that get red, take a little longer to get hot than the burners on a gas stove.

2. The knobs for the burners are marked to show you high, medium, simmer, and low heat.

3. Always start the burner at "high," so it will get very hot fast.

4. When the burner is hot, turn the knob to the kind of heat you want.

5. Be careful that the burner does not stay too hot. If the burner is too hot, the food will boil over.

6. Turn the burner off before the food is finished cooking. Burners on electric stoves stay hot for a long time.

7. Be sure your pan covers the red part of the surface unit.

8. To use the oven, you turn the oven knob to the temperature you want.

9. Use warm, soapy water to clean the electric stove the same as you do the gas stove, but do not put the surface units in water. Water will ruin the electrical connections.

Vocabulary:

surface units	- sûr'fĭs ū'nĭts -- the burners on top of the stove
high heat	- hī hĕt -- large heat. The heat is turned all the way on, and the unit gets very, very hot.
medium heat	- mē'dĭ ŭm -- middle heat. The heat is not large or small. The heat is between high and low.
simmer	- sĭm'ẽr -- to cook slowly on top of the stove. Keep the liquid just under the boiling point. You see tiny bubbles around the edge of the liquid.
low heat	- lō -- little heat. The heat is turned on just a little
electrical connections	- ē lĕk'trĭ kăl kŏ nĕk'shŭns -- all the wires on the electric stove

Assignment:

1. What are the surface units on the electric stove?

2. Where do you turn the knob for the burner when you start cooking?

3. Why do you turn the burner of an electric stove off before the food is finished cooking?

4. Why should your pan cover the red part of the surface unit?

5. Why don't you put the surface units in water?

UNIT III - MEASUREMENTS AND ABBREVIATIONS

Rules About Measuring **Lesson 1**

Objective: To learn some rules about measuring.

Information: The way we measure the ingredients in a recipe can make our food taste good or bad. Let us measure exactly, so that everything we make will be perfect. The recipes we use have been made many times before. The people who wrote the recipes know just how much of each food is needed. Be sure to read and follow the measurements exactly. Never guess when you measure.

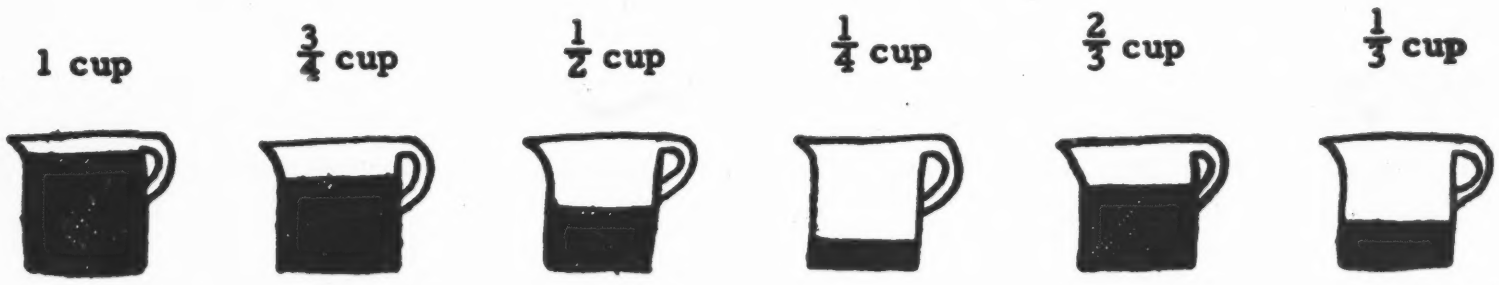
Now we will learn some rules about measuring.

1. You have a metal measuring cup for dry ingredients. The one-cup mark is at the very top of the cup so that you can level off the food.

2. You have a glass measuring cup for liquid ingredients. The one-cup mark is below the top of the cup so that you will not spill the liquid.

3. A liquid measuring cup has a lip to make it easy to pour from.

4. Measuring cups are marked for:



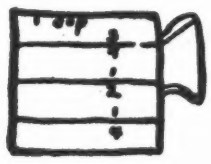
5. You have a set of measuring spoons.

6. A teaspoon or tablespoon used at the table is not used for measuring.

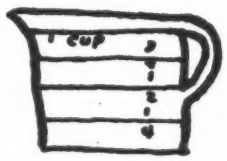
7. You have a spatula to level off dry food to make your measurement perfect. Always fill the cup or spoon heaping full. Then level off with the spatula.

8. The measurements you read in a recipe are level.

1 cup of dry ingredients



1 cup of liquid ingredients



9. Measure dry ingredients first, then liquids, then fats.

Vocabulary:

abbreviation	-	ă brē vĭ ā′ shŭn -- a short way to write a word
perfect	-	pûr′ fĕkt -- without any mistakes
lip of a cup	-	lĭp -- the part of the cup that bends out so that liquid will pour out without spilling
level	-	lĕv′ ĕl -- flat and smooth
heaping	-	hĕp′ ĭng -- filled more than level
spatula	-	spăt′ ū lȧ -- a flat utensil that can bend. It looks like a knife, but it is not sharp

Assignment:

1. Name the two kinds of measuring cups.

2. Which kind of cup is used to measure dry ingredients?

3. Which kind of cup is used to measure liquid ingredients?

4. What is the difference between the two kinds of measuring cups?

5. How are measuring cups marked?

6. Name the kinds or sizes of spoons in your set of measuring spoons.

7. Why can't you measure with a teaspoon or tablespoon that you use at the table?

8. Why do you use the spatula when you measure?

9. Why must your measurements be level?

10. Why do you measure dry ingredients first, then liquids, then fats?

UNIT III - MEASUREMENTS AND ABBREVIATIONS

How To Measure Dry Ingredients **Lesson 2**

Objective: To learn how to measure dry ingredients.

Information: We know some general rules about measuring. We know how to level off a measurement. There are some special rules for measuring different dry foods. They are very important. We will practice measuring dry foods to make sure we understand how to do it. We must remember these rules because the recipe will not explain them. They are things you have to know before you start cooking.

Now you will learn how to measure dry ingredients.

1. There are four things you must always do when you measure flour:
   a. Measure the flour you need.
   b. Sift the flour onto a paper towel.
   c. Measure the flour again.
   d. Sift the flour again with the other dry ingredients in the recipe.
2. Use a spoon to fill the cup with flour.
3. Never shake or pack the flour down in the cup.
4. If you need part of a cup of flour, tap the cup lightly with a spoon to level the flour in the cup.
5. Sift granulated sugar before you measure it, if the sugar is lumped.
6. Sift powdered sugar before you measure it.
7. Brown sugar is the only dry ingredient that you pack down in the cup or spoon when you measure it.
8. For all other dry ingredients, just remember that all measurements are level.

Vocabulary:

practice	-	prăk' tĭs -- to do the same thing over and over again
sift	-	sĭft -- to put through a screen to keep any big pieces away from the little pieces
granulated sugar	-	grăn' ū lāt ĕd -- grains of sugar that are the same size as grains of fine sand
powdered sugar	-	pou' dĕrd -- white sugar that has been ground into a fine powder
lumpy	-	lŭmp' ĭ -- sticking together of a food in bunches

Assignment:

1. What are the four things you must do when you want to measure flour?

2. Why must you measure flour after you sift it?

3. Why is it wrong to shake or pack down flour in a cup?

4. How do you measure part of a cup of flour?

5. Why do you sift powdered sugar before you measure it?

UNIT III - MEASUREMENTS AND ABBREVIATIONS

How To Measure Liquid Ingredients — Lesson 3

Objective: To learn how to measure liquid ingredients.

Information: Our recipes tell us just how much of each food is needed. Our rules for measuring liquids are different from the rules we learned for dry ingredients. We will remember that all measurements must be perfect. That rule is the same for liquid and dry foods.

Now you will learn how to measure liquids.

1. Put the glass measuring cup on a flat surface. Never hold it in your hand when you measure.
2. Always have the cup at eye level. If you look down or up at the cup, your measurement will be wrong.
3. Remember to fill the cup to the mark that shows the measurement you need.
4. Never pour liquid to the top of the glass measuring cup. This would give you more than one cup. Read the marked lines.
5. Put a silver spoon in the glass measuring cup when you measure hot liquids. Pour the hot liquid on the spoon, and not on the glass, when you fill the cup.
6. Butter the cup or spoon lightly before you measure sticky liquids like honey.

Vocabulary:

flat surface	-	flăt sûr'fĭs -- smooth, straight part
eye level	-	ī lĕv'ĕl -- in a straight line with the eye
pour	-	pōr -- to make something flow
marker lines	-	mär'kĕr līns -- lines to show where an exact measurement is
sticky	-	stĭk'ĭ -- making things hold together

Assignment:

1. Why do you put the glass measuring cup on a flat surface when you measure liquids?

2. Why must you have the glass measuring cup at eye level for perfect measurements?

3. What measurements are marked on a glass measuring cup?

4. Why is it wrong to pour liquid to the top of a glass measuring cup?

5. Why do you pour hot liquids on a silver spoon, and not on the glass, when you fill the cup?

6. Why do you butter the cup or spoon lightly before you measure sticky foods?

How To Measure Fats

Lesson 4

Objective: To learn how to measure fats.

Information: We use many kinds of fats. Some are solid and some are liquid. The solid fats we will use are butter, oleomargarine, and shortening. Sometimes we have to melt our fat for a recipe. We call the liquid fat that we use an oil. Again, we remember that all measurements must be perfect.

Now you will learn how to measure fats.

1. To measure a solid fat:

   a. You use a glass measuring cup.

   b. You must be able to add fractions to equal one cup.

$$\begin{array}{r} \frac{1}{4} \\ +\ \frac{3}{4} \\ \hline \frac{4}{4} = 1 \end{array} \qquad \begin{array}{r} \frac{1}{3} \\ +\ \frac{2}{3} \\ \hline \frac{3}{3} = 1 \end{array} \qquad \begin{array}{r} \frac{1}{2} \\ +\ \frac{1}{2} \\ \hline \frac{2}{2} = 1 \end{array}$$

   c. Pour cold water into the measuring cup up to the mark which will equal one cup when the amount of fat you need is added. For $\frac{1}{3}$ cup of fat, pour in $\frac{2}{3}$ cup of cold water. For $\frac{1}{4}$ cup of fat, pour in $\frac{3}{4}$ cup of water.

   d. Put in fat until the water is up to the mark for one cup.

   e. Use a tablespoon and rubber scraper to put the fat into the cup.

   f. You must not spill any of the water.

   g. Be sure the water covers the fat.

   h. When the water reaches the 1-cup mark, stop adding fat and pour off all the water.

   i. Now you have the perfect amount of fat.

2. If you need melted fat for a recipe, melt the fat before you measure it.

3. When you use a spoon to measure solid fat, hold your finger under the bowl of the spoon to keep from bending the spoon.

Vocabulary:

solid	-	sŏl' ĭd -- anything that is firm and will not flow
melt	-	mĕlt -- to change a solid to a liquid
fraction	-	frăk' shŭn -- a part of something
equal	-	ē' kwăl -- the same
rubber scraper	-	rŭb' ĕr skrāp' ĕr -- a utensil with a flat piece of rubber on a handle
bowl of a spoon	-	bōl -- the rounded part of the spoon which holds food or liquid
margarine	-	mär' jä rĭn -- a food made of fats and vegetable oils. It may be used instead of butter.
shortening	-	shôrt' nĭng -- a fat used in cooking

Assignment:

1. What kind of measuring cup do you use to measure fat?

2. How much water do you need to measure $\frac{1}{3}$ cup of fat?

3. How much water do you need to measure $\frac{1}{2}$ cup of fat?

4. How much water do you need to measure $\frac{3}{4}$ cup of fat?

5. Why must you be careful not to spill any water when you measure fat?

6. If you spill any water when you measure fat , what should you do?

7. Why must all the fat be covered with water?

8. Why do you hold your finger under the bowl of the spoon when you use a spoon to measure solid fat?

UNIT III - MEASUREMENTS AND ABBREVIATIONS

Abbreviations — Lesson 5

Objective: To learn the abbreviations used in cooking.

Information: Abbreviations are short ways of writing words. They are used in recipes to save time and space. We must know the meaning of the abbreviations we will use. Some of the short forms are very much alike, so always read them carefully.

Now we will learn the abbreviations.

1. t. or tsp. means teaspoon
2. T. means tablespoon
3. C. means cup
4. B. P. means baking powder
5. B. S. means baking soda
6. Sq. means square
7. oz. means ounce
8. lb. means pound
9. pt. means pint
10. qt. means quart
11. gal. means gallon
12. min. means minute
13. hr. means hour
14. choc. means chocolate
15. temp. means temperature
16. ^{o} means degrees
17. f. g. means few grains

Assignment:

1. What are abbreviations?

2. Name some abbreviations and their meanings.

UNIT III - MEASUREMENTS AND ABBREVIATIONS

Equivalents — Lesson 6

Objective: To learn the equivalents you will use.

Information: Equivalents are different units of measure that are the same in size. These are important because they give you a shorter way to measure foods in many recipes.

Now you will learn some equivalents.

1. 3 tsp. = 1 T.
2. 4 T. = $\frac{1}{4}$ C.
3. 8 T. = $\frac{1}{2}$ C.
4. 16 T. = 1 C.
5. 2 C. = 1 pt.
6. 4 C. = 1 qt.
7. 2 pt. = 1 qt.
8. 4 qt. = 1 gal.
9. 1 C. of fat = $\frac{1}{2}$ lb.
10. 2 C. of fat = 1 lb.
11. 2 C. of sugar = 1 lb.
12. 4 C. of flour = 1 lb.
13. 1 C. of cake flour = 1 C. less 2 T. of all-purpose flour
14. 1 egg = 4 T.

Vocabulary:

equivalents - ē kwiv'ə lĕnts -- different ways to get the same amount of something

Assignment:

1. What does the word, equivalent, mean?

2. Name some equivalents.

UNIT IV - TABLE MANNERS, TABLE SETTING, AND TABLE SERVICE

How To Act at the Table — Lesson 1

Objective: To learn how to act at the table.

Information: Our table manners tell a lot about us. We should not have special ways to eat for visitors. We practice good manners at every meal. Then we do not have to stop and think how to act when others are with us. You cannot hope to have good manners without practice. When we know the rules for correct manners, it is easier for us to enjoy eating. Remember that practice makes perfect!

Now you will learn some good table manners.

1. Wash your hands before you eat.
2. Sit straight on your chair.
3. Keep your feet on the floor.
4. Open your napkin in half and lay it across your lap.
5. Keep your hands in your lap when you are not using them. Never put your elbows on the table.
6. Keep your hands close to your body at the table. You do not want to knock anything over.
7. Wait until everyone is seated before you start to eat.
8. Eat slowly.
9. Eat the piece of food that is nearest you on your plate.
10. Do not mix different kinds of food on your plate together before starting to eat.
11. If a food is very hot, just wait until it cools. Do not blow on it.
12. Take small bites. Chew one bite and swallow it before you put more food in your mouth.
13. Cut one piece of food at a time.

14. Never talk with food in your mouth.

15. Chew with your lips together. It makes a noise when your mouth opens and shuts. No one wants to hear you chew food.

16. Do not reach in front of other people for food. Ask someone to please pass the food.

17. Turn the handle of a pitcher toward the person to whom it is being passed.

18. Never hand food, like a roll, to someone else. Always pass the serving plate.

19. Never butter a whole slice of bread at one time. Break off a small piece and then butter that piece.

20. Do not bend your head to reach your food. Bring the food up to your mouth.

21. Never comb your hair or put on make-up at the table.

22. Press your napkin lightly against your lips while you are eating. Do not wipe your face. A napkin is not the same as a towel.

23. When you are finished eating, put your napkin next to your plate.

24. Ask to be excused before you leave the table.

Vocabulary:

manners	-	măn'ĕrs -- the way you act
correct	-	kŏ rĕkt'-- right
napkin	-	năp'kĭn -- a piece of cloth or paper used at the table to keep your lips and fingers clean
serving plate	-	sûrv'ĭng plāt -- a plate of food that is passed to each person. You take some food from the serving plate and put it on your own plate. You do not eat from a serving plate.

Assignment:

1. Why do you wash your hands before you eat?

2. Why should you sit straight on your chair?

3. Why do you keep your hands close to your body at the table?

4. Why should you take the piece of food on your plate that is nearest you?

5. Do you blow on food to cool it?

6. If you are asked a question while you have food in your mouth, what should you do?

7. Is it all right to talk with food in your mouth?

8. Is it all right to cut all your food into little pieces before you start to eat?

9. Why do you keep your mouth closed when you chew food?

10. How do you get food that you cannot reach on the table?

11. How do you pass rolls?

12. How do you butter bread?

13. How would you pass a serving fork? a knife?

14. Where do you put your napkin when you finish eating?

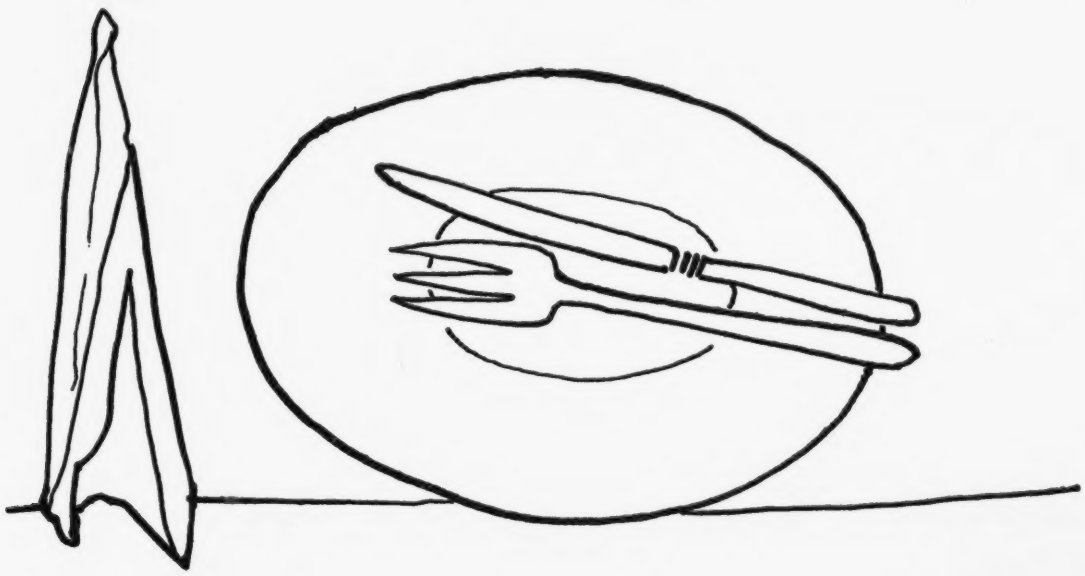
15. What do you say before you leave the table?

Use of the Silverware Lesson 2

Objective: To learn the right way to use silverware.

Information: It is important to know what silverware to use for different foods. We must also know the right way to hold our silverware. Each knife, fork, and spoon is placed on the table for a reason. If you are not sure which piece of silver to use, watch your hostess. Let the hostess start first.

Now you will learn some rules about the use of silverware.



1. Eat with your right hand if you are right-handed. Eat with your left hand if you are left-handed.

2. Use the silver that is farthest away from you on both sides first.

3. Never bring food to your mouth with a knife.

4. Do not put soiled silverware on the tablecloth.

5. Never leave a spoon in your cup or glass. Put it on the saucer or plate that is under your cup or glass.

6. The sharp edge of the knife is always toward you.

7. Use your knife only for foods that cannot be cut with a fork.

8. Turn the tines of the fork up, when you bring food to your mouth.

9. Hold the fork in your left hand, with the tines down, when you cut food.

10. After cutting food, change the fork from the left to the right hand, if you are right-handed.

11. When cutting food, hold the handle of the knife and fork firmly. Each handle should rest in the palm of the hand. Put the forefinger along the handle to keep the knife and fork from slipping.

12. When you have finished eating, leave your knife and fork across the center of the plate.

13. If you have a bread-and-butter plate, leave the butter knife on your bread-and-butter plate.

Vocabulary:

hostess	-	hōs'tĕs -- the girl who is in charge of the meal
saucer	-	sô'sĕr -- a small dish on which a cup is set
tines	-	tīns -- the points of a fork
palm of the hand	-	päm -- the inside of the hand
forefinger	-	fōr'fĭng gĕr -- the finger next to the thumb

Assignment:

1. How do you know which silverware to use first?

2. Do you ever bring food to your mouth with your knife?

3. Where do you leave your spoon, when you are finished eating?

4. Where is the sharp edge of the knife, when the knife is on your plate?

5. Do you hold the tines of the fork up or down, when you bring food to your mouth?

6. How do you hold the fork, when you cut food?

7. Where do you leave your knife and fork when you finish eating?

UNIT IV - TABLE MANNERS, TABLE SETTING, AND TABLE SERVICE

How To Set the Table — Lesson 3

Objective: To learn how to set the table.

Information: We all like to see a pretty table. The things we put on the table are there to be used. The way we place things on the table makes the setting look nice. We must keep in mind that each piece of flatware, china, and glassware has a certain place on the table. Let us practice setting the table in the correct way at home and in school.

Now you will learn the rules for setting the table.

1. Everything you use must be clean.

   a. Dishes, glassware, and flatware should be shining.
   b. Tablecloths and napkins must be spotless.

2. The flatware, china, glassware, and napkin to be used by each person is called a cover.

3. The plate is placed in the center of the cover. It should be one inch from the edge of the table.

4. The knife is put to the right of the plate. The sharp edge of the knife goes toward the plate.

5. The spoons go to the right of the knife. The bowls of the spoons are turned up.

6. Forks are placed to the left of the plate. The tines of the forks are turned up.

7. All flatware should be one inch from the edge of the table in a straight line with the china and napkin.

8. If no knife is to be used, the fork may be placed to the right of the plate.

9. Place on the table the flatware that is needed.

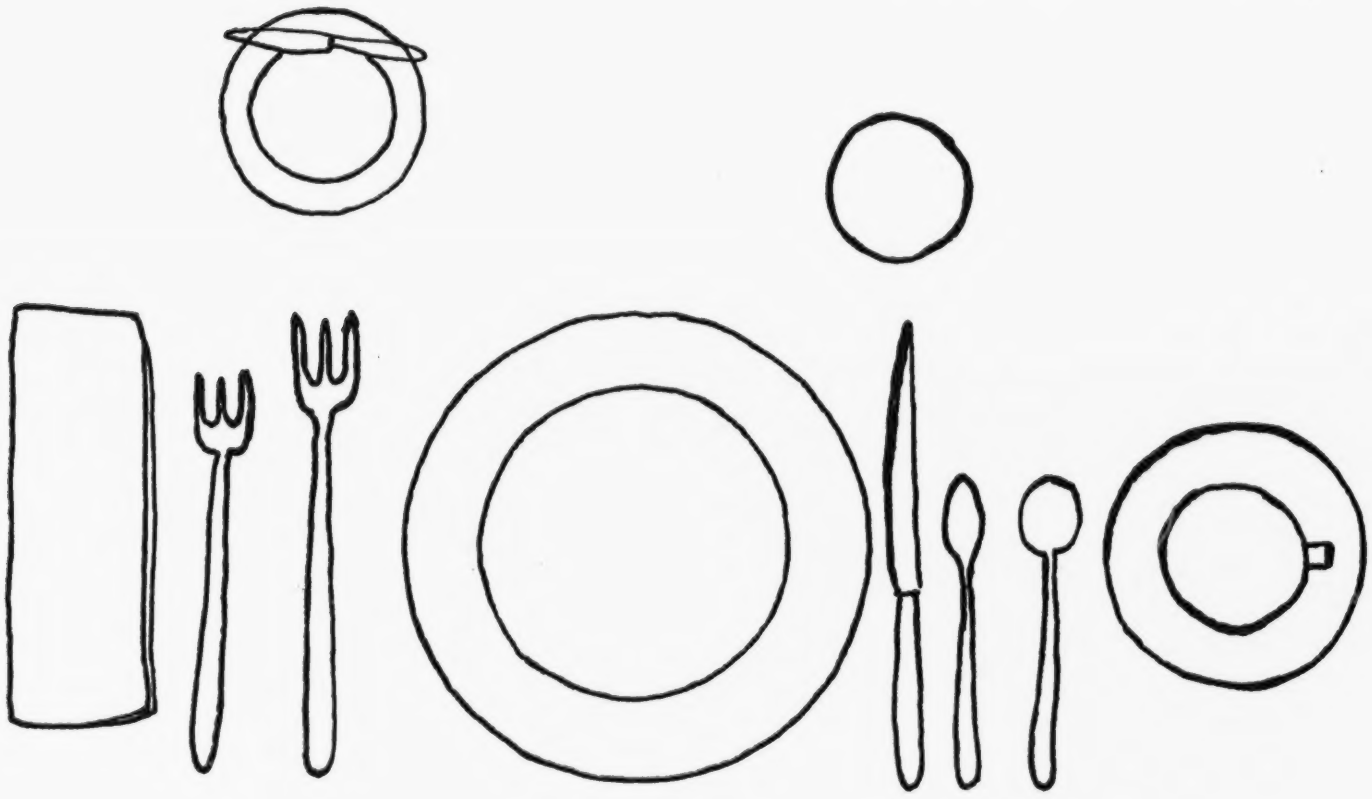
10. The water glass is placed just above the tip of the knife.

11. A milk glass is put next to the water glass, and just a little below it.

12. A cup and saucer are placed to the right of the spoon. The handle of the cup is to the right.

13. A bread-and-butter plate is placed just above the fork. The butter spreader goes across the top of plate with the handle to the right.

14. The napkin is placed to the left of the fork. The open corner of the napkin is at the lower right.



Vocabulary:

flatware	-	flăt'wâr -- the silverware that you eat with
cover	-	kŭv'ẽr -- the flatware, china, glassware, and napkin to be used by one person
butter spreader	-	bŭt'ẽr sprĕd'ẽr -- a small knife given to each person for buttering bread or rolls

Assignment:

1. What is a cover?

2. How far from the edge of the table do you place the dishes and flatware?

3. On which side of the plate do the knife and spoons go?

4. Where do you place the fork?

5. If you do need a knife, where do you put the fork?

6. Where does the sharp edge of the knife go?

7. Where do you place the water and milk glasses?

8. Where do you put the bread-and-butter plate?

9. Why is the open corner of the napkin at the lower right?

10. Draw a cover.

How To Serve a Meal — Lesson 4

Objective: To learn how to serve a meal.

Information: We have all helped to serve meals at home. Have you been serving meals in the right way? We have some easy rules to follow. These rules will help to make serving easier. We use these rules for every meal, whether it is a very small one or a large dinner. We like to see a quiet and careful person serve meals. Take your time and think of the people who are eating. We do not want to bump a person's arm, or spill any food.

Now you will learn now to serve a meal.

1. Always wash your hands before you serve food.

2. Do not handle food or dishes any more than you have to.

   a. Never touch the top or inside of a cup or glass.

   b. Never touch the bowl of a spoon, the blade of a knife, or the tines of a fork.

   c. Never touch the part of a plate where food will be placed.

3. Use a tray to carry the dishes, flatware, and glasses to the table. This saves time and work.

4. Never reach across anyone.

5. Serve all food from the left side of the person.

6. Use your left hand to put plates on the table.

7. Serve all beverages from the right side of the person.

8. Use your right hand to serve all beverages.

9. When a guest serves herself at the table, you must pass the serving dishes to the left of the guest.

10. Do not stack used dishes at the table.

11. Do not start to clear the table until everyone is all finished eating.

12. After the meal, take away serving dishes first.

13. Remove all used dishes from one cover at a time.

14. Remove dishes with your left hand from the left side of the guest.

15. Remove glasses and cups with your right hand from the right side of the guest.

16. Leave water glasses on the table until last.

Vocabulary:

blade - blād -- the flat, thin part of the knife that is used for cutting

beverage - bĕv'ĕr ĭj -- something to drink

Assignment:

1. Why should you wash your hands before you serve food?

2. Why must you be careful how you handle food and dishes?

3. How does it help you to use a tray to carry dishes, flatware, and glasses to the table?

4. From which side do you serve food to each person?

5. Which hand do you use to put a plate in front of a guest?

6. From which side are beverages served and taken away?

7. Which hand do you use to serve milk?

8. Is it all right to stack used dishes at the table?

9. Which dishes are taken away from the table first?

10. Why do you leave water glasses on the table until last?

UNIT V - BEVERAGES

Fruit Beverages — Lesson 1

Objective: To learn about fruit beverages.

Information: Fruit helps to keep our bodies healthy. We use fresh fruit, fresh fruit juices, canned fruit juices, and frozen fruit juice concentrates in different kinds of fruit beverages. Many times we like to mix two or three kinds of juices for our beverage. To make a pretty drink, we may add fresh fruit or colored ice cubes to the beverage.

Now you will learn about some fruit beverages.

1. Fruitade is made by mixing fruit juice with sugar and water.
2. Punch is a mixture of different fruit juices. You may add ginger ale.
3. Fruit soda is made by mixing fruit juice or soda with sherbet.
4. Fruit fizz is a mixture of fruit juice, sugar, water, and carbonated water.

Vocabulary:

fruit	-	froōt -- the part of certain plants that you can eat
beverage	-	bĕv'ĕr ĭj -- something to drink
juice	-	jōōs -- the liquid part of a food
concentrate	-	kŏn'sĕn trāt -- a food or beverage with some of the liquid taken out
mix	-	mĭks -- to put together or to stir together
ade	-	ād -- a beverage that is made by mixing fruit juice with sugar and water
punch	-	pŭnch -- a drink made by mixing fruit juices and other liquids
mixture	-	mĭks'tŭr -- two or more things that are put together

sherbet	-	shûr'bĕt -- a frozen dessert made of fruit juice, sugar, water, and egg white
fizz	-	fĭz -- a beverage that bubbles up or makes a hissing sound
carbonated	-	kär'bŏn ā̆t ĕd -- water that is made to bubble. You can see bubbles in it
attractive	-	ŭ trăk'tĭv -- pretty

Assignment:

1. What are beverages?

2. How do you make a fruit drink look more attractive?

3. What is punch?

4. What is a fruit fizz?

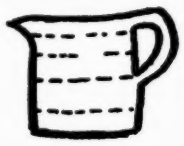
UNIT V - BEVERAGES

Recipe for Orangeade **Lesson 2**

Objective: To prepare and serve orangeade for four people.

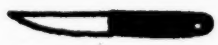
Utensils:

glass measuring cup
glăs mĕzh'ĕr ĭng kŭp



metal measuring cup
mĕt'ᵊl mĕzh'ĕr ĭng kŭp

paring knife
pâr'ĭng nīf



wooden spoon
wŏŏd'ᵊn spōōn

squeezer
skwēz'ĕr

bread board
brĕd bord

pitcher
pĭch'ĕr

strainer
strān'ĕr

Ingredients:

2 oranges

1 lemon

½ C. of sugar

3 C. of cold water

ice cubes

Procedure:

1. Cut oranges and lemon in half on bread board.

2. Squeeze oranges and lemon.

3. Strain the juice into a pitcher.

4. Pour the cold water and sugar into the pitcher.

5. Stir well.

6. Add ice cubes to the orangeade.

7. Serve in a tall glass on a small plate.

Vocabulary:

procedure	-	prō sē'dur -- the way to make something
strain	-	strān -- press through strainer to keep out little pieces, so that you will have only liquid
squeeze	-	skwēz -- to press hard

Assignment:

1. Name the utensils you will have ready when you start to make orangeade.

2. Why do you use a bread board for cutting?

3. How many oranges and lemons do you need to make orangeade for eight people?

4. What new words have you learned?

Recipe for Lime Fizz

Lesson 3

Objective: To prepare and serve lime fizz for four people.

Utensils:

glass measuring cup

metal measuring cup

squeezer

paring knife

pitcher

wooden spoon

bottle opener
bŏt'ᵊl ō'pĕn ᵊr

Ingredients:

$\frac{1}{2}$ C. lime juice

$\frac{3}{4}$ C. sugar

2 C. water

2 7 oz. bottles of carbonated water

ice cubes

Procedure:

1. Cut three limes in half on bread board.
2. Squeeze limes.
3. Strain the juice into the pitcher.
4. Add the sugar to the juice.
5. Pour the water into the pitcher.
6. Stir well.
7. Put ice cubes into each glass.
8. Pour 2 T. of lime juice into each glass.
9. Fill glasses with carbonated water when you are ready to serve.

Vocabulary:

lime	-	līm -- a small, sour, greenish-yellow fruit that grows on a tree
sour	-	sour -- not sweet

Assignment:

1. Why do you call this beverage a fizz?

2. Why do you wait to pour the carbonated water into the glasses until you are ready to serve?

3. How much lime juice would you need to serve lime fizz to eight people?

4. How much sugar would you need to serve lime fizz to eight people?

Milk Lesson 4

Objective: To learn about milk.

Information: Milk is one of our best foods. It helps make strong bones, good teeth, and rich, red blood. It is important to have some milk at every meal. There are many ways to get our milk besides drinking it. We may use milk on cereal and fruit. Puddings and custards are made from milk.

Now you will learn about some different kinds of milk.

1. Whole milk is milk with cream in it.

   a. Pasteurized milk is whole milk in which the cream separates from the milk. You can see the cream at the top of the bottle.

   b. Homogenized milk is whole milk in which the cream does not separate from the milk. (Homogenized milk has also been pasteurized, but it is not called pasteurized milk.)

2. Skim milk is milk with the cream taken out.

3. Buttermilk is the liquid that is left after butter is made, but the buttermilk we buy in the stores is usually made out of skim milk.

4. Evaporated milk is canned milk with some of the water taken out.

5. Condensed milk is canned milk with some of the water taken out and sugar added.

6. Powdered or dry milk is milk with all of the water taken out.

Now you will learn some things about milk.

1. Each kind of milk is good for you.

2. Milk in the bottle is called fresh milk.

3. Milk in the bottle must be kept cold, or it will sour.

4. Skim milk and buttermilk have very little fat.

5. Evaporated milk can be used in place of whole milk by adding the amount of water that was taken out before it was canned.

6. Canned and powdered milk can be kept for a much longer time than fresh milk.

7. Canned and powdered milk do not cost as much as fresh milk.

8. You may use powdered milk for whole milk by adding the right amount of water.

9. To heat milk, always use a low flame.

10. Milk is hot enough to drink when it scalds, or a skin forms on the top of the milk.

Vocabulary:

homogenized milk	-	hō mŏj'ē nīzd -- whole milk in which the cream does not separate from the milk
pasteurized milk	-	păs'tĕr īzd -- whole milk in which the cream does separate from the milk
separate	-	sĕp'ȧ rāt -- to come apart or to break into parts
skim milk	-	skĭm -- milk with the cream taken out
evaporated milk	-	ē văp'ō rāt ĕd -- milk with some of the water removed
condensed milk	-	kŏn dĕnst' -- milk with some of the water removed and sugar added
powdered milk	-	pou'dĕrd -- milk with all of the water removed
sour milk	-	sour -- milk that has spoiled. It does not taste good to drink, but is sometimes used in cooking.
scald	-	skôld -- to heat just below the boiling point

Assignment:

1. How does milk help your body?

2. Should you have milk at every meal?

3. If you do not drink enough milk, how else can you get milk at your meals?

4. Name two kinds of whole milk.

5. Name two kinds of canned milk.

6. What is powdered milk?

7. Name two kinds of milk that have very little fat.

8. Why must fresh milk be kept cold?

9. What must you add to evaporated milk or powdered milk if you want to use it in place of whole milk?

10. What kind of flame do you use to heat milk?

11. How do you know when milk is hot enough to drink?

12. What kind of milk do you get at home?

UNIT V - BEVERAGES

Cold and Hot Beverages Made With Milk — **Lesson 5**

Objective: To learn about some cold and hot beverages made with milk.

Information: We do not always drink plain milk. There are many things we may mix with milk. Sometimes we may add another food and sugar, if we want a sweeter drink. We want to make different kinds of milk drinks. Let us see how many kinds we have had before!

Now you will learn about some cold beverages made with milk.

1. A milk shake is milk with another food beaten into it.

   a. Milk with flavoring, like vanilla or chocolate.

   b. Milk with fruit juice or mashed fruit.

   c. Milk with flavoring or fruit and ice cream added to it.

2. For a chocolate milk shake, you may buy chocolate syrup in a can, or make your own.

3. Eggnog is milk with egg, sugar, and flavoring beaten into it.

Now you will learn about some hot beverages made from milk.

1. Cocoa is a mixture of cocoa, sugar, salt, and water heated with milk.

2. Hot eggnog is scalded milk added to egg and flavoring.

Vocabulary:

flavoring	-	flā'vĕr ĭng -- anything that is added to a food to give a certain taste
vanilla	-	vȧ nĭl'ȧ -- a flavoring made from the beans of the vanilla plant
chocolate	-	chŏk'ō lĭt -- a food that is sometimes used for flavoring

mash - mŭsh -- to beat smooth

eggnog - ĕg′ nŏg -- a beverage of eggs beaten with sugar, flavoring, and milk

syrup - sĭr ŭp -- a sticky or thick liquid made of sugar and other food

cocoa - kō′kō -- ground chocolate with some of the fat removed. It is also the name given to the beverage made by cooking this powder with sugar and hot milk.

Assignment:

1. What is a milk shake?

2. What is a syrup?

3. What is cocoa?

4. Name two flavorings.

Recipe for Vanilla Milk Shake

Lesson 6

Objective: To prepare and serve vanilla milk shakes for four people.

Utensils:

glass measuring cup

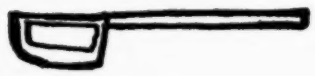
metal measuring cup

measuring spoons
mĕzh'ẽr ing spōons

mixing bowl
mĭks'ing bōl

pitcher

food scraper
fōod skrāp'ẽr



egg beater
ĕg bēt'ẽr

Ingredients:

$2\frac{2}{3}$ C. milk

2 tsp. vanilla

$\frac{1}{3}$ C. sugar

pinch of nutmeg or cinnamon

Procedure:

1. Pour the milk into the mixing bowl.
2. Add the vanilla and sugar to the milk.
3. Beat with an egg beater.
4. Pour into a pitcher. Use your food scraper to get everything out of the bowl.
5. Pour milk shake into glasses.
6. Sprinkle nutmeg or cinnamon on top of each milk shake just before serving.
7. Serve in a tall glass.

Vocabulary:

pinch	-	pĭnch -- very little - as much as you can take between the finger and thumb
nutmeg	-	nŭt'mĕg -- a powder that is used for flavoring
cinnamon	-	sĭn'ə mŭn -- a powder that is used as a spice for flavoring
sprinkle	-	sprĭng'k'l -- to drop something in small bits

Assignment:

1. Why do you use an egg beater instead of a spoon?

2. How does a food scraper help you?

3. Why do you sprinkle nutmeg or cinnamon on a milk shake?

4. How much milk would you need to make milk shakes for eight people?

UNIT V - BEVERAGES

Recipe for Banana Milk Shake **Lesson 7**

Objective: To prepare and serve banana milk shakes for four people.

Utensils:

mixing bowl

paring knife

masher
mă̆sh'ẽr

glass measuring cup

measuring spoons

egg beater

food scraper

spatula
spă̆t'ṵ lȧ

Ingredients:

3 bananas

3 T. sugar

$2\frac{2}{3}$ C. milk

1 tsp. vanilla

Procedure:

1. Peel and slice bananas.
2. Put sliced bananas in mixing bowl.
3. Mash the bananas.
4. Add sugar, vanilla, and milk.
5. Beat with egg beater.
6. Pour into pitcher, and then glasses.
7. Serve.

Vocabulary:

banana	-	bȧ năn'ȧ -- a long fruit with a heavy yellow skin. The part you eat is soft, and has a creamy color.
peel	-	pēl -- to take off the outside skin
slice	-	slīs -- cut across in thin, flat pieces

Assignment:

1. What utensil is used to mash bananas?

2. If you do not have this utensil, what can you use to mash bananas?

3. What does slice mean?

4. Name some other fruits you may use instead of bananas.

Recipe for Eggnog — Lesson 8

Objective: To prepare and serve eggnog for four people.

Utensils:

mixing bowl	measuring spoons
glass measuring cup	egg beater
spatula	case knife kās nīf
food scraper	

Ingredients:

2 eggs	$\frac{1}{4}$ tsp. salt
4 T. sugar	$\frac{1}{4}$ tsp. vanilla
4 C. milk	dash of nutmeg

Procedure:

1. Break eggs into mixing bowl.
2. To break an egg, make a crack in the shell by striking across the middle of the egg with the sharp edge of a case knife. With the tip of your thumbs on either side of the crack, carefully open the egg.
3. Beat the eggs with an egg beater until fluffy.
4. Add sugar, milk, salt, and vanilla.
5. Beat the mixture again.
6. Pour the mixture into a pitcher, then into glasses.
7. Sprinkle nutmeg on each eggnog.
8. Serve.

Vocabulary:

dash - dăsh -- a tiny bit, pinch

fluffy - flŭf'ĭ -- very soft and light

Assignment:

1. How do you break an egg?

2. What part of a cup is the same as 4 T. ?

3. How many cups are in 1 quart?

4. Using a measuring cup, how much sugar would you need to make eggnog for eight people?

Recipe for Chocolate Milk Shake

Lesson 9

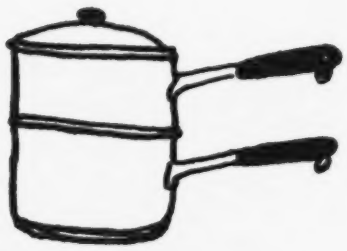
Objective: To prepare and serve chocolate milk shakes for four people.

Utensils:

glass measuring cup

metal measuring cup

double boiler
dŭb'l boil'ĕr



measuring spoons

food scraper

wooden spoon

spatula

saucepan
sôs'păn

Ingredients:

1 sq. unsweetened chocolate

$\frac{1}{3}$ C. boiling water

$\frac{1}{3}$ C. sugar

dash of salt

$\frac{1}{4}$ tsp. vanilla

$2\frac{2}{3}$ C. milk

pinch of nutmeg or cinnamon

Procedure:

First you will make chocolate syrup.

1. Fill the bottom part of the double boiler $\frac{1}{3}$ full with hot water. This is not the water listed under ingredients.

2. Put the bottom part of the double boiler on a burner on the stove. Turn the burner on.

3. Put the chocolate in the top of the double boiler.

4. Place the top part in the bottom part of the double boiler.

5. Cook until the chocolate is melted.

6. While the chocolate is melting, boil some water in a small saucepan.

7. After the water has boiled, measure $\frac{1}{3}$ C. of water.

8. Add the water, sugar, and salt to the melted chocolate in the top of the double boiler.

9. Cook for 5 minutes, or until smooth.

10. Stir the mixture a little, while it is cooking.

11. Turn off the burner.

12. Take the top part of the double boiler out of the bottom part.

13. Let the mixture cool.

14. Add vanilla to the mixture.

Now you will make the milk shake.

1. Put the chocolate syrup and milk into a mixing bowl.

2. Beat this mixture with an egg beater.

3. Pour the milk shakes into a pitcher, and then into four glasses.

4. Sprinkle a little nutmeg or cinnamon on the top of each milk shake.

5. Serve.

Vocabulary:

unsweetened - ŭn swēt'nd -- not sweet

smooth - smōōth -- without bumps or lumps

Assignment:

1. What is always put in the bottom part of the double boiler?

2. Why do you put hot water in the bottom part of the double boiler?

3. Why do you melt chocolate over water?

4. How much boiling water would you need to make milk shakes for eight people?

Recipe for Cocoa

Lesson 10

Objective: To prepare and serve cocoa for four people.

Utensils:

saucepan	wooden spoon
glass measuring cup	double boiler
measuring spoons	ladle lā'd'l
spatula	

Ingredients:

3 T. sugar	$\frac{1}{2}$ C. water
3 T. cocoa	$3\frac{1}{2}$ C. milk
dash of salt	

Procedure:

1. Mix sugar, cocoa, and salt in a saucepan.
2. Add water and mix again.
3. Bring to boiling point over low heat.
4. Cook for 3 minutes.
5. Stir the mixture while it is cooking.
6. Pour the mixture into the double boiler. Look at Lesson 9 to make sure you know how to use the double boiler.
7. Add milk to the mixture in the double boiler. Stir.

8. Heat the cocoa.

9. Use a ladle to put the cocoa into cups.

10. Sometimes you may put a marshmallow into each cup.

11. Serve.

Vocabulary:

marshmallow - mär̈sh'mäl̆ ō -- a soft, white candy covered with powdered sugar

Assignment:

1. How much is a dash of salt?

2. If you measure the cocoa with a teaspoon, how many teaspoons will you need to make 3 tablespoons?

3. Why do you put a saucer under the cup?

UNIT VI - TOAST

How To Prepare Buttered Toast **Lesson 1**

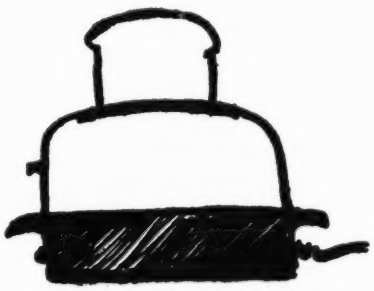
Objective: To learn how to prepare and serve buttered toast.

Information: All of us have eaten toast. Toast is bread that is made brown by heating. How do you make toast at home? Do you use a toaster or broiler? Sometimes we serve plain toast, and sometimes we add food to the toast to make it taste a little different. We eat toast for breakfast, or use toast for a sandwich, or for a snack.

Now you will learn some different ways to make toast.

1. Most people make toast in a toaster. The new toasters have a little knob you may turn to get light or dark toast.

2. To make many slices of toast at one time, you may use the broiler in your stove.



   a. For dry, crisp toast set the temperature control knob for the broiler at 350°.

   b. Put the rack 2 inches from the heat in the broiler.

   c. Put the slices of bread on the rack in your broiler.

   d. You must watch the toast in the broiler.

   e. When one side of the bread is brown, turn the toast over to brown the other side.

3. Butter the toast while it is warm.

4. Always serve toast hot.

5. If toast gets cold, warm it in the oven before serving.

6. Always cut the toast in half before serving.

7. Toast may be served with jam or marmalade.

Vocabulary:

toast	-	tōst -- bread that is made brown by heating
broiler	-	broil'ĕr -- the part of a stove where food can be cooked directly under the flame. There is nothing between the flame and the food.
breakfast	-	brĕk'fȧst -- the first meal of the day
meal	-	mēl -- the food you prepare to be eaten at one time
sandwich	-	sȧnd'wĭch -- two or more slices of bread with other food between them
snack	-	snȧk -- a small amount to eat at one time
jam	-	jȧm -- fruit boiled with sugar until it is thick and smooth
marmalade	-	mär'mȧ lād -- fruit, fruit peelings, and sugar boiled together until thick. Marmalade is not smooth.

Assignment:

1. Name two ways to make toast.

2. What do you use to make many slices of toast at the same time?

3. Why do you turn on the broiler before you get out the bread?

4. If toast gets cold, how do you warm it before serving?

5. When do you butter the toast?

6. Do you serve toast in a whole slice?

UNIT VI - TOAST

Cinnamon Toast **Lesson 2**

Objective: To prepare and serve cinnamon toast for four people.

Utensils:

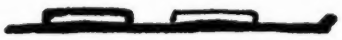
measuring spoons

spatula

small jar
smôl jär

butter spreader
bŭt'ĕr spred er

baking sheet
bāk'ĭng shēt



Ingredients:

4 slices of bread

butter

3 T. sugar

2 tsp. cinnamon

Procedure:

1. Turn on the broiler. Set the temperature control knob at 350°.
2. Be sure the rack is 2 inches below the heat.
3. Measure the sugar and cinnamon and put in jar.
4. Close jar tight, and shake well.
5. Put 4 slices of bread on the rack in the broiler.
6. When one side of bread is brown, turn bread to the other side.
7. Butter the bread as soon as it is toasted on both sides.
8. Sprinkle each slice of toast with the mixture of cinnamon and sugar.
9. If toast gets cold, placd the toast on a baking sheet, and put it in a warm oven for about 3 minutes.
10. Cut each slice of toast in half, and serve at once.

Vocabulary:

tight - tīt -- firm or hard so that no food can spill out

shake - shāk -- to move up and down quickly

Assignment:

1. How many teaspoons are in 3 T.?

2. Why do you shake the cinnamon and sugar?

3. Why do you use the broiler for toast in class?

4. When eating, do you pick up half a slice of toast at one time?

5. Make toast, using a mixture of 3 T. sugar, 1 T. cocoa, and $\frac{1}{2}$ tsp. cinnamon to sprinkle on the toast.

French Toast — Lesson 3

Objective: To prepare and serve French toast for four people.

Utensils:

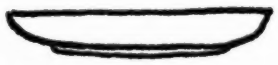
baking sheet

glass measuring cup

measuring spoons

fork
fôrk

shallow bowl
shăl'ō bōl



frying pan
frī'ing păn

turner
tûr'nĕr

Ingredients:

4 slices of bread

2 eggs

$\frac{1}{2}$ C. milk

$\frac{1}{4}$ tsp. salt

1 T. shortening

Procedure:

1. Break the eggs into a shallow bowl.
2. Add the milk and salt to the eggs.
3. Beat well with a fork.
4. Put the frying pan on the stove, over a small flame.

5. As soon as it is hot, add the shortening. Butter or cooking oil may be used instead of shortening.

6. Melt the shortening. Be sure the shortening covers the whole bottom of the frying pan.

7. Be careful not to burn the shortening because your fat will turn brown and make smoke.

8. Dip 1 slice of bread at a time in the egg mixture.

9. Be sure the whole slice of bread is covered with the egg mixture.

10. Use your turner to put the bread in the frying pan.

11. When one side of the bread is brown, turn the bread over with your turner, and brown the other side.

12. Place bread on a baking sheet in a warm oven until all the French toast is ready to be served.

13. When you are finished using the frying pan, let it cool a little before putting water in it.

14. Serve French toast while it is hot.

15. French toast may be served with butter, syrup, jam, honey, or fruit.

Vocabulary:

shallow	-	shăl'ō -- not deep
dip	-	dĭp -- to wet by putting into a liquid and lifting out
honey	-	hŭn'ĭ -- a sweet, sticky, yellow liquid made by bees

shortening?

the whole bottom of the frying pan?

UNIT VII - FRUIT

Names of Some Fruits **Lesson 1**

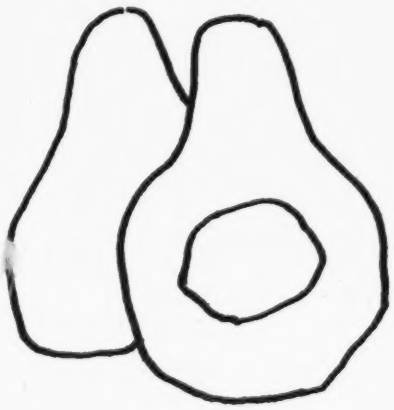
Objective: To learn the names of some fruits.

Information: We all eat fruit. How many kinds of fruit have you eaten? Have you eaten some fruits that are sweeter than others? Fruits are not only good to look at but they taste so good. Fruits help to give us energy and vitamins. We find a lot of Vitamin C in fruit. We should have some fruit every day.

Now you will learn the names of some fruits. Color the pictures of these fruits.

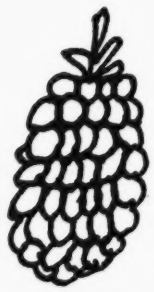
apple
ăp''l

apricot
ā'pri ŏt



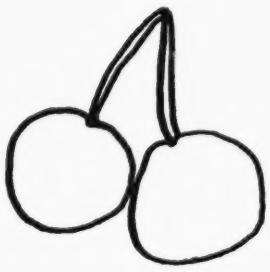
avocado
ăv ō kä'dō

banana
bȧ năn'ȧ



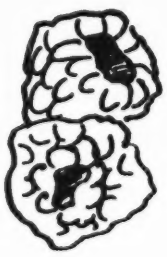
blackberry
blăk'bĕr ĭ

blueberries
blōō'bĕr ĭz

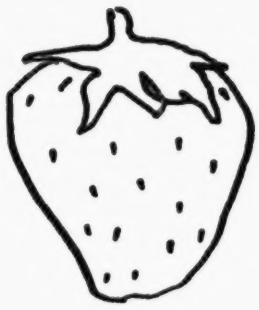


cherries
chĕr'ĭz

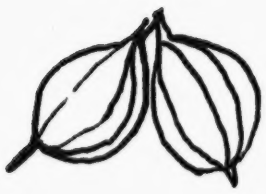
currants
kûr'ănts



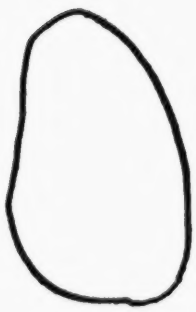
raspberries
răz'bĕr ĭz



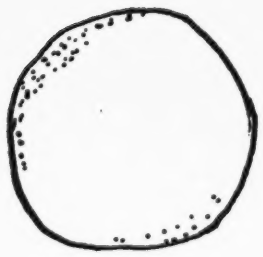
strawberry
strô'bĕr ĭ



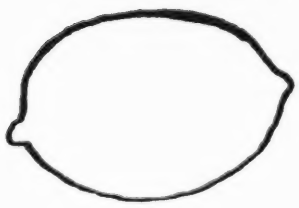
gooseberries
gōoz'bĕr ĭz



kumquat
kŭm'kwŏt

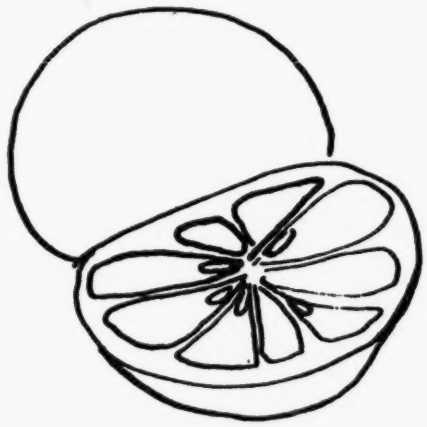


orange
ŏr'ĕnj

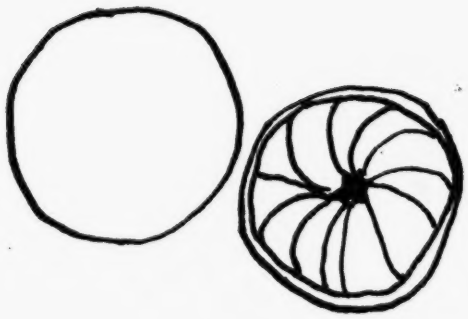


lemon
lĕm'ŭn

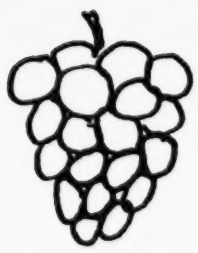
lime
līm



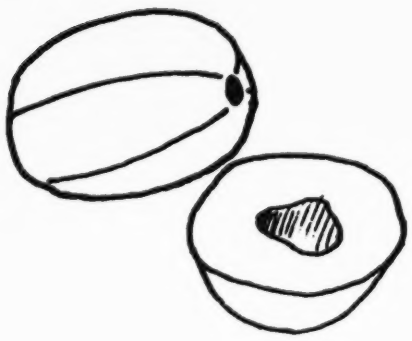
grapefruit
grāp ˈfro̅o̅t



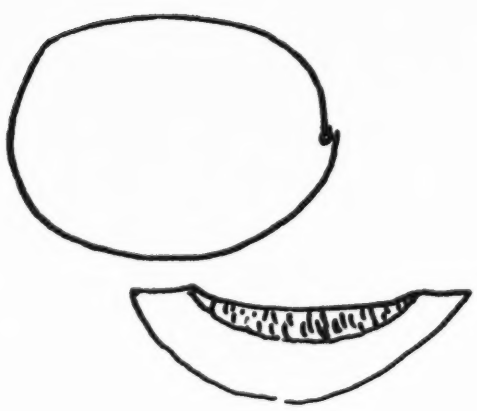
tangerine
tăn jĕ rēn ˈ



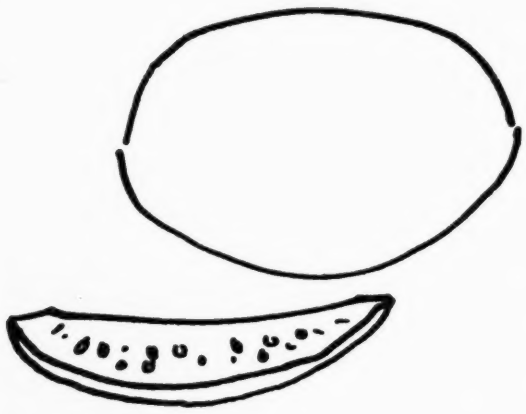
grapes
grāps



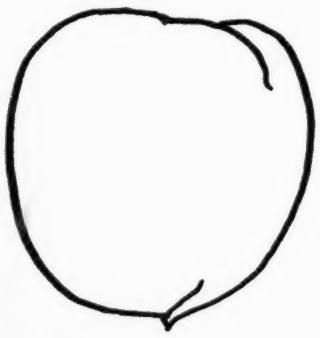
cantaloupe
kăn ˈtȧ lōp



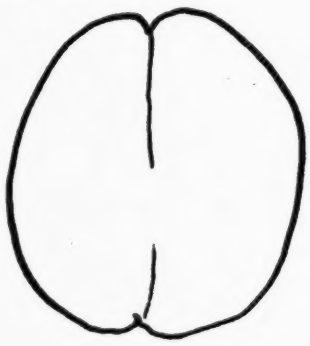
honeydew melon
hŭn ˈĭ dū měl ˈŭn



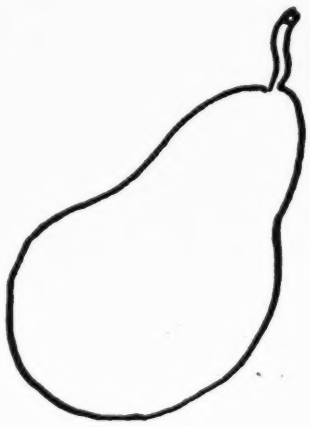
watermelon
wô'tĕr mĕl ŭn



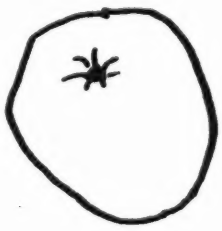
peach
pēch



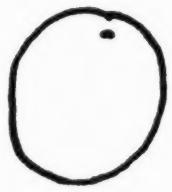
nectarine
nĕk tĕr ēn'



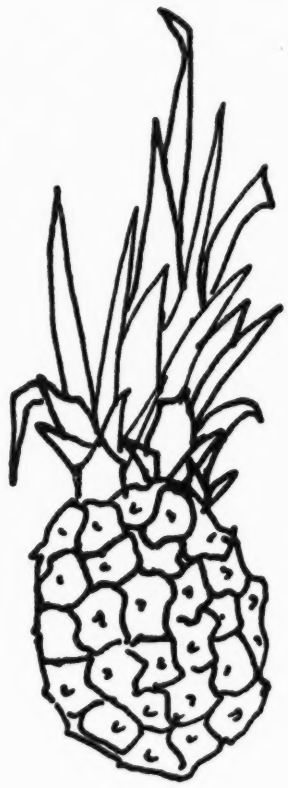
pear
pâr



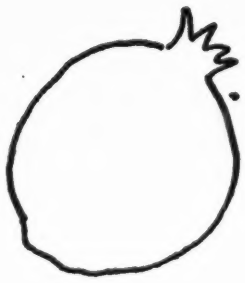
plum
plŭm



prune
prōon



pineapple
pīn 'ăp' l



pomegranate
pŏm 'grăn ĭt

Vocabulary:

energy - ěn ˈêr jǐ - the strength to do things

vitamin - vī ˈtà mǐn -- things found in foods that are needed to keep us well and strong. Different vitamins are found in different foods.

Assignment:

1. How do fruits help your bodies?

2 What vitamin is found in many fruits?

3. Should you have some fruit every day?

4. Name some different kinds of berries.

5. Name three kinds of melons.

UNIT VII - FRUIT

Some Ways To Buy Fruit **Lesson 2**

Objective: To learn some of the different ways that you can buy fruit.

Information: We see fruit in many different ways in the store. When you go to the store, find some of the ways that fruit is sold. Look for fresh fruit and fruit in boxes, jars, and cans. See how many names you can remember.

Now you will learn some different ways to buy fruit.

1. Fresh or raw fruit is fruit that you buy just as it is grown.
2. Dried fruit is fruit that has had the water taken out of it.
3. Canned fruit is fruit that is preserved in liquid in a can or jar, sometimes with sugar added.
4. Frozen fruit is fruit that is preserved by keeping it hard and cold.
5. Fruit juice can be bought either fresh, canned, or frozen.

Vocabulary:

raw - rō -- not cooked

preserve - prē zûrv′-- keep from spoiling

Assignment:

1. What is raw fruit?
2. What is dried fruit?
3. Name some canned fruit that you have eaten.
4. What does preserve mean?

Ways To Prepare Fruit Lesson 3

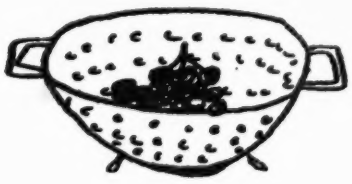
Objective: To learn some ways to prepare fruit.

Information: Fruit may be served fresh, or cooked in many ways. How many of you have fruit growing in your yard at home? People grow fruit to eat fresh, to make juice, to can or freeze for the winter, or to make jams or jellies.

Now you will learn some ways to prepare fruit:

To prepare fresh fruit to be eaten raw:

1. Wash large fruit in water, using a brush to make sure all dirt is off the fruit.
2. Wipe the fruit dry.
3. Wash berries and grapes in a colander, by running cold water over the fruit.
4. Let the water drain off.
5. Remove stems from the berries.
6. Keep fruit in the refrigerator or a cool place. Bananas should not be kept in the refrigerator.



To prepare fresh fruit for cooking:

1. Select fruit which is fresh and ripe.
2. Wash the fruit well, and drain it.
3. Handle the fruit lightly. Do not crush it.
4. Remove any bad spots.
5. If fruit is to be peeled, take off thin peelings. Do not waste the fruit. Take off only the skin.

6. When cooking fruit, do not overcook. The color and flavor change when fruit is cooked too long.

7. You will learn to cook fruit by stewing and baking

To prepare dried fruit:

1. Some dried fruits, like dates, figs, and raisins, are eaten as they are bought.

2. Dates are sometimes stuffed.

3. Dried fruits may be stewed, like stewed prunes or stewed apricots.

Vocabulary:

colander	-	kŭl'ŭn dĕr -- a bowl with holes to let liquid drain off a food
stem	-	stĕm -- the part that holds the fruit to the plant or tree
select	-	sĕ lĕkt'-- pick out
stew	-	stū -- boil slowly or simmer
bake	-	bāk -- to cook in the oven
stuffed	-	stŭft -- filled

Assignment:

1. Why do you use a brush to wash large fruit?

2. Why do you wash berries in a colander?

3. Why is it important to take off only the skin, when peeling fruit?

4. What happens when fruit is overcooked?

5. What is stewing?

6. What is baking?

7. How do you use dried fruit?

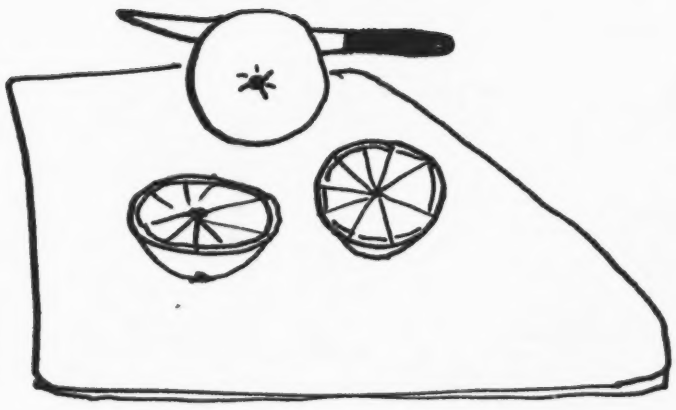
How To Prepare Fresh Fruit — Lesson 4

Objective: To learn how to prepare fruit to be served in halves, sliced, and as a fruit cup.

Information: We have learned that fresh fruit may be served in halves, sliced, or cut up. We are going to learn how to prepare grapefruit halves, orange slices, and fruit cup. We always wash and chill the fruit first. We are careful how we handle cut fruits because we don't want to lose the juice. We want the fruit to look attractive when we serve it.

Now you will learn how to prepare grapefruit halves, orange slices, and fruit cup.

To prepare halves of grapefruit:



1. Cut the grapefruit in half so that the blossom end is in one half and the stem end in the other half.
2. Remove the seeds.
3. Cut the sections from the membrane and skin with a fruit knife.
4. Remove the center with a paring knife or scissors.
5. Serve cold on a salad plate.
6. Serve half a grapefruit to each person.

To prepare orange slices:

1. Remove the skin and membrane from an orange with a paring knife.

2. Cut along the membrane line of each section, and take out the sections.

3. Chill the sections.

4. Serve in a small dish.

To prepare fruit cup:

1. Use three or four different kinds of fruit.

2. To use grapefruit, orange, banana, and berries:

   a. Prepare the grapefruit and orange, just as you did for orange slices.

   b. Peel the banana. Cut it in pieces.

   c. Put cut banana in bowl.

   d. Put the grapefruit and orange sections on top of the banana. This will keep the banana from getting dark.

   e. Add some berries to the other fruit.

   f. Chill the fruit.

   g. Serve in sherbet glasses.

Vocabulary:

halves	-	hăvs -- two parts the same size
seeds	-	sēds -- the little pits or stones in some fruit
sections	-	sĕk′shŭns -- parts of the fruit that can be cut apart
membrane	-	mĕm′brān -- a thin, soft covering or skin
skin	-	skĭn -- a covering
fruit knife	-	froōt nīf -- a knife with a thin, curved blade
core	-	kōr -- the center of some fruits, like apples and pears. You do not eat the core.

Assignment:

1. Why must you be careful how you handle cut fruit to be served in a fruit cup?

2. How do you cut a grapefruit in half?

3. What kind of knife do you use to cut grapefruit sections?

4. Why do you put the grapefruit and orange sections on top of the banana in the bowl?

5. How do you serve fruit cup?

UNIT VII - FRUIT

Ways To Fill Dates **Lesson 5**

Objective: To learn about filling dates.

Information: A date is a small, sweet, brown fruit. It is a fruit that has a long pit through the middle. Many people buy pitted dates, which are dates with the pit taken out. Dates are very good as a snack. We may eat plain dates, or put different kinds of fillings in the dates.

Now you will learn about filling dates.

1. Pitted dates are bought in a package.
2. Be sure you have a long slit in one side of the date.
3. Fill each date with peanut butter, or nuts, or cream cheese, or a cherry.
4. For a sweet filling, you may make a sugar mixture, which you will learn in the next lesson.
5. After the dates are filled, you may press the edges together or leave an opening so that the filling shows.
6. You may roll the dates in sugar to make them a little different.

Vocabulary:

filling	-	fĭl'ĭng -- what is put in
pit	-	pĭt -- the seed of the fruit
package	-	păk'ĭj -- something that is wrapped and tied or sealed
slit	-	slĭt -- opening
press	-	prĕs -- push

Assignment:

1. What is the color of a date?

2. What are pitted dates?

3. What does filling mean?

4. Name some different fillings for dates.

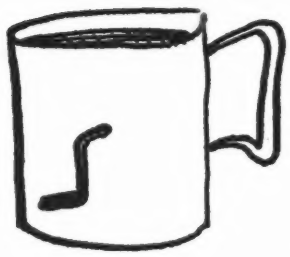
UNIT VII - FRUIT

Recipe for Stuffed Dates **Lesson 6**

Objective: To prepare stuffed dates.

Utensils:

- measuring spoons
- metal measuring cup
- mixing bowl
- wooden spoon
- sifter
- sift 'er
- strainer
- squeezer
- scraper
- paring knife



Ingredients:

1 T. butter

$1\frac{3}{4}$ C. confectioners' sugar

2 T. orange juice

1 $6\frac{1}{2}$-ounce package of pitted dates

Procedure:

1. Put butter into mixing bowl.
2. Soften butter by pressing butter against the sides of the mixing bowl with a wooden spoon.
3. Sift the confectioners' sugar onto a paper towel.
4. Measure the confectioners' sugar.
5. Add sugar to butter and beat with a wooden spoon.
6. Squeeze an orange and put the juice through a strainer.
7. Measure the orange juice and stir it into the sugar mixture.

8. Roll this mixture in your hands until it is about one inch thick.

9. Cut in pieces and stuff some into each date.

10. To make the dates look pretty, sometimes you may put some jelly or a gumdrop on top of the filling.

Vocabulary:

soften	-	sŏf'ĕn -- make something so that it can be mixed easily
roll	-	rōl -- turn over and over again
gumdrop	-	gŭm' drŏp -- a candy that is soft enough to chew

Assignment:

1. How do you soften butter?

2. Do you always sift confectioners' sugar before you measure it?

3. Why do you put the juice through a strainer?

4. Do beat and stir mean the same thing?

5. What does it mean to roll the mixture in your hands?

6. How much confectioners' sugar would you need to make the filling for two packages of pitted dates?

Recipe for Baked Apples

Lesson 7

Objective: To prepare and serve baked apples for four people.

Utensils:

metal measuring cup

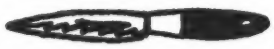
glass measuring cup

measuring spoons

baking dish
bāk'ing dish

spatula

apple corer
ăp'l kōr'ẽr



baking cup
bāk'ing kŭp

Ingredients:

4 apples
$\frac{1}{4}$ C. brown sugar
$\frac{1}{4}$ tsp. cinnamon
2 tsp. butter
$\frac{1}{2}$ C. water

Procedure:

1. Set the temperature control knob for the oven at 375°.
2. Wash and dry apples.
3. Core the apples. Do not peel them.
4. Put the apples in the baking dish.
5. Mix the sugar and cinnamon in the baking cup.
6. Put some of the sugar mixture in the hole in each apple.
7. Put some butter on top of the sugar mixture that is in the apple.
8. Pour the water around the apples in the baking dish.
9. Bake for 45 minutes.
10. Serve hot or cold. You may serve whipped cream on top of each apple.

Vocabulary:

whipped cream	-	hwipt krēm -- cream that has been beaten with a beater to make it thick

Assignment:

1. Do you pack brown sugar in the cup when you measure it?

2. What does core mean?

3. Why do you pour the water around the apples in the baking dish?

4. Try making baked apples with a different filling. Put half a marshmallow in the bottom of the hole. Fill the hole with raisins. Put the other half of the marshmallow on top of the raisins.

Recipe for Applesauce

Lesson 8

Objective: To prepare and serve applesauce for four people.

Utensils:

bread board

paring knife

saucepan

cover
kŭv'ĕr

mixing bowl

fork

glass measuring cup

metal measuring cup

measuring spoons

wooden spoon

large strainer
lärj strān'ĕr

Ingredients:

4 apples
½ C. water
¼ C. sugar
¼ tsp. cinnamon

Procedure:

1. Wash the apples, but do not peel them.
2. Cut them into four parts.
3. Take out the pits and any brown spots.
4. Cut the apples into smaller pieces on the bread board.
5. Put the cut apples in a saucepan.
6. Pour the water into the saucepan.
7. Cover the saucepan.
8. Cook over medium heat.
9. Stir once in a while, not all the time.

10. Cook until the apples are soft. Prick the apples with a fork to find out if they are soft.

11. Take the pan off the stove.

12. Put the strainer in the mixing bowl.

13. Pour the apples into the strainer.

14. Mash the apples through the strainer with a wooden spoon, until only the skins are left in the strainer.

15. Add the sugar and cinnamon to the cooked apples. Stir.

16. Serve hot or cold in a small dish.

Vocabulary:

prick - prĭk -- make a little hole

Assignment:

1. Why do you have to cook apples in water?

2. Why do you cover your saucepan?

3. How can you tell when the apples are soft?

4. Why do you use a strainer?

5. What is a dessert dish?

6. Do you put a plate under the dish of applesauce when you serve it?

7. You have made smooth applesauce. Now to make applesauce that is not smooth. Follow your recipe, except for two steps:

   a. Peel your apples after you wash them.
   b. Do not put the cooked apples through the strainer.

Recipe for Stewed Prunes — Lesson 9

Objective: To prepare and serve stewed prunes for four people.

Utensils:

saucepan

measuring spoons

paring knife

Ingredients:

$\frac{1}{2}$ lb. of prunes

1 slice of lemon

3 T. sugar

Procedure:

1. Wash the prunes.
2. Put the prunes in the saucepan.
3. Cover the prunes with water.
4. Let the prunes soak for one hour.
5. Add the slice of lemon.
6. Put the pan over a medium flame.
7. When the water comes to a boil, turn the flame low, so that the prunes will simmer.
8. Cook for 45 minutes.
9. Take out the lemon slice.
10. Add the sugar.
11. Let the prunes cool before serving.

Assignment:

1. Are prunes a dried fruit?

2. Why do you soak the prunes before cooking them?

3. What does simmer mean?

4. Name some other fruits that you may stew.

Ways To Serve Fruit

Lesson 10

Objective: To learn some ways to serve fruit.

Information: How many ways has fruit been served to you? We drink fruit juice, and we eat fresh and cooked fruit. Sometimes fruit is served whole, and sometimes it is cut up. Fruit is very good for us whether we eat it fresh or cooked.

Now you will learn some ways to serve fruit.

Fresh fruit may be served:

1. Whole, like an apple or banana.
2. Halved or cut in half, like a grapefruit or melon.
3. Slices, like sliced peaches or pears.
4. Cut in small pieces, like a dish of different kinds of fruit mixed together. This is called fruit cup.
5. As a juice, like orange juice.

Cooked fruit may be served:

1. Whole, like a baked apple, or stewed berries.
2. In halves, or smaller pieces, like stewed peaches or pears.
3. Mashed, like apple sauce.

Dried fruit may be served:

1. Whole, like dates or figs or raisins.
2. Stuffed, like dates with a filling.
3. Stewed, like stewed prunes or apricots.

Assignment:

1. Name some ways that fresh fruit may be served.

2. What is fruit cup?

3. How may cooked fruit be served?

4. Name some dried fruits that you eat without cooking them.

When To Serve Fruit — Lesson 11

Objective: To learn when to serve fruit.

Information: When do you eat fruit? Do you think you should eat fruit only for breakfast? We see people eat fruit at any meal, and sometimes between meals. Fruit may be served in one way at breakfast, in another way at lunch or supper, and in a different way again at dinner.

Now you will learn when to serve fruit.

1. Fruit as an appetizer.
   a. Fruit juice at breakfast or before dinner.
   b. Whole or cut raw fruit at breakfast or before lunch or dinner.
   c. Stewed fruit at breakfast.
2. Fruit as a salad.
   a. Many kinds of cut-up fresh fruit served on lettuce for lunch.
   b. Sliced fruit on lettuce for dinner.
3. Fruit as a garnish.
   a. Slices of fruit with meat, like baked ham with pineapple slices.
   b. Lemon slices with fish.
4. Fruit as a dessert.
   a. Raw fruit served whole or cut up.
   b. Stewed or baked fruit.
   c. Fruit with other food, such as jello or cake, or in a pie.
5. Fruit as a snack--any kind of fruit is good as a snack.

Vocabulary:

lunch	-	lŭnch -- a light meal served in the middle of the day
dinner	-	dĭn'ẽr -- the biggest meal of the day
supper	-	sŭp'ẽr -- a light meal in the evening, when dinner is eaten in the middle of the day
appetizer	-	ăp'ē tīz ẽr -- a little food or drink served at the beginning of a meal
salad	-	săl'ăd -- food, usually cold, that is served with a dressing
dressing	-	drĕs'ĭng -- a food or mixture of foods that is added to a salad to give it a certain flavor
lettuce	-	lĕt'ĭs -- a green leaf used in salads
garnish	-	gär'nĭsh -- something to make a dish of food look pretty
dessert	-	dĭ zûrt'-- something that is eaten at the end of a meal

Assignment:

1. What is an appetizer?

2. How is fruit served as an appetizer?

3. At what meals are fruits used in a salad?

4. What food is put under the fruit in a salad?

5. What is a garnish?

6. How do you serve fruit for dessert?

UNIT VIII - CEREALS AND QUICK BREADS

Cereals Lesson 1

Objective: To learn about cereals.

Information: There are many, many kinds of cereal. Some are ready to eat, and some need to be cooked. Cereals give us energy. They are a very good breakfast food. Some cereals are better for us than others. Watch for the words "whole-grain cereal" on the package. Whole-grain cereals are the best for us.

Now you will learn about cereals.

Ready-to-eat cereals.

1. Ready-to-eat cereals should be kept in a dry place to keep them crisp.

2. Be sure to keep the package tightly closed.

3. If cereal becomes soft, put it in a shallow pan in a warm oven for a few minutes. This will make the cereal crisp again.

4. Cereal may be served with sugar and milk, or with fruit and milk.

Cooked cereals.

1. Cooked cereals should be smooth. You do not want lumps.

2. Cooked cereals must be well cooked.

3. Cooked cereals should be salted during cooking for flavor.

4. Cooked cereals should be firm, not watery.

5. Cereal may be cooked with milk instead of water.

6. When cooking cereal, do not stir all the time. That will make the cereal too soft.

7. Follow the measurements and directions on the package exactly.

8. Cooking in the double boiler after the cereal has thickened will keep the cereal from burning.

Vocabulary:

cereal	-	sēr'ē ŭl -- food made from grain
grain	-	grān -- the seeds of certain plants that can be eaten
crisp	-	krĭsp -- not soft; easily broken
thickened	-	thĭk'ĕnd -- made more solid

Assignment:

1. Find the names of some whole-grain cereals in the store.

2. Why are cereals good for us?

3. Why should you keep packages of ready-to-eat cereals tightly closed?

4. If ready-to-eat cereal gets soft, how do you make it crisp again?

5. Why do you put salt in cereal when you are cooking it?

6. What is sometimes used instead of water to make cooked cereal?

7. When cooking cereal, why do you put it in the double boiler after the cereal has thickened?

Objective: To learn about quick breads.

Information: We are going to learn about quick breads that are made light by baking powder. We do not want to eat a bread that is heavy to pick up. That is why we use baking powder. We have all eaten biscuits and muffins. These are two kinds of quick breads. When we know how to make plain biscuits and muffins, we may add other foods to our recipes to change the flavor of a quick bread. This is very helpful because these breads are served at many meals.

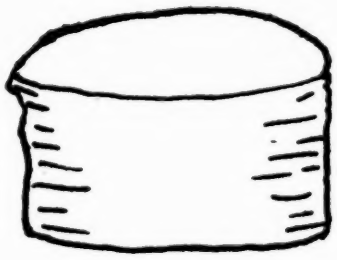
Now you will learn about some quick breads.

1. Baking powder biscuits.

   a. Baked biscuits should be about twice as big as when they were put in the oven.

   b. The biscuits should be light brown on top and bottom.

   c. The biscuits should have straight sides and smooth tops.



   d. The biscuits should have tiny, even holes on the inside. They should not have some big and some little holes.

   e. The color of the inside should be creamy white.

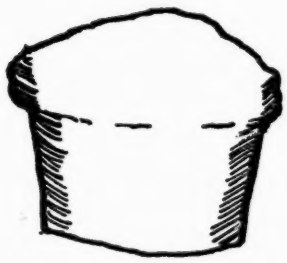
   f. When you break open a biscuit, the inside should come apart in layers.

   g. Do not use a knife to open a biscuit. Biscuits are too soft for a knife to cut.

   h. Biscuits may be served with butter or jam.

   i. Biscuits taste best when served hot.

2. Muffins



a. Muffins should have a well-rounded top, The tops are not as smooth as the tops of baking powder biscuits.

b. The tops should be evenly and lightly browned.

c. The insides should have tiny, even holes.

d. Muffins should feel very light.

e. The crust should be crisp and thin.

3. Dough

a. A baking powder biscuit mixture is a dough.

b. For a dough, cold shortening is put with the dry ingredients.

c. For a dough, mix the ingredients only enough to make a soft dough.

d. A soft dough is one which you can pick up in your hands. It will not stick to your hands.

4. Batter

a. A muffin mixture is a batter.

b. For a batter, melted shortening is poured into the dry ingredients.

c. Stir only enough to wet the dry ingredients. You will have muffins with big holes if you stir the batter too much.

d. A batter is too thin and sticky to be picked up in your hands. You use a spoon or pour the batter.

Vocabulary:

biscuit - bĭs'kĭt -- a kind of bread baked in small shapes

muffin - mŭf'ĭn -- a quick bread made with egg

layers - lā'ẽrs -- one flat piece on top of another

dough - dō -- a mixture of flour, liquid, and other foods that can be kneaded

knead - nēd -- work or mix with the hands

batter - bŭt'ẽr -- a mixture of flour, liquid, and other foods that can be stirred or poured

Assignment:

1. What helps to make your quick breads light?

2. Name two kinds of quick breads.

3. What is the color of the inside of a baking powder biscuit?

4. Do you use a knife to open a biscuit?

5. Do the tops of muffins and baking powder biscuits look the same?

6. Does a good muffin have tiny holes through the inside?

7. Should muffins have a thick crust?

8. What is a dough? Name a dough.

9. Do you melt the shortening for a dough?

10. What is a soft dough?

11. What is a batter? Name a batter.

12. What happens if you stir a batter too much?

13. Can you pick up a batter with your hands?

UNIT VIII - CEREALS AND QUICK BREADS

Recipe for Baking Powder Biscuits **Lesson 3**

Objective: To prepare and serve baking powder biscuits.

Utensils:

mixing bowl

glass measuring cup

metal measuring cup

measuring spoons

pastry blender
pās'trĭ blĕnd'ẽr

flour sifter

spatula

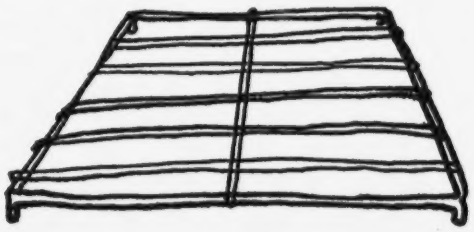
wooden spoon

food scraper

baking sheet

wooden board

cake rack
kāk răk



cookie cutter
kŏok'ĭ kŭt'ẽr

Ingredients:

1 C. sifted flour

2 tsp. baking powder

$\frac{1}{4}$ tsp. salt

2 T. shortening

$\frac{1}{3}$ C. milk

Procedure:

1. Turn your oven on to 450°.
2. Measure the flour.
3. Sift the flour onto a paper towel.
4. Put the sifter into the mixing bowl.
5. Measure the flour again.
6. Sift flour, baking powder, and salt into the mixing bowl.
7. Add the shortening to the flour mixture.
8. Cut in the shortening with a pastry blender until you cannot see any lumps of shortening.
9. Add the milk, stirring only until the mixture is in one ball.

10. Sprinkle a little flour on the wooden board.
11. Knead the dough with your hands only until the dough is smooth.
12. Pat the dough on the board until it is about $\frac{3}{4}$ inch thick.
13. Cut the dough with a floured cookie cutter.
14. Place the biscuits, 1 in. apart, on an ungreased baking sheet.
15. Bake in a 450° oven for about 15 minutes.
16. Place biscuits on cake rack until ready to serve.
17. Serve hot with butter or jam.
18. This recipe makes about eight biscuits.

Vocabulary:

pat - pŭt -- touch lightly to make flat

ungreased - ŭn grēst'-- with no fat

Assignment:

1. Why do you turn your oven on before you start to prepare the biscuits?

2. How do you know when the shortening is cut into the flour mixture?

3. What does knead mean?

4. Why do you put flour on your cookie cutter?

5. Why do you place the biscuits 1 inch apart on the baking sheet?

6. How do you know if you have a perfect biscuit?

Recipe for Muffins — Lesson 4

Objective: To prepare and serve muffins.

Utensils:

2 mixing bowls	spatula	cake rack
glass measuring cup	small saucepan	wooden spoon
metal measuring cup	baking cup	tablespoon
measuring spoons	egg beater	muffin pan mŭf'ĭn păn
food scraper	sifter	

Ingredients:

1 C. sifted flour	$\frac{1}{3}$ C. milk
$1\frac{1}{2}$ tsp. B. P.	1 egg, beaten
2 T. sugar	1 T. melted shortening
$\frac{1}{4}$ tsp. salt	

Procedure:

1. Turn the oven on to 400°.
2. Mix and sift dry ingredients.
3. Put a little hot water in a saucepan.
4. Put the shortening in the baking cup, and place the baking cup in the saucepan.
5. Heat on the stove until the shortening is melted.
6. Beat the egg in a mixing bowl.
7. Add milk and melted shortening to the egg.
8. Pour this egg mixture into the flour mixture.

9. Stir only until the flour is wet. The batter should have lumps. Do not make it smooth.

10. Grease the muffin pan. Put a little shortening on wax paper and rub each muffin cup. If the cups are not greased, the muffins will stick to the cups.

11. Fill each cup half full with the batter. Use a tablespoon and food scraper to put the batter in the muffin pan.

12. Put a little water in each muffin cup that does not have batter in it.

13. Bake in 400° oven for 20 to 25 minutes.

14. Put a clean toothpick into the center of one muffin to see if it is baked. If the toothpick comes out clean and dry, the muffins are ready to be taken out of the oven.

15. This recipe makes six muffins.

Vocabulary:

wax paper - wăks pā'pĕr -- paper that has a coating of wax to keep food from soaking through

greased - grēst -- with fat put on

Assignment:

1. What are the rules for mixing and sifting dry ingredients?

2. Why do you melt shortening over hot water?

3. Should muffin batter be smooth?

4. What will happen if the muffin pan is not greased?

5. Why do you fill the muffin cups only half full?

6. Why do you put water in the muffin cups that you don't use?

7. How do you know when the muffins are baked?

Different Biscuit and Muffin Recipes — Lesson 5

Objective: To learn how to make different biscuit and muffin recipes.

Information: First, we must be able to make perfect plain biscuits and muffins. Then, we may add food or make some changes in the basic recipe to give different flavors to our quick breads.

Now you will learn how to make different biscuit and muffin recipes.

1. Cheese biscuits

   Add $\frac{1}{2}$ C. grated cheese to basic biscuit dough before adding the milk.

2. Drop biscuits

   Use $\frac{1}{2}$ C. of milk instead of $\frac{1}{3}$ C. The dough will be sticky. Drop by spoonfuls on a greased baking sheet.

3. Butterscotch biscuits

   Put a little butter and brown sugar under each biscuit on the baking sheet. When the biscuits are done, turn them upside down, so that the butterscotch mixture will be on top.

4. Berry muffins

   Use the basic muffin recipe, and 1 tsp. more of shortening, 1 T. more of sugar and $\frac{1}{3}$ C. of berries. Add the fruit at the same time the liquid is added.

5. Jelly muffins

   Put the basic muffin batter in the muffin cups, but save a little. Put 1 tsp. of jelly on each muffin. Cover the jelly with the batter you saved.

Vocabulary:

basic - bās' ĭk -- most important. A basic thing is something you must learn first, and then you can go ahead to make other things that are like it.

grated cheese - grāt' ĕd chēz -- cheese that has been rubbed against a prickly piece of metal to cut it into small bits

butterscotch - bŭt' ẽr skŏch' -- a mixture of brown sugar and butter

Assignment:

1. What is grated cheese?

2. How is the dough of drop biscuits different from the dough of plain baking powder biscuits?

3. How do you make butterscotch biscuits?

4. When you make berry muffins, when do you add the berries to the muffin mixture?

5. How do you make jelly muffins?

UNIT IX - EGGS

About Eggs — Lesson 1

Objective: To learn about eggs.

Information: We should eat at least four or five eggs every week. Eggs may be eaten at any meal. Many times eggs are eaten instead of meat at dinner. They are also very good at breakfast. lunch, or supper. There are so many different ways to fix eggs. We are going to learn just a few ways to cook eggs.

Now you will learn some things about eggs.

1. Eggs with a brown shell are just as good as eggs with a white shell.
2. Eggs should be kept in the refrigerator.
3. The two parts of an egg are the white part and the yolk or yellow part.
4. Eggs should be cooked slowly. Eggs cooked over a high flame get tough and hard.
5. Never boil eggs. When you cook eggs in boiling water, you will find a greenish color around the yolk.
6. The easiest way to cook eggs is in the shell, like a hard-cooked egg.
7. Devilled eggs or stuffed eggs are made from hard-cooked eggs.
8. A fried egg is an egg cooked in a little fat.
9. A scrambled egg is a beaten egg, cooked in a little fat.
10. Sometimes other food, like chopped meat, is cooked with scrambled eggs.
11. When eggs are served on a plate, you eat them with a fork.
12. When soft-cooked eggs are served in a cup or small dish, eat them with a spoon.
13. Devilled eggs are eaten with your hand.

Vocabulary:

shell	-	shĕl -- the hard outside covering
yolk	-	yōk -- the yellow part of an egg
tough	-	tŭf -- not easy to chew
fried	-	frīd -- cooked in a little fat in a pan on top of the stove
scrambled	-	skrăm'b'ld -- mixed together
chopped	-	chŏpt -- cut into small pieces
devilled egg	-	dĕv''ld ĕg -- hard-cooked egg, in which the yolk has been mashed with other food and put back into the hard-cooked white

Assignment:

1. How many eggs should you eat every week?

2. At what meals do you serve eggs?

3. Are eggs with a white shell better than eggs with a brown shell?

4. Where should you keep eggs?

5. What are the two parts of an egg?

6. Do you cook eggs over a high flame?

7. Do you ever boil eggs?

8. What is a fried egg?

9. What is a scrambled egg?

10. How do you eat eggs served on a plate?

11. How do you eat devilled eggs?

Eggs Cooked in the Shell

Lesson 2

Objective: To prepare and serve eggs cooked in a shell.

Utensils: saucepan wooden spoon

Ingredients: eggs

Procedure:

1. If eggs are very cold, put them in a bowl of warm water. Then they will not crack when placed in the boiling water.
2. Fill the saucepan about half full with hot water.
3. Put the saucepan on the stove.
4. Bring the water to a boil.
5. Turn the flame low, so that the water will simmer, and not boil.
6. Place the eggs, one at a time, in the water with a wooden spoon. Put the eggs in slowly, so they will not crack.
7. Be sure the water covers the eggs.
8. For soft-cooked eggs:
   a. Cook the eggs for 3 to 5 minutes.
   b. Take the eggs out of the water with a wooden spoon.
   c. Break open the eggs and serve hot in an egg cup or small dish.
   d. Serve with butter, salt, and pepper.
9. For hard-cooked eggs:
   a. Cook the eggs for 20 minutes.
   b. Put the eggs in cold water right away. This makes them easy to peel.
   c. Crack the big end of the egg and peel off the shell.
   d. Serve sliced on lettuce, cut in halves, as devilled eggs, or in a salad.
   e. Serve with salt and pepper.
   f. Hard-cooked eggs keep well in the refrigerator.

Vocabulary:

crack - krăk -- break open

egg cup - ĕg kŭp

Assignment:

1. What utensil is used to put eggs in simmering water?

2. Why do you use this utensil?

3. How long do you cook soft-cooked eggs?

4. How do you serve soft-cooked eggs?

5. Do you serve soft-cooked eggs hot or cold?

6. How long do you cook half-cooked eggs?

7. Why do you put hard-cooked eggs in cold water as soon as they are cooked?

8. Name some different ways to serve hard-cooked eggs.

Recipe for Devilled Eggs **Lesson 3**

Objective: To prepare and serve four devilled eggs.

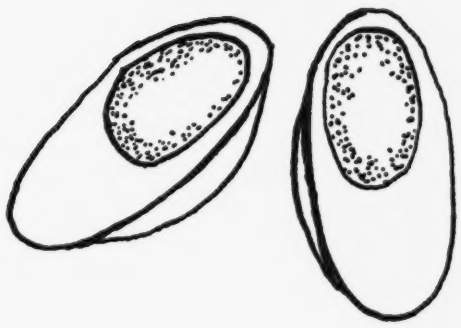
Utensils:

- paring knife
- wooden board
- mixing bowl
- measuring spoons
- spatula
- fork
- teaspoon

Ingredients:

- 4 hard-cooked eggs
- 2 tsp. mayonnaise
- $\frac{1}{8}$ tsp. of salt
- paprika

Procedure:



1. Cut each egg in half the long way.
2. Take out the yolks with a fork and put the yolks in a bowl. Be careful not to break the white part.
3. Add mayonnaise and salt. To measure $\frac{1}{8}$ tsp. of salt, first measure $\frac{1}{4}$ tsp. and take out $\frac{1}{2}$ of the $\frac{1}{4}$ tsp.
4. Mash the egg yolk mixture with a fork.
5. Use a teaspoon to press some egg yolk mixture into each egg-white half.
6. Sprinkle a little paprika on top of each stuffed egg.

Vocabulary:

mayonnaise	-	mā ˈŏ nāz′-- a salad dressing made of egg yolks beaten with other food
paprika	-	pă prē ˈkȧ -- a red-colored powder that is sprinkled on some food to make it look attractive

Assignment:

1. What kind of eggs are used for devilled eggs?

2. Which way do you cut each egg?

3. How do you measure $\frac{1}{8}$ tsp. ?

4. What utensil do you use to mash the egg yolk mixture?

5. Why do you put paprika on top of each devilled egg?

Fried Eggs

Lesson 4

Objective: To prepare and serve a fried egg.

Utensils:

saucer

frying pan

turner

Ingredients:

egg

fat

Procedure:

1. Break the egg into a saucer.
2. Put a little fat in the frying pan. The fat may be shortening, butter, or oil.
3. Melt the fat in the frying pan over a low flame. Do not let the fat burn.
4. Pour the egg carefully into the frying pan.
5. Cook slowly until the egg white is firm. You do not want the egg white brown on the edge.
6. Sometimes, you may like to turn the egg over to cook it more on the other side.
7. Use a turner to take the egg from the pan to the plate.
8. Serve hot with salt and pepper.

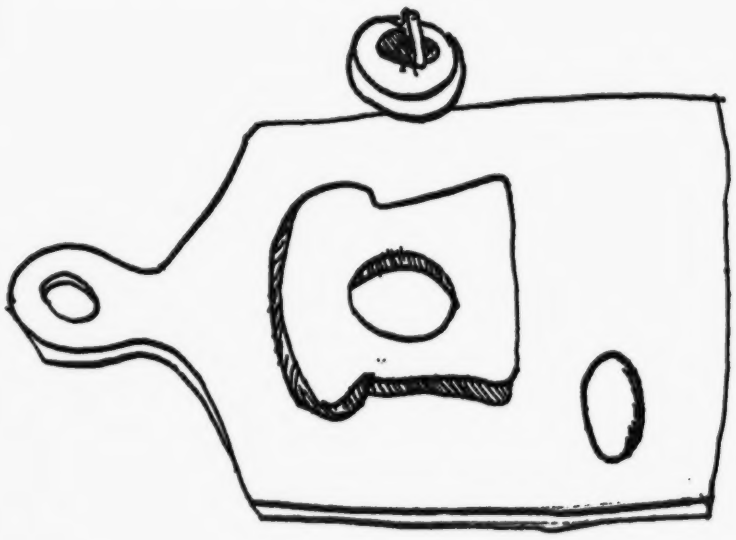
Assignment:

1. What kind of flame do you use for a fried egg? Why?

2. How do you know when the egg is cooked?

3. Try serving a fried egg between two slices of toast.

4. Try another way to serve a fried egg:



a. Cut a hole in a slice of bread with a cookie cutter.

b. Spread the bread with butter.

c. Place the bread, buttered side down, in the frying pan.

d. Break the egg into the hole in the bread.

e. Cook over low heat.

f. Serve hot with salt and pepper.

Scrambled Eggs — Lesson 5

Objective: To prepare and serve four scrambled eggs.

Utensils:

mixing bowl	frying pan
fork	turner
measuring spoons	

Ingredients:

4 eggs	$\frac{1}{4}$ tsp. salt
4 T. milk	fat

Procedure:

1. Break the eggs into the mixing bowl.
2. Beat the eggs with a fork.
3. Add the milk and salt to the eggs.
4. Beat again.
5. Melt a little fat in the frying pan over a low flame.
6. Pour the egg mixture into the hot frying pan.
7. Cook slowly, stirring all the time, until the eggs are done.
8. Use a turner to take the eggs from the frying pan to the plate.
9. Serve hot.

Assignment:

1. What utensil do you use to beat the eggs for scrambled eggs?

2. Try making scrambled eggs, leaving the milk out.

3. Try serving scrambled eggs between two slices of toast.

4. Try adding chopped meat, chopped onion, or chopped green pepper to the egg mixture before it is cooked.

5. Try making scrambled eggs in the double boiler.

UNIT X - SIMPLE BREAKFASTS

How to Plan, Prepare, and Serve Breakfast **Lesson 1**

Objective: To learn how to plan, prepare, and serve simple breakfasts.

Information: We know how to prepare many foods that may be served for breakfast. Now we want to prepare some of these foods at the same time and serve a breakfast. Maybe we would like to have fruit, cereal, and cocoa for a meal. There are many different breakfasts that may be planned from the foods we have prepared.

Now you will learn how to plan, prepare, and serve breakfast.

1. First you must plan what food you will serve for the breakfast. This food is called the menu.
2. You must know how long it takes to prepare each food.
3. Be sure the hot foods will be served hot, and cold foods cold.
4. The table must be set before any food is served.
5. To set the table, you must know what flatware, china, and glassware will be needed.
6. Remember the rules for setting the table and serving food that you learned in Unit IV.
7. Be sure to serve the food in the order in which you will eat it.

Vocabulary:

plan - plăn -- think of how to do something

menu - mĕn'ū -- a list of foods to be served at one meal

Assignment:

1. What is the first thing you do when you are going to make a breakfast?
2. What is a menu?
3. Why must you know how long it will take to prepare each food?
4. Why must you know what flatware, china, and glassware will be needed?

UNIT X - SIMPLE BREAKFASTS

Breakfast Menu No. 1 **Lesson 2**

Objective: To plan, prepare, and serve breakfast for four people.

Information: Breakfast Menu:

Pineapple Juice
French Toast
Milk

Now you will plan, prepare, and serve this menu.

1. The only food that will take time to prepare is the French toast.
2. You will need about 20 minutes to prepare the French toast.
3. Set the table before you start to prepare the toast.
4. Get out the glasses and plates you will need for serving the food.
5. Prepare the egg mixture.
6. While the toast is cooking, pour the pineapple juice and milk.
7. Set the glass of juice and milk at each place.
8. Put the better and jelly on the table.
9. Remember to watch your toast, so that it will not burn.
10. Serve the French toast hot.

Assignment:

1. Why do you set the table before you prepare the French toast?

2. What flatware is needed for this menu?

3. What glasses and plates are needed for this menu?

4. Which foods are served cold, and which foods are served hot?

5. Draw the cover you will use for this menu.

6. Prepare and serve this menu.

UNIT X - SIMPLE BREAKFASTS

Breakfast Menu No. 2 Lesson 3

Objective: To plan, prepare, and serve this breakfast for four people.

Information: Breakfast Menu:

Half Grapefruit
Cooked cereal
Milk

Assignment:

1. How many grapefruits will you need?

2. Which foods will be served hot and which foods will be served cold?

3. Which food will take you the longest time to prepare?

4. What kind of dish will you use to serve cereal?

5. What flatware, china, and glassware will be needed?

6. In what order will you prepare and serve the food in this menu?

7. Draw the cover you will use for this menu.

8. Prepare and serve this menu.

UNIT X - SIMPLE BREAKFASTS

Breakfast Menu No. 3 **Lesson 4**

Objective: To plan, prepare, and serve this breakfast for four people.

Information: Breakfast Menu:

Fruit Cup
Scrambled Eggs
Buttered Toast
Cocoa

Assignment:

1. Plan the order in which you will prepare this menu.

2. Which foods may be prepared first and set aside?

3. How many eggs will you need?

4. Will you serve whole slices of toast?

5. Which food must be served as soon as it is ready?

6. Is all the food put on the table at the same time?

7. Draw a cover for this menu.

8. Prepare and serve this menu.

UNIT X - SIMPLE BREAKFASTS

Breakfast Menu No. 4 **Lesson 5**

Objective: To plan, prepare, and serve this breakfast for four people.

Information: Breakfast Menu:

Orange Juice
Fried Eggs
Butterscotch Biscuits
Butter
Milk

Assignment:

1. What is the first thing you will do before you prepare any of the food?

2. Which foods must be prepared and served as soon as they are ready?

3. How long will it take you to make biscuits?

4. When will you put the butter on the table?

5. Do you need a knife for this breakfast?

6. Will you have all the food on the table at the same time?

7. Draw a cover for this menu.

8. Prepare and serve this menu.

UNIT XI - COOKIES

Recipe for Peanut Butter Cookies **Lesson 1**

Objective: To prepare peanut butter cookies.

Utensils:

glass measuring cup	spatula
metal measuring cup	baking sheets
measuring spoons	sifter
three mixing bowls	fork
wooden spoon	cake rack
food scraper	turner

Ingredients:

$\frac{3}{4}$ C. flour	$\frac{1}{4}$ C. brown sugar
$\frac{1}{2}$ tsp. baking soda	$\frac{1}{4}$ C. granulated sugar
dash salt	$\frac{1}{4}$ tsp. vanilla
$\frac{1}{4}$ C. shortening	$\frac{1}{4}$ C. peanut butter
	$\frac{1}{2}$ egg

Procedure:

1. Set the oven at 375°.
2. Grease the baking sheets.
3. Sift the flour, then measure it.
4. Sift the flour with baking soda and salt. Set this mixture aside.
5. Put egg into small bowl. Beat with a fork. Set aside.
6. Cream the shortening in another bowl.
7. Beat in the sugars with a wooden spoon.
8. Add egg and beat again.
9. Stir in peanut butter and vanilla.
10. Stir in the flour mixture, a little at a time.
11. Make the dough into small balls with your hands.
12. Place cookies on a greased baking sheet.

13. Flatten each ball with the tines of a fork.

14. Bake in 375° oven for 10 minutes.

15. Be sure the baking sheet does not touch the side of the oven.

16. Use a turner to take cookies from the baking sheet to the cake rack to cool.

Vocabulary:

cookie	-	kōok'i -- a small, thin cake
peanut butter	-	pē'nut but'er -- a smooth, soft food made from peanuts
cream	-	krēm -- to mix until soft and smooth

Assignment:

1. How do you measure $\frac{1}{2}$ egg?

2. What does it mean when you say to "cream" the shortening?

3. How much water do you need to measure $\frac{1}{4}$ C. of shortening?

4. What is a greased baking sheet?

5. What does it mean when the recipe says to flatten each ball with the tines of a fork?

6. Why must you make sure the baking sheet is not touching the side of the oven?

Recipe for Raisin-Oatmeal Cookies

Lesson 2

Objective: To prepare raisin-oatmeal cookies.

Utensils:

- glass measuring cup
- metal measuring cup
- measuring spoons
- sifter
- mixing bowl
- spatula
- food scraper
- wooden spoon
- baking sheets
- teaspoons
- cake rack
- turner

Ingredients:

- $\frac{1}{2}$ C. flour
- $\frac{1}{4}$ tsp. baking soda
- $\frac{1}{2}$ tsp. cinnamon
- $\frac{1}{4}$ tsp. salt
- $\frac{1}{4}$ C. shortening
- $\frac{1}{4}$ C. brown sugar
- 2 T. granulated sugar
- $\frac{1}{2}$ egg
- 1 T. milk
- $\frac{1}{2}$ C. raisins
- 1 C. quick-cooking rolled oats

Procedure:

1. Set oven at 375°.
2. Grease the baking sheets.
3. Sift the flour, then measure it.
4. Sift the flour again with baking soda, cinnamon, and salt into a bowl.
5. Add the shortening, sugars, egg, and milk.
6. Beat well with a wooden spoon.
7. Stir in raisins and oats.
8. Drop teaspoons of the mixture 2 inches apart on greased baking sheets.
9. Bake for 12 to 15 minutes.
10. Cool cookies on a cake rack.
11. Keep cookies in a covered jar.

Vocabulary:

oats - ōts -- a grain which is used for food

Assignment:

1. Why do you grease the baking sheets?

2. What kind of cup do you use to measure the raisins?

3. Why do you put the cookies 2 inches apart on the baking sheet?

4. Why do you use a cake rack?

5. Why do you keep cookies in a covered jar?

Recipe for Sugar Drops

Lesson 3

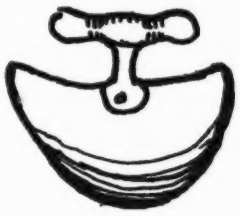
Objective: To prepare sugar drops.

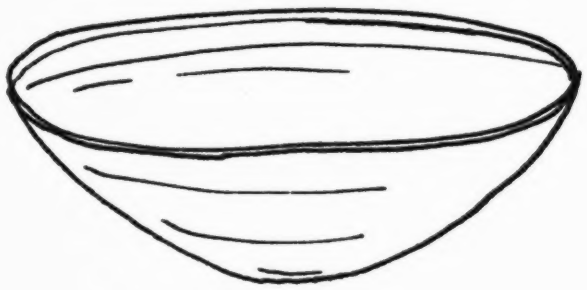
Utensils:

glass measuring cup
metal measuring cup
measuring spoons
spatula
mixing bowl
wooden spoon
sifter
food scraper

baking sheets
cake rack
turner
chopping bowl
chŏp'ping bōl

food chopper
fōōd chŏp'ẽr





Ingredients:

$\frac{2}{3}$ C. shortening	$1\frac{1}{2}$ C. flour
$\frac{3}{4}$ C. sugar	$1\frac{1}{2}$ tsp. baking powder
1 egg	$\frac{1}{4}$ tsp. salt
1 tsp. vanilla	$\frac{1}{2}$ C. chopped nuts
4 tsp. milk	$\frac{1}{2}$ C. raisins

Procedure:

1. Set the oven at 375°.
2. Chop walnuts in the chopping bowl. Measure the nuts after they are chopped.
3. Grease the baking sheets.
4. Cream the shortening with a wooden spoon.
5. Mix the sugar in with the shortening.

6. Add the eggs and beat well.

7. Beat in the vanilla and milk.

8. Sift the flour, then measure it.

9. Sift the flour again with baking powder and salt into the shortening mixture.

10. Mix well.

11. Stir in the chopped nuts and raisins.

12. Drop on greased baking sheets by teaspoons.

13. Bake for 12 minutes.

14. Cool cookies on a cake rack. Cookies must be flat on the rack.

Vocabulary:

walnut - wôl'nŭt -- a large nut with a rough shell

Assignment:

1. Why is your chopping bowl made of wood?

2. How do you measure $\frac{2}{3}$ C. of shortening?

3. Name the dry ingredients in this recipe.

4. Why must you be sure the cookies are flat on the cake rack?

UNIT XII - SANDWICHES

About Cold Sandwiches — Lesson 1

Objective: To learn about cold sandwiches.

Information: We know that a sandwich is two or more slices of bread with food in between. We may use white, whole wheat, or rye bread. Sometimes the bread for sandwiches is toasted or cut into shapes.

Now you will learn about sandwiches.

1. Gold sandwiches may be:

   a. Made for lunch or supper at home.
   b. Made and packed to take out.
   c. Made for parties.

2. Bread must be sliced for a sandwich.

3. Bread slices more easily if it is one day old.

4. For a fancy sandwich, cut sliced bread into shapes with cookie cutters.

5. Spread each slice of bread with softened butter or margarine. This keeps the sandwich filling from soaking through the bread.

6. Mayonnaise may be used instead of butter if the sandwich is to be eaten right away. Mayonnaise will soak through bread if it is left on the bread for a while.

7. Fillings for sandwiches:

   a. Sliced meat or cheese.
   b. Meat, fish, or egg salad.
   c. Cream cheese alone or mixed with other food.
   d. Peanut butter alone or mixed with other food.
   e. Jelly alone or mixed with other food.

8. If sandwiches are not to be eaten right away, wrap each sandwich in wax paper. You do not want the bread to get dry or hard.

9. Cut each sandwich in half or in four parts before it is served.

Assignment:

1. Name three kinds of bread that may be used for sandwiches.

2. When do you serve sandwiches?

3. What is used to cut bread slices into fancy shapes?

4. Why do you spread softened butter or margarine on each slice of bread?

5. What happens if mayonnaise is left on bread slices for a while?

6. Name four different fillings for sandwiches.

7. When do you wrap sandwiches in wax paper? Why?

8. Do you cut a sandwich before you serve it?

Recipe for Egg Salad Sandwich — Lesson 2

Objective: To prepare and serve four egg salad sandwiches.

Utensils:

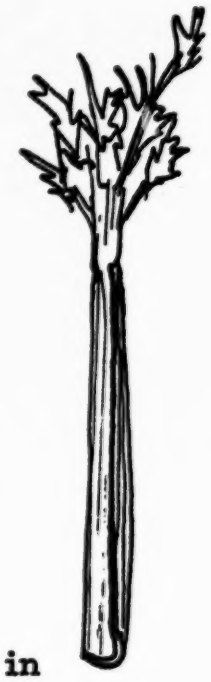
chopping bowl	measuring spoons
food chopper	spatula
mixing bowl	food scraper
paring knife	case knife
wooden board	

Ingredients:

4 hard-cooked eggs	$\frac{1}{4}$ tsp. salt
2 T. diced celery	8 slices of bread
1 T. diced onion	softened butter
3 T. mayonnaise	lettuce

Procedure:

1. Peel eggs.
2. Chop eggs in chopping bowl. Then put eggs in mixing bowl.
3. Wash celery, then dice it.
4. Peel and wash onion, then dice it.
5. Add celery and onion to chopped eggs.
6. Mix in the mayonnaise and salt.
7. Wash lettuce. Pat lettuce dry in a towel.
8. Spread softened butter on each slice of bread.
9. Spread egg salad on four slices of bread.
10. Put a lettuce leaf on top of the egg salad.
11. Place a slice of bread on top of each of the slices with filling.
12. Cut in half or in four parts.
13. Serve.



Vocabulary:

dice - dīs -- to cut into small pieces

celery - sĕl'ẽr ĭ -- a vegetable that grows in stalks. It may be eaten raw or cooked.

onion - ŭn'yŭn -- a round vegetable that grows in the ground

vegetable - vĕj'ē tȧ bl -- a plant or part of a plant that is used for food

Assignment:

1. What does dice mean?

2. Are celery, onions, and lettuce vegetables?

3. How do you wash and dry lettuce?

4. Try making egg salad, using chopped olives or chopped pickles instead of onions and celery.

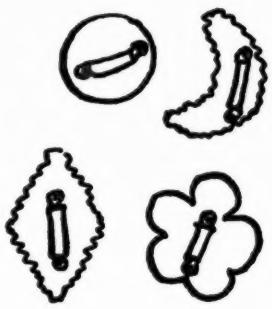
Party Sandwiches **Lesson 3**

Objective: To prepare party sandwiches.

Utensils:

wooden board
cookie cutters

mixing bowl
fork
case knife



Ingredients:

sliced bread
softened butter

cream cheese
jelly

Procedure:

1. Cut the bread with fancy cookie cutters.

2. Have two slices of bread the same shape for each sandwich.

3. Spread each slice of bread with softened butter. Be sure the butter goes to the edge of the bread.

4. Put the cream cheese in a bowl and mash with a fork until it is soft.

5. Spread cream cheese on one piece of bread.

6. Spread jelly on the other piece of bread.

7. Put the two pieces together.

Assignment:

1. Why is it important to spread the butter to the edge of each slice of bread?

2. Why do you want the cream cheese to be soft?

3. Make fancy sandwiches with other fillings.

4. Make fancy sandwiches using a piece of bread with filling, and no bread on top of the filling. These are called open-faced sandwiches.

UNIT XIII - SIMPLE DESSERTS

Jello Whip **Lesson 1**

Objective: To prepare and serve jello whip for four people.

Utensils:

saucepan	wooden spoon
glass measuring cup	egg beater
mixing bowl	

Ingredients: 1 package of Jello 2 C. water

Procedure:

1. Empty the package of Jello into a mixing bowl.
2. Boil 1 cup of water.
3. Pour the 1 cup of boiling water over the jello powder. Boiling water makes the powder melt faster.
4. Stir until you can't see any powder.
5. Add 1 cup of cold water. Stir.
6. Put bowl of jello in the refrigerator.
7. After the jello begins to set or get solid, beat the jello with an egg beater.
8. Serve plain or put whipped cream on top of each dish of jello.

Vocabulary:

jello - jĕl'ō -- a kind of dessert that comes as a powder

Assignment:

1. Why do you pour boiling water on the jello powder?

2. Serve jello without beating it.

3. Make jello with pieces of fruit in it. When jello begins to set, do not beat it. Just add pieces of fruit, and put jello back in the refrigerator until it is firm.

UNIT XIII - SIMPLE DESSERTS

Vanilla Pudding **Lesson 2**

Objective: To prepare and serve vanilla pudding for four people.

Utensils:

mixing bowl	egg beater
glass measuring cup	ladle

Ingredients:

1 package of instant vanilla pudding
2 C. milk

Procedure:

1. Pour milk into a mixing bowl.
2. Empty the package of instant pudding into the milk.
3. Beat the mixture with an egg beater. The mixture will start to get thick as you beat.
4. Use a ladle to put the pudding into dessert dishes.
5. Chill in the refrigerator for about 15 minutes.
6. Serve plain or put a little whipped cream on each serving.

Vocabulary:

pudding - pŏod'ĭng -- a sweet, soft dessert with some kind of flour in it

Assignment:

1. What is a pudding?
2. Make pudding using a package of instant chocolate, butterscotch, or strawberry pudding.
3. How much instant pudding and milk would you need to make this recipe for eight people?

UNIT XIII - SIMPLE DESSERTS

Grape Tapioca Pudding **Lesson 3**

Objective: To prepare and serve grape tapioca pudding for four people.

Utensils:

glass measuring cup	saucepan
metal measuring cup	wooden spoon
measuring spoons	ladle

Ingredients:

$\frac{1}{4}$ C. quick-cooking tapioca	$2\frac{1}{2}$ C. grape juice
$\frac{1}{4}$ C. sugar	1 T. lemon juice
dash of salt	

Procedure:

1. Mix tapioca, sugar, salt, and grape juice in a saucepan.
2. Cook over medium heat until mixture boils. Stir all the time.
3. Stir in lemon juice.
4. Cool the mixture for 20 minutes by setting saucepan in a larger pan of cold water. Keep the water cold.
5. Stir the pudding and spoon it into dessert dishes.
6. Chill in refrigerator.
7. Serve plain or with a little whipped cream on top of each serving.

Vocabulary:

tapioca - tăp ĭ ō' kȧ -- a food used in puddings. It helps to thicken the pudding

Assignment:

1. What is tapioca?
2. What is medium heat?
3. How do you cool the mixture in the saucepan?
4. How much grape juice would you need if you were making this recipe for eight people?

UNIT XIV -- SIMPLE LUNCHEONS

Luncheon Menu No. 1 **Lesson 1**

Objective: To plan, prepare, and serve this luncheon for four people.

Information: Luncheon Menu:

Cream Cheese and Jelly Sandwich
Raisin-Oatmeal Cookies
Banana Milk Shake

Vocabulary:

luncheon - lŭn'chŭn -- a light meal served in the middle of the day

Assignment:

1. Which food will you prepare ahead of time, or the day before you are to serve this menu?

2. Where will you keep the cookies until you are ready to serve them?

3. Name the order in which you will prepare this menu.

4. Draw a cover for this menu.

5. Prepare and serve this menu.

Luncheon Menu No. 2 Lesson 2

Objective: To plan, prepare, and serve this luncheon for four people.

Information: Luncheon Menu:

Lunch Meat Sandwich with Lettuce
Applesauce
Peanut Butter Cookies
Milk

Assignment:

1. Which food may be prepared the day before this menu is to be served?

2. Will any of this food be served hot?

3. Plan the order in which you will prepare this meal.

4. Will all of this food be served at the same time?

5. Draw a cover for this menu.

6. Prepare and serve this menu.

Luncheon Menu No. 3 Lesson 3

Objective: To plan, prepare, and serve this luncheon for four people.

Information: Luncheon Menu:

Egg Salad Sandwich
Jello with Fruit
Sugar Drops
Cocoa

Assignment:

1. Which food must be prepared the day before this menu is to be served?

2. Name the order in which you will prepare this food.

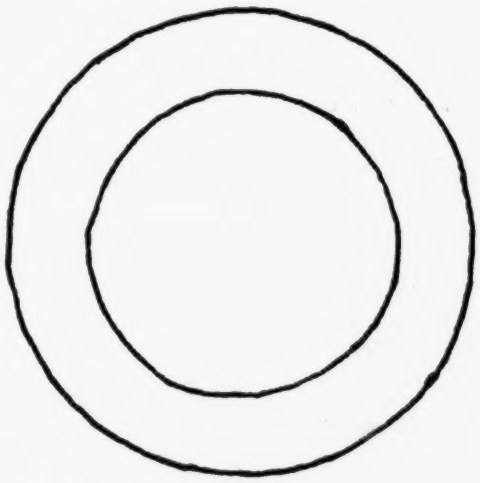
3. Will any of this food be served hot?

4. Will all of this food be served at the same time?

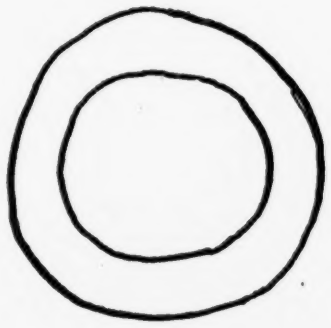
5. Draw a cover for this menu.

6. Prepare and serve this menu.

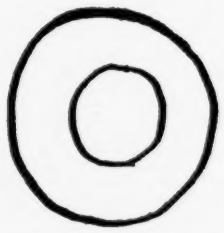
TABLEWARE



Dinner Plate



Luncheon Plate



Bread-and-
Butter Plate

Cup

Saucer

Cereal or Soup Bowl

Vegetable or
Dessert Dish

Water Glass

Juice Glass

Sherbet
Dish

Fork

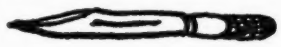
Teaspoon

Butter Spreader

Knife

UTENSILS

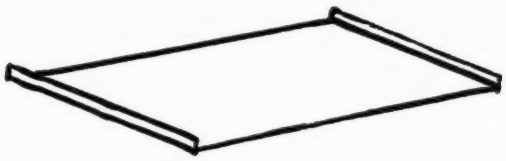
Apple corer



Baking cup

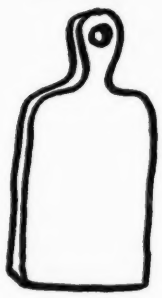
Baking dish

Baking sheet



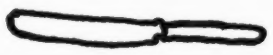
Bottle opener

Bread board or wooden board



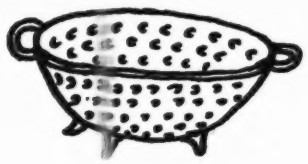
Cake rack

Case knife



Chopping bowl

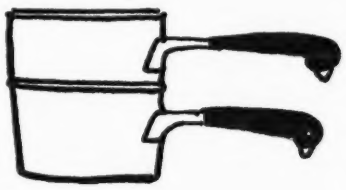
Colander



Cookie cutter

Cover

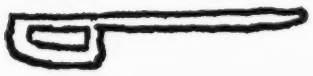
Double boiler



Egg beater

Food chopper

Food scraper

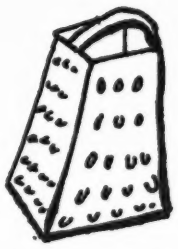


Fork

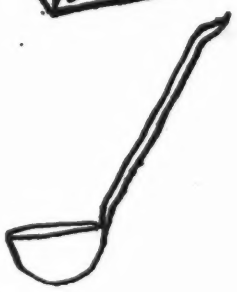
Frying pan

Glass measuring cup

Grater



Ladle



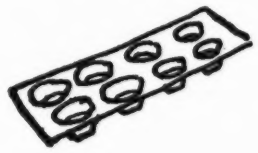
Masher

Measuring spoons

Metal measuring cup

Mixing bowl

Muffin pan



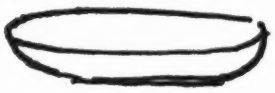
Paring knife

Pastry blender

Pitcher

Saucepan

Shallow bowl



Sifter

Spatula

Squeezer

Strainer

Tablespoon

Teaspoon

Turner

Wooden spoon

WORDS YOU NEED TO KNOW

abbreviation - ă brē vĭ ā'shŭn -- a short way to write a word

add to - ăd -- put with

ade - ād -- a beverage that is made by mixing fruit juice with sugar and water

adjust - ă jŭst' -- change to make right

appearance - ă pēr'ăns -- the way you look

appetizer - ăp'ē tīz ẽr -- a little food or drink served at the beginning of a meal

assignment - ă sīn'mĕnt -- work to be studied

attractive - ă trăk'tĭv -- pretty

automatic stove - ô tō măt'ĭk -- a stove that lights by turning a knob. You do not need a match, as the stove has pilot lights.

backwards - băk'wẽrdz -- with your back first

bake - bāk -- to cook in the oven

banana - bȧ năn'ȧ -- a long fruit with a heavy yellow skin. The part you eat is soft, and has a creamy color.

basic - bās'ĭk -- most important. A basic thing is something you must learn first, and then you can go ahead to make other things

batter - băt'ẽr -- a mixture of flour, liquid, and other foods that can be stirred or poured

beverage - bĕv'ẽr ĭj -- something to drink

biscuit - bĭs'kĭt -- a kind of bread baked in small shapes

blade - blād -- the flat, thin part of the knife that is used for cutting

boil - boil -- to make the liquid hot enough so that you see bubbles on the top

bowl of a spoon	-	bōl -- the rounded part of the spoon which holds food or liquid
breakfast	-	brĕk'fȧst -- the first meal of the day
broiler	-	broil'ẽr -- the part of a stove where food can be cooked directly under the flame. There is nothing between the flame and the food
burner	-	bûr'nẽr -- the part of the top of the stove where the flame comes
butterscotch	-	bŭt'ẽr skŏch'-- a mixture of brown sugar and butter
butter spreader	-	bŭt'ẽr sprĕd'ẽr -- a small knife given to each person for buttering bread or rolls
cabinets	-	kăb'ĭ nĕts -- closets with shelves in them where you will keep your food and utensils
carbonated	-	kär'bŏn ȧt ĕd -- water that is made to bubble. You can see bubbles in it.
celery	-	sĕl'ẽr ĭ -- a vegetable that grows in stalks. It may be eaten raw or cooked.
cereal	-	sēr'ē ăl -- food made from grain
china	-	chī'nȧ -- all the dishes you use when you eat
chocolate	-	chŏk'ō lĭt -- a food that is sometimes used for flavoring
chopped	-	chŏpt -- cut into small pieces
cinnamon	-	sĭn'ȧ mŭn -- a powder that is used as a spice or flavoring
cleanser	-	klĕnz'ẽr -- the powder used to clean the sink
cocoa	-	kō'kō -- ground chocolate with some of the fat removed. It is also the name given to the beverage made by cooking this powder with sugar and hot milk.
colander	-	kŭl'ăn dẽr -- a bowl with holes to let liquid drain off a food

concentrate	-	kŏn'sĕn trāt -- a food or beverage with some of the liquid taken out
condensed milk	-	kŏn dĕnst'-- milk with some of the water removed and sugar added
container	-	kŏn tān'ĕr -- anything that is used to hold something
cookie	-	kōōk'ĭ -- a small, thin cake
core	-	kōr -- the center of some fruits, like apples and pears. You do not eat the core. To core a fruit means to take out the center part
control	-	kŏn trōl'-- a way to keep the temperature just as you want it
correct	-	kŏ rĕkt'-- right
cover	-	kŭv'ĕr -- the flatware, china, glassware, and napkin to be used by one person
crack	-	krăk -- break open
cream	-	krēm -- to mix until soft and smooth
crisp	-	krĭsp -- not soft; easily broken
dash	-	dăsh -- a tiny bit, pinch
defrost	-	dē frŏst'-- to take away frost or ice
dessert	-	dĭ zûrt'-- something that is eaten at the end of a meal
detergent	-	dē tûr'jĕnt -- a product that is like soap and is used for washing
devilled egg	-	dĕv'ld ĕg -- hard-cooked egg, in which the yolk has been mashed with other food and put back into the hard-cooked white
dice	-	dīs -- to cut into small pieces
dinner	-	dĭn'ĕr -- the biggest meal of the day
dip	-	dĭp -- to wet by putting into a liquid and lifting out

direction - dĭ rĕk'shŭn -- a telling how to do something

dough - dō -- a mixture of flour, liquid, and other foods that can be kneaded

drain in the sink - drān -- the pipe in which the water goes down

to drain - drān -- to pour off liquid

dressing - drĕs'ĭng -- a food or mixture of foods that is added to a salad to give it a certain flavor

eggnog - ĕg'nŏg -- a beverage of eggs beaten with sugar, flavoring, and milk

electrical connections - ē lĕk'trĭ kăl kŏ nĕk'shŭns -- all the wires on the electric stove

empty - ĕmp'tĭ -- to take everything out of

energy - ĕn'ẽr jĭ -- the strength to do things

equal - ē'kwăl -- the same

equipment - ē kwĭp'mĕnt -- the big things you need, like the stove and refrigerator

equivalents - ē kwĭv'ȧ lĕnts -- different ways to get the same amount of something

evaporated milk - ē văp'ȯ rāt ĕd -- milk with some of the water removed

exactly - ĕg zăkt'lĭ -- perfectly or just right

eye level - ī lĕv'ĕl -- in a straight line with the eye

faucets - fô'sĕts -- what you use to turn the water on or off in the sink

filling - fĭl'ĭng -- what is put in

fizz - fĭz -- a beverage that bubbles up or makes a hissing sound

flatware - flăt'wâr -- the silverware that you eat with

flavoring - flā'vẽr ĭng -- anything that is added to a food to give a certain taste

flat surface	- flăt sûr ˈfĭs -- smooth, straight part
fluffy	- flŭfˈĭ -- very soft and light
forefinger	- fōrˈfĭng gĕr -- the finger next to the thumb
fraction	- frăkˈshŭn -- a part of something
freezer	- frēzˈĕr -- a box that keeps food so cold that the food becomes hard
fried	- frīd -- cooked in a little fat in a pan on top of the stove
fruit	- frōōt -- the part of certain plants that you can eat
garbage	- gärˈbĭj -- any food or part of food that is not to be eaten
garnish	- gärˈnĭsh -- something to make a dish of food look pretty
glassware	- glăsˈwâr -- all the glasses you use when you eat
grain	- grān -- the seeds of certain plants that can be eaten
granulated sugar	- grănˈū lāt ĕd -- grains of sugar that are the same size as grains of fine sand
grated cheese	- grātˈĕd chēz -- cheese that has been rubbed against a prickly piece of metal to cut it into small bits
grease	- grēs -- any oil or fat
greased	- grēst -- with fat put on
gumdrop	- gŭmˈdrŏp -- a candy that is soft enough to chew
halves	- hăvs -- two parts the same size
handle	- hănˈdᵊl -- the part of the pot that you hold when you pick up the pot
heaping	- hēpˈĭng -- filled more than level

high heat	- hī hēt -- large. The heat is turned all the way on, and the unit gets very, very hot
homogenized milk	- hō mŏj'ē nīzd -- whole milk in which the cream does not separate from the milk
honey	- hŭn'ĭ -- a sweet, sticky, yellow liquid made by bees
hostess	- hōs'tĕs -- the girl who is in charge of the meal
information	- ĭn fŏr mā'shŭn -- the things you must know in the lesson
ingredients	- ĭn grē'dĭ ĕnts -- foods used in a recipe
instruction	- ĭn strŭck'shŭn -- a telling of what you are to do
jam	- jăm -- fruit boiled with sugar until it is thick and smooth
jello	- jĕl'ō -- a kind of dessert that comes as a powder
juice	- jōōs -- the liquid part of a food
knead	- nēd -- work or mix with the hands
knob	- nŏb -- a handle to turn
layers	- lā'ĕrs -- one flat piece on top of another
lettuce	- lĕt'ĭs -- a green leaf used in salads
level	- lĕv'ĕl -- flat and smooth
lime	- līm -- a small, sour, greenish-yellow fruit that grows on a tree
lip of a cup	- lĭp -- the part of the cup that bends out so that liquid will pour out without spilling
liquid	- lĭk'wĭd -- anything that flows or pours
low heat	- lō -- little heat. The heat is turned on just a little

lumpy	-	lŭmp'ĭ -- sticking together of a food in bunches
lunch	-	lŭnch -- a light meal served in the middle of the day
luncheon	-	lŭn'chŭn -- a light meal served in the middle of the day
manners	-	măn'ẽrs -- the way you act
margarine	-	mäj'já rĭn -- a food made of fats and vegetable oils. It may be used instead of butter
marker lines	-	mär'kẽr līnes -- lines to show where an exact measurement is
marmalade	-	mär'mȧ lād -- fruit, fruit peelings, and sugar boiled together until thick. Marmalade is not smooth
marshmallow	-	märsh'măl'ō -- a soft, white candy covered with powdered sugar
mash	-	măsh -- to beat smooth
mayonnaise	-	mā ŏ nāz -- a salad dressing made of egg yolks beaten with other food
meal	-	mēl -- the food you prepare to be eaten at one time
measurement	-	mĕzh'ẽr mĕnt -- a way of finding the size or amount of anything
medium heat	-	mē'dĭ ŭm -- middle heat. The heat is not large or small. The heat is between high and low
melt	-	mĕlt -- to change a solid to a liquid
membrane	-	mĕm' brān -- a thin, soft covering or skin
menu	-	mĕn'ū -- a list of foods to be served at one meal
mix	-	mĭks -- to put together or to stir together
mixture	-	mĭks' tŭr -- two or more things that are put together
muffin	-	mŭf'ĭn -- a quick bread made with egg

napkin - nap'kin -- a piece of cloth or paper used at the table to keep your lips and fingers clean

nutmeg - nut'meg -- a powder that is used for flavoring

oats - ōts -- a grain which is used for food

objective - ob jek'tiv -- what you are going to learn

onion - un'yun -- a round vegetable that grows in the ground

order - ôr'dĕr -- the way one thing follows another

package - pak'ij -- something that is wrapped and tied or sealed

palm of the hand - päm -- the inside of the hand

paprika - pa prē'kà -- a red-colored powder that is sprinkled on some food to make it look attractive

pasteurized milk - pas'tĕr īzd -- whole milk in which the cream separates from the milk

pat - pat -- touch lightly to make flat

peanut butter - pē'nut but'ĕr -- a smooth, soft food made from peanuts

peel - pēl -- to take off the outside skin

perfect - pûr'fĕkt -- without any mistakes

pilot light - pī'lut līt -- the small flame that is always lit so that a burner can be turned on

pinch - pinch -- very little -- as much as you can take between the finger and thumb

pit - pit -- the seed of the fruit

plan - plan -- think of how to do something

pot holder - pot hōl'dĕr -- many small pieces of cloth sewed together, with which you pick up hot pots

pour - pōr -- to make something flow

powdered milk	-	pou'dĕrd -- milk with all of the water removed
powdered sugar	-	pou'dĕrd -- white sugar that has been ground into a fine powder
practice	-	prăk'tĭs -- to do the same thing over and over again
prepare	-	prē pâr'-- to get ready
preserve	-	prē zûrv'-- keep from spoiling
press	-	prĕs -- push
prick	-	prĭk -- make a little hole
procedure	-	prō sē'dūr -- the way to make something
product	-	prŏd'ŭkt -- something that is made
proper	-	prŏp'ĕr -- right, correct
pudding	-	pŏod'ĭng -- a sweet, soft dessert with some kind of flour in it
punch	-	pŭnch -- a drink made by mixing fruit juices and other liquids
raw	-	rô -- not cooked
recipe	-	rĕs'ĭ pē -- the way to make something to eat
refrigerator	-	rē frĭj'ĕr ā tĕr -- a box to keep things cold
remove	-	rēmōōv'-- to take away
rinse	-	rĭns -- to wash in clean water
roll	-	rōl -- turn over and over again
rubber scraper	-	rŭb'ĕr skrāp'ĕr -- a utensil with a flat piece of rubber on a handle
safety	-	sāf'tĭ -- carefulness for yourself and others so that no one will get hurt

salad	-	sǎl'ăd -- food, usually cold, that is served with a dressing
sandwich	-	sǎnd'wĭch -- two or more slices of bread with other food between them
saucer	-	sô'sĕr -- a small dish on which a cup is set
scald	-	skôld -- to heat just below the boiling point
scrambled	-	skrăm'b'ld -- mixed together
scrape	-	skrāp -- to clean off
sections	-	sĕk'shŭns -- parts of the fruit that can be cut apart
seeds	-	sēds -- the little pits or stones in some fruits
select	-	sē lĕkt' -- pick out
separate	-	sĕp'ȧ rāt -- to come apart or to break into parts
serving plate	-	sûrv'ĭng plat -- a plate of food that is passed to each person. You take some food from the serving plate and put it on your own plate. You do not eat from a serving plate
shake	-	shāk -- to move up and down quickly
shallow	-	shăl'ō -- not deep
shell	-	shĕl -- the hard, outside covering
sherbet	-	shûr'bĕt -- a frozen dessert made of fruit juice, sugar, water, and egg white
shortening	-	shôrt'ŭning -- a fat used in cooking
sift	-	sĭft -- to put through a screen to keep any big pieces away from the little pieces
silverware	-	sĭl'vĕr wâr -- all the knives, forks, and spoons you use when you eat
simmer	-	sĭm'ĕr -- to cook slowly on top of the stove. Keep the liquid just under the boiling point. You see tiny bubbles around the edge of the liquid

skim milk	-	skĭm -- milk with the cream taken out
skin	-	skĭn -- a covering
slice	-	slīs -- to cut across in thin, flat pieces
slit	-	slĭt -- opening
smooth	-	smōōth -- without lumps or bumps
snack	-	snăk -- a small amount to eat at one time
soak	-	sōk -- to keep wet
soften	-	sŏf'ĕn -- make something so that it can be mixed easily
soiled	-	soil'd -- dirty
solid	-	sŏl'ĭd -- anything that is firm and will not flow
sour	-	sour -- not sweet
sour milk	-	sour -- milk that has spoiled. It does not taste good to drink, but is sometimes used in cooking.
spatula	-	spăt'ū lá -- a flat utensil that can bend. It looks like a knife, but it is not sharp
spic and span	-	spĭk and spăn -- neat and clean
spill	-	spĭl -- to drop food or liquid
sprinkle	-	sprĭng'k'l -- to drop something in small bits
squeeze	-	skwēz -- to press hard
stack	-	stăk -- to put the dishes one on top of the other in a neat way
stained	-	stānd -- soiled or dirty
stem	-	stĕm -- the part that holds the fruit to the plant or tree
stew	-	stū -- boil slowly or simmer

sticky - stĭk'ĭ -- making things hold together

stir - stûr -- mix or move with a spoon

strain - strān -- press through a strainer to keep out little pieces, so that you will have only liquid

stuffed - stŭft -- filled

supper - sŭp'ẽr -- a light meal in the evening, when dinner is eaten in the middle of the day

surface units - sûr'fĭs ū'nĭts -- the burners on top of the stove

switch - swĭch -- the thing you use to turn the refrigerator on or off

syrup - sĭr'ŭp -- a sticky or thick liquid made of sugar and other food

tapioca - tăp ĭ ō'kȧ -- a food used in puddings. It helps to thicken the pudding

taste - tāst -- the feeling you get when food is in the mouth. The taste may be sweet, or sour, or bitter, or salty.

temperature - tĕm'pĕr ȧ tūr -- how hot or cold

thickened - thĭk'ĕnd -- made more solid

tidy - tīdĭ -- neat

tight - tīt -- firm or hard, so that no food can spill out

tines tīns - the points of a fork

toast - tōst -- bread that is made brown by heating

tough - tŭf -- not easy to chew

ungreased - ŭn grēst'-- with no fat

uniforms - ū'nĭ fôrms -- dresses that look alike and are worn by each girl in class

unit	- ū 'nĭt -- one part of the classroom
unsweetened	- ŭn swēt'nd -- not sweet
utensils	- ū tĕn 'sĭls -- tools used in the kitchen
vanilla	- vă nĭl' ă -- a flavoring made from the beans of the vanilla plant
vegetable	- vĕj 'ē tă b'l -- a plant or part of a plant that is used for food
vitamins	- vī 'tă mĭnz -- things found in foods that are needed to keep us well and strong. Different vitamins are found in different foods.
vocabulary	- vō kăb 'ū lĕr ĭ -- words and their meanings that you will learn
walnut	- wôl' nŭt -- a large nut with a rough shell
wax paper	- wăks pā 'pĕr -- paper that has a coating of wax to keep food from soaking through
whipped cream	- hwĭpt krēm -- cream that has been beaten with a beater to make it thick
work space	- wûrk spās -- the counter on which you will prepare your food
yolk	- yōk -- the yellow part of an egg

STUDENT ACHIEVEMENTS

I. Things To Know Before You Start Cooking	
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WHAT I HAVE COOKED AT HOME

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UNIT I - ACHIEVEMENT TEST

True or False

1. Your uniform must always be neat and clean.

2. When you put on your uniform, it is all right to leave your dress on the back of the chair.

3. Carry your comb with you in cooking class.

4. You do not have to wash your hands after using a handkerchief.

5. Keep your books on your work space.

6. Only wipe your work space when you are all finished.

7. Get out all utensils and food needed before you start to cook.

8. Sweep the floor before you wash dishes.

9. Look around before you walk with any food.

10. It is all right to use the dish cloth to lift a hot pan.

11. Always turn pot handles toward the inside of the stove.

12. Do not stir hot foods with a wooden spoon.

13. Always cut towards you.

14. Wash sharp knives with the other utensils.

15. Soak dishes with milk, egg, or flour in hot water.

16. Wash only a few dishes at a time.

17. Always wash glassware first.

18. Steel wool is used to wash china.

19. Use the same dish towel for one week.

20. Baking soda is used to clean the refrigerator.

UNIT II - USE AND CARE OF EQUIPMENT

ACHIEVEMENT TEST

True or False

1. Do not put any dishes in the sink while you are cooking.

2. Keep sharp-edged tools away from other utensils.

3. Pour the grease you do not want into the sink.

4. Push small pieces of garbage down into the drain.

5. Use cleanser to clean the sink.

6. Keep the cover of the garbage can closed.

7. Put broken glass and tin cans in the garbage cans.

8. Drain off liquid before you put garbage in the garbage can.

9. It is all right to put warm food in the refrigerator.

10. The coldest part of the refrigerator is near the freezer.

11. Leave the switch on while you clean the refrigerator.

12. Use baking soda in warm water to clean the inside of the refrigerator.

13. The pilot lights in a gas stove must be lit, or you cannot light the stove.

14. Leave the match box open while you strike the match.

15. Strike a match away from you.

16. Throw the burned match in the garbage can, as soon as you are finished with it.

17. Food will cook faster if the flame goes around the pan.

18. The best gas flame is yellow.

19. An electric burner gets hot faster than a gas burner.

20. Food will boil over or burn if the burner is too high.

21. The burners on an electric stove stay hot for some time after the burner is turned off.

UNIT III - MEASUREMENTS AND ABBREVIATIONS

ACHIEVEMENT TEST

True or False

1. A metal measuring cup is used for dry ingredients.

2. Some liquid ingredients are flour, sugar, and salt.

3. All measurements should be level.

4. Measure liquids first, then fats, then dry ingredients.

5. A spatula is used to level off dry foods.

6. A recipe tells you how to make something to eat.

7. Always sift flour two times.

8. Measure the flour after you sift the flour once.

9. Be sure to pack the flour down in the cup.

10. All measurements must be perfect.

11. You do not have to have the measuring cup at eye level to measure liquid ingredients.

12. Butter is a liquid fat.

13. To measure $\frac{1}{3}$ cup of fat, you need $\frac{2}{3}$ cup of water.

14. To measure $\frac{3}{4}$ cup of fat, you need $\frac{1}{2}$ cup of water.

15. When you measure fat, the water must cover the fat.

16. Write the abbreviations for these words:

teaspoon
cup
temperature
tablespoon
baking powder
pound
quart
minute
pint
hour

17. Write the equivalents for these measurements:

1 tablespoon = _____ teaspoons

1 cup = _____ tablespoons

1 pint = _____ cups

1 pound of fat = _____ cups of fat

1 egg = _____ tablespoons

UNIT IV - TABLE MANNERS, TABLE SETTING, AND TABLE SERVICE

ACHIEVEMENT TEST

True or False

1. Wash your hands before you start to eat.

2. Rest your elbows on the table while you are waiting to eat.

3. Start to eat as soon as you sit down at the table.

4. Never blow your food to make it cool.

5. Put as much food in your mouth as you can at one time.

6. Never talk with food in your mouth.

7. Keep your mouth closed when you are chewing food.

8. Bend your head to your food, while eating.

9. Butter the whole slice of bread, then break off a piece to eat.

10. It is all right to put your knife in your mouth.

11. When you are finished eating, put your soiled silverware on the table.

12. The sharp edge of the knife is always toward you.

13. Place only the flatware that is needed, on the table.

14. The plate, flatware, and napkin are placed at the edge of the table.

15. Hold the top of the glass when serving a beverage.

16. Stack soiled dishes at the table, then carry them away.

Fill in the blanks

1. The flatware, china, glassware, and napkin to be used by each person is called a _____.

2. The knife is placed to the _____ of the plate.

3. Spoons go to the right of the _____.

4. The bowls of the spoons are turned _____.

5. Forks are placed to the _____ of the plate.

6. All flatware should be _____ from the edge of the table.

7. The water glass is placed just above the _____.

8. A cup and saucer are placed to the right of the _____.

9. A bread-and-butter plate is placed above the _____.

10. Use a _____ to carry the dishes, flatware, and glasses to the table.

11. The napkin is placed to the left of the _____.

12. Serve and take away all food from the _____ side of the guest.

13. Use your _____ hand to serve all food.

14. Serve and take away all beverages from the _____ side of the guest.

15. Use your _____ hand to serve beverages.

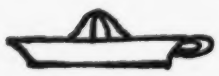
UNIT V - BEVERAGES

ACHIEVEMENT TEST

1. Match the following:

___	1. Fruitade	a.	whole milk in which the cream separates from the milk
___	2. Fruit fizz	b.	milk with some of the water removed and sugar added
___	3. Homogenized milk	c.	a beverage made by mixing fruit juice with sugar and water
___	4. Skim milk	d.	the liquid that is left after butter is made
___	5. Condensed milk	e.	milk with all of the water removed
___	6. Milk shake	f.	a beverage of fruit juice, sugar, water, and carbonated water
___	7. Pasteurized milk	g.	milk with another food beaten into it
___	8. Buttermilk	h.	whole milk in which the cream does not separate from the milk
___	9. Evaporated milk	i.	milk with the fat taken out
___	10. Powdered milk	j.	milk with some of the water removed

2. Name the following utensils:



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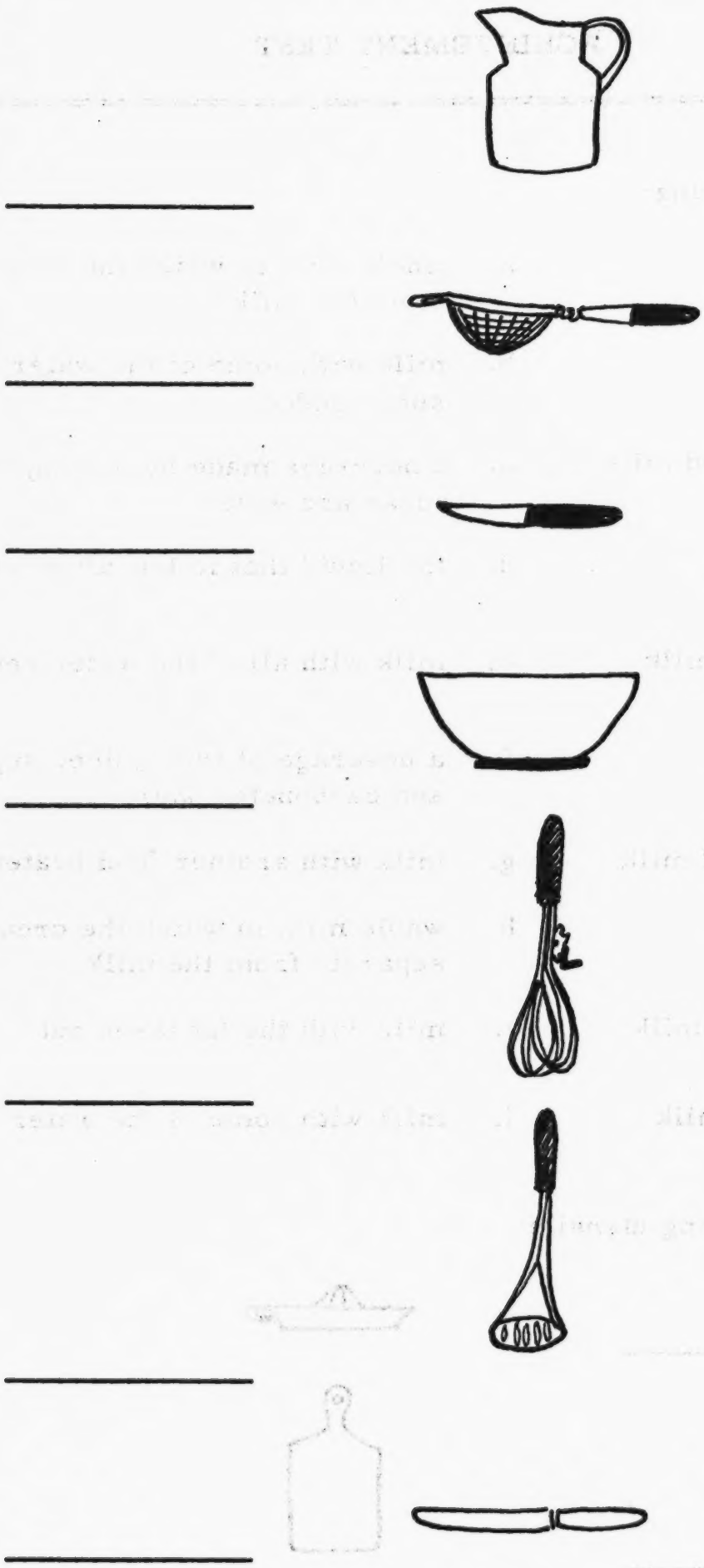
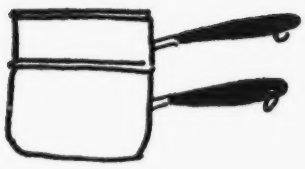




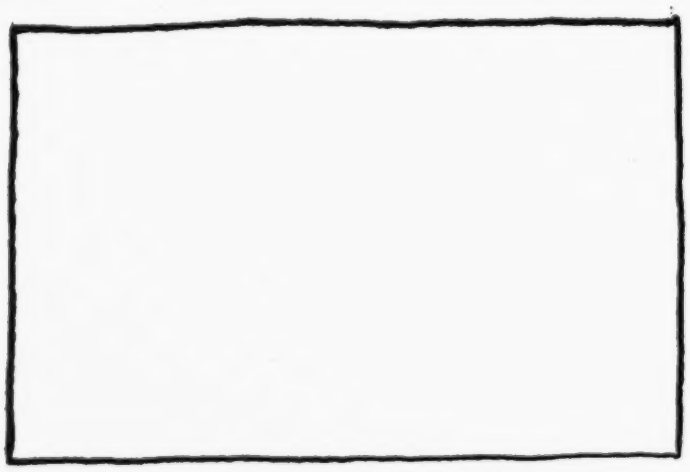
UNIT VI - TOAST

ACHIEVEMENT TEST

Match the following:

___	1.	broiler	a.	two or more slices of bread with other food between them
___	2.	jam	b.	a small amount to eat at one time
___	3.	marmalade	c.	the first meal of the day
___	4.	snack	d.	a sweet, sticky, yellow liquid made by bees
___	5.	shortening	e.	bread that is made brown by heating
___	6.	honey	f.	fruit boiled with sugar until it is thick and smooth
___	7.	breakfast	g.	the food you prepare to be eaten at one time
___	8.	sandwich	h.	a fat that is used in cooking
___	9.	toast	i.	the part of the stove where food can be cooked directly under the flame
___	10.	meal	j.	fruit, fruit peelings, and sugar boiled together until thick

Fill in the cover with the things you would use to serve French toast and cocoa.



Prepare and serve cinnamon toast and chocolate milk shake for two people.

UNIT VII - FRUIT

ACHIEVEMENT TEST

Match the following:

___ 1.	raw fruit	a.	things found in foods that are needed to keep us well and strong
___ 2.	canned fruit	b.	the seedy part in the middle of some fruit
___ 3.	dried fruit	c.	fruit that you buy just as it is grown
___ 4.	frozen fruit	d.	boil slowly or simmer
___ 5.	vitamins	e.	food that is preserved in a liquid, sometimes with sugar added
___ 6.	colander	f.	filled with something
___ 7.	core	g.	fruit with the water taken out
___ 8.	stuffed	h.	a bowl with holes to let the liquid drain off
___ 9.	stew	i.	cook in the oven
___ 10.	bake	j.	fruit that is preserved by keeping it hard and cold

True or False

___ 1. To preserve fruit means to keep it from spoiling.

___ 2. Large fruit is washed in a colander.

___ 3. The color and flavor of fruit changes when fruit is cooked too long.

___ 4. If a fruit is pitted, it means that the pit has been taken out.

___ 5. Always peel the apple when you make baked apples.

___ 6. Halved fruit is fruit that is cut in small pieces.

___ 7. Fruit juice may be served as an appetizer.

___ 8. Fresh fruit on lettuce is called a garnish.

___ 9. Lunch is the biggest meal of the day.

___ 10. Dessert is eaten at the end of a meal.

UNIT VIII - CEREALS AND QUICK BREADS

ACHIEVEMENT TEST

True or False

___ 1. Whole grain cereals are the best for you.

___ 2. Ready-to-eat cereals should be crisp.

___ 3. Cooked cereals should be lumpy.

___ 4. Never cook cereal with milk.

___ 5. Baking powder biscuits do not change in size during baking.

___ 6. The top of a baking powder biscuit is smooth.

___ 7. Always open a biscuit with a knife.

___ 8. The crust of a muffin should be thick.

___ 9. Cold shortening is used for a dough.

___10. Baking powder biscuits and muffins are basic recipes.

Match the following:

___ 1.	cereal	a.	work or mix with your hands
___ 2.	greased	b.	mixture of flour, liquid, and other foods that can be kneaded
___ 3.	cheese biscuits	c.	utensil used to cut shortening into flour
___ 4.	knead	d.	with no fat
___ 5.	meaning of "batter"	e.	food made from grain
___ 6.	jelly muffins	f.	a food made from dough
___ 7.	butterscotch	g.	mixture of flour, liquid, and other foods that can be stirred or poured
___ 8.	ungreased	h.	with fat put on
___ 9.	meaning of "dough"	i.	a food made from batter
___10.	pastry blender	j.	a mixture of brown sugar and butter

UNIT IX - EGGS

ACHIEVEMENT TEST

True or False

___ 1. We should eat at least four or five eggs every week.

___ 2. Eggs are served only for breakfast.

___ 3. Eggs with a white shell are better than eggs with a brown shell.

___ 4. Eggs should be kept cold.

___ 5. The yolk is the white part of the egg.

___ 6. Cook eggs over a high flame.

___ 7. Eggs served on a plate should be eaten with a fork.

___ 8. When cooking eggs in the shell, be sure the eggs are covered with water.

___ 9. Put hard-cooked eggs in cold water as soon as they are cooked.

___10. Serve devilled eggs while they are hot.

Match the following:

___ 1.	soft-cooked egg	a.	egg cooked in a little fat in a frying pan
___ 2.	scrambled egg	b.	egg cooked in water for 3 to 5 minutes
___ 3.	hard-cooked egg	c.	hard-cooked egg in which the yolk has been mashed with other food
___ 4.	fried egg	d.	egg beaten with milk and cooked in a little fat in a frying pan
___ 5.	devilled egg	e.	egg cooked in water for 20 minutes

UNIT X - SIMPLE BREAKFASTS

ACHIEVEMENT TEST

True or False

___ 1. A menu is a list of the food to be served at one meal.

___ 2. You must know the menu before you set the table.

___ 3. Always be sure to put all the food on the table at the same time.

___ 4. The first thing you do, when you are going to make a breakfast, is to prepare the food.

___ 5. Always set a knife, fork, and spoon for each person.

___ 6. Serve cooked cereal while it is hot.

___ 7. Fruit cup may be prepared ahead of time, and kept in the refrigerator.

___ 8. Always serve a sharp knife with biscuits.

UNIT XI - COOKIES

ACHIEVEMENT TEST

True or False

___ 1. Turn on the oven after the ingredients in a recipe are mixed together.

___ 2. Half an egg is the same as 2 T. of beaten egg.

___ 3. A dash of salt is about the same as $\frac{1}{4}$ tsp. of salt.

___ 4. Grease the baking sheet so that the cookies will not stick to the sheet.

___ 5. To cream the shortening means to mix it until it is soft and smooth.

___ 6. The baking sheet should not touch the sides of the oven.

___ 7. Pile cookies on a cake rack to cool.

___ 8. Measure nuts before they are chopped.

___ 9. To measure $\frac{2}{3}$ C. of shortening, you use $\frac{1}{2}$ C. water.

___ 10. Use a glass measuring cup to measure raisins.

UNIT XII - SANDWICHES

ACHIEVEMENT TEST

Fill in the blanks.

1. Two or more slices of bread with food in between is called a _____.

2. Three kinds of bread that may be used for sandwiches are _____, _____, and _____.

3. Bread must be _____ for a sandwich.

4. For fancy sandwiches, cut slices of bread into shapes with _____ _____.

5. Spread each slice of bread with _____ or _____.

6. If sandwiches are not to be eaten right away, wrap each sandwich in _____.

7. A sandwich should be cut into _____ or _____ parts before it is served.

8. To _____ means to cut into little pieces.

9. Celery, onions, and lettuce are _____.

10. Mash cream cheese with a _____.

UNIT XIII - SIMPLE DESSERTS

ACHIEVEMENT TEST

Match the following:

____	1.	jello	a.	a sweet, soft dessert with some kind of flour in it
____	2.	pudding	b.	a food used in puddings
____	3.	tapioca	c.	a dessert that has been made into a powder

UNIT XIV - SIMPLE LUNCHEONS

ACHIEVEMENT TEST

True or False

____ 1. Lunch and luncheon mean the same thing.

____ 2. Always put a knife on the table when serving a sandwich.

____ 3. It is all right to put a cookie jar on the table for lunch.

____ 4. A cover is all the flatware, china, and glassware on the table.

____ 5. Serve the food for each person from the right of the person.

____ 6. Plan how much food you will need before you start to prepare a meal.

____ 7. Be sure to know how many people your recipe will serve before you make the food.

____ 8. Put a spoon at each cover if you are serving cocoa.

____ 9. When you are finished eating, stack your dishes at the table.

____ 10. Leave the table as soon as you are finished eating.

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BASIC PLAN

for the

Organization and Management of Instruction

in

VOCATIONAL RADIO & TELEVISION

PRELIMINARY DRAFT --- FOR DISCUSSION ONLY

Prepared and Issued by the
CURRICULUM LABORATORY
TRADE AND TECHNICAL EDUCATION
STATE DEPARTMENT OF VOCATIONAL AND TECHNICAL EDUCATION
Jackson, Mississippi

Located in the
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MEMORANDUM

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(Address) Drawer NU, State College, Mississippi 39762

DATE: June 16, 1967

RE: (Author, Title, Publisher, Date) Curriculum Laboratory
BASIC PLAN FOR THE ORGANIZATION AND MANAGEMENT OF INSTRUCTION IN VOCATIONAL RADIO & TELEVISION; Curriculum Laboratory

May 1967

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STATE DEPARTMENT OF VOCATIONAL AND TECHNICAL EDUCATION
Jackson, Mississippi

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ACKNOWLEDGMENTS

This publication was developed by a group of instructors and tradesmen attending a workshop held on the campus of Mississippi State University on April 7 and 8, 1967. The group, called a Curriculum Committee, took the traditional approach and developed an analysis for the trade. The trade was systematically broken into its major segments, called blocks, and then into the basic manipulative tasks, called operations. Next, typical on-the-job activities, which contained the operations, were listed to give the trainee experience in useful and productive work. Then, informational topics which, when understood by the tradesman, would contribute to the intelligent use of his skills, were identified by the committee. Finally, the equipment, tools, and supplies necessary for training were listed.

The members of the Curriculum Committee are to be commended for their efforts and their cooperative attitude in the development of this basic plan. The Committee was composed of:

H. M. Cook, Instructor, Hinds Junior College, Raymond
L. H. Holt, Instructor, Meridian Junior College, Meridian
C. F. Moore, Instructor, Holmes Junior College, Goodman
Herman Ray Nelson, Instructor, Hinds Junior College, Raymond
James J. Petrik, Instructor, Gulfport East High School, Gulfport
E. K. Rushing, Instructor, Mississippi Delta Junior College, Moorhead

This publication will serve as the starting point for the development of instructional materials to be used by the trade instructor.

HOW TO USE THIS PUBLICATION

As a tool for teaching, this publication is primarily designed for use in planning, preparing, presenting, and evaluating instruction. As a tool, it lists operations, jobs, and informational topics--with the job as the focal point. Each job should be assigned to students, either as a group, a subgroup, or individually. The following procedure is recommended as an effective teaching sequence.

Step I. -- Tell how the job is done.
Give a full explanation of the steps necessary to perform the job. Emphasize the proper sequence; stress techniques requiring special care; point out the hazards to persons and the equipment.

Step II. -- Show how the job is done.
Demonstrate the proper procedure for performing the job. Re-emphasize the sequence, techniques, and hazards. Make sure each student can see what is being done and understands the steps.

Step III. -- Have the student do the job.
Assign each student the task of applying what he has just learned. Supervise his work; correct any variation from proper procedure or any hazardous techniques. Re-explain when necessary.

Step IV. -- Check the student for proficiency.
Assign a similar job to the student to be performed independently. Observe his work and examine the completed product or service. He is proficient when he can perform the job without supervision in a prescribed length of time.

Students who have demonstrated proficiency in one job move to the next job. The teaching steps *tell, show, do, check* are used again. Students who are not proficient perform additional jobs of a similar nature and are retaught in weak areas.

Additionally, this publication can be used (1) by the director and the instructor in a local program in communicating with their craft committee, (2) by the local director in supervising instruction and program operation, and (3) by the state supervisory staff in communicating with local school administrators and in supervising the operation of local programs.

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RADIO AND TELEVISION SERVICE AND REPAIRMAN

The radio and television service and repairman uses electronic testing instruments, such as ohmmeters, voltmeters, oscilloscopes, multimeters, and signal or cross bar generators. His hand tools include pliers, screwdrivers, metal snips, punches, hammers, electric soldering equipment, drills, vises, and hacksaws.

He locates the source of trouble in a radio or television receiver by first tuning it on various channels and wave bands to observe noises, non-lighting or heating of tubes, picture aberrations, and other interferences. He tests and replaces tubes where necessary and adjusts controls.

Minor adjustments, replacements, and repairs are done in the home or place of business of the customer. When extensive testing and major servicing are indicated, the serviceman takes the receiving set to the shop where, with the chassis removed from the cabinet, he visually checks for apparent defects; inspects wiring and solders loose connections; looks for discoloration, scale, or corrosion on condensers, resistors, and transformers which might indicate defective parts. Following a schematic diagram and using his electronic instruments, he tests voltages and resistances of circuits to isolate defects. Using his hand tools, he repairs and/or replaces defective capacitors, resistors, selection rectifiers, filters, transformers, and other faulty parts. He makes final adjustment of controls to obtain the desired density, linearity, focus, color convergence, and size of picture.

The television serviceman also installs antennas, selecting the antenna appropriate for the type of receiving set and the location of the transmission station. He bolts crossarms and elements in position and uses brackets and guy wires to secure the assembled antenna in place, observing insurance codes and local ordinances. After connecting the antenna to the receiving set, he orients the antenna and installs a reflector to obtain the strongest possible signal reception and checks the receiving set on all channels for desired results.

Detailed description may be found in the Dictionary of Occupational Titles, third edition, under TELEVISION SERVICE-AND-REPAIRMAN (any ind.) 720.281, and TELEVISION-INSTALLATION MAN (any ind.) 823.781.

COURSE DESCRIPTION

GENERAL OBJECTIVES

To develop knowledges and skills that make the trainee a radio and television repairman employable on a beginner's level.

ASSUMPTIONS

1. That those enrolling in training have had little or no previous experience in electronic or radio and television work.
2. That trainees have a nontechnical background in general science.
3. That they need additional instruction in the fundamentals of mathematics.

DESIRABLE PREREQUISITES

1. That trainees have a vocational committment to electronics, radio and television trade.
2. That trainees have a general mechanical and electrical aptitude.
3. That they have had a course in general mathematics or algebra, but need additional instruction in arithmetic, simple algebra, and plane geometry and trigonometry.

NATURE OF TRAINING

1. The duration of training is normally three hours per day, five days per week, thirty-six weeks per year for two years; or, six hours per day, five days per week, thirty-six weeks per year for one year -- a total of 1080 clock hours of training.
2. Related instruction by lecture, demonstration, the use of audiovisuals, etc. immediately precedes application by the trainee in shop practice; instruction and its application are correlated as closely as possible at all times; and the major allotment of time is given to the development of manipulative skills.
3. No instruction directly related to the trade is offered outside the shop.

CONTENT OF THE RELATED INSTRUCTION

1. Detailed coverage of the following areas: radio, black-and-white television, and color television
2. Detailed coverage of soldering; use and care of hand tools; use, care, and adjustment of test instruments and equipment
3. Broad coverage of f-m receivers, recorders, record changers, and antennas
4. A strong enphasis on safety practices and processes and on work hazards
5. An explanation of fundamental information in basic electronics, radio, and television
6. The reading of schematics with emphasis on the use of manufacturer's specifications for the voltage, current and resistant valves, wave-forms, measurement procedures and the interpretations of symbols for the radio and television field
7. The definition and spelling of trade terms applicable to the electronics, radio and television trade
8. Instruction in mathematics, such as arithmetic, simple algebra, plane geometry, and trigonometry, as applicable to the radio and television trade

TYPES AND LEVELS OF SKILLS TO BE DEVELOPED

1. Immediate marketable skills in the troubleshooting of electrical circuits and the repair of radio and television sets
2. Basic manipulative skills in soldering, assembling, and disassembling of electronic components in both hand-wired and printed circuitry

INSTRUCTIONAL BLOCKS

The following blocks are the major areas of instruction. Each has been assigned a number of hours for the purpose of indicating the relative amount of emphasis it is to receive in the total training period. Instructors are urged to plan training carefully, to select, sequence, and assign learning experience, thus making maximum use of available time. It should not be inferred that hour allotments be rigidly adhered to or that students be rotated on a clockwork or calendar basis. On the contrary, the emphasis is on individual proficiency. It is likely that students of lesser ability will require longer periods in certain areas. These students may gain only the minimum proficiencies while more able students will progress more rapidly and engage in many enriching experiences. Consequently, the planning, sequencing, and allotting are not designed to standardize programs, but to assist local teachers in planning more carefully and in conducting their instruction more carefully.

INSTRUCTIONAL BLOCKS

		Contact Hours
I.	FUNDAMENTALS OF ELECTRONICS	390
II.	RADIO	150
III.	BLACK-AND-WHITE TELEVISION	360
IV.	COLOR TELEVISION	180
	Total Hours	1080

ANALYSIS OF OPERATIONS

I. FUNDAMENTALS OF CONSTRUCTION

A. Soldering and splicing

1. File the tip of a soldering gun, pencil, or iron with a single-cut, flat-blade file
2. Tin the tip of a soldering gun, pencil, or iron
3. Tin the end of a strand of solid wire
4. Solder resistor leads with a soldering gun
5. Solder resistor leads with a soldering iron
6. Solder transistor leads with a soldering pencil
7. Splice and solder two pieces of hook-up wire together
8. Disconnect resistors from a chassis, using a soldering pencil, gun, or iron
9. Disconnect resistors from a printed circuit, using a soldering pencil
10. Replace tip on soldering gun
11. Disassemble components, using a soldering gun with solder vacuum attachment
12. Solder components, using a soldering pencil and heat sink
13. Solder heavy wire to the chassis, using a soldering gun and rosin core solder
14. Assemble and disassemble components, using right-angle pliers and a soldering gun
15. Assemble and disassemble components, using right-angle pliers and a soldering gun

B. Hand tools

1. Cut and remove components from a chassis, using diagonal pliers
2. Cut heavy wire with lineman's side-cutting pliers
3. Assemble and disassemble components with a flat-blade screwdriver
4. Assemble and disassemble components with a Phillips screwdriver
5. Cut light stock with a hacksaw
6. Remove and install screw and nuts with a spintite or socket wrench
7. Remove or install nuts and bolts with an adjustable wrench
8. Remove and install set screws with an allen wrench
9. Mark a center with a center punch and a hammer
10. Sharpen a twist drill

11. Drill holes in aluminum stock with a hand drill and twist drill
12. Drill holes in chassis or wood with twist drills and an electric drill
13. Cut a square hole in sheet metal with a square-hole punch
14. Cut a round hole in sheet metal with a round-hole punch
15. Measure the gage of a wire with a wire gage
16. Strip the insulation from wire with wire strippers
17. Sharpen a screwdriver blade with a file or grinder
18. Replace a hacksaw blade

II. METERS AND TEST EQUIPMENT

A. Volt-ohm-milliammeter (VOM)

1. Zero-adjust an ohmmeter
2. Measure d-c voltage with a VOM
3. Measure a-c voltage with a VOM
4. Measure d-c current with a VOM
5. Measure d-c current with a VOM (10-amp range)
6. Measure d-c current with a VOM (microamps)
7. Measure resistance with a VOM

B. Vacuum tube voltmeter (VTVM)

1. Zero-adjust a VTVM
2. Measure d-c voltage with a VTVM
3. Measure a-c voltage with a VTVM
4. Measure a-c, peak-to-peak voltage with a VTVM
5. Measure resistance with a VTVM

C. Basic measurements and checks with VOM and/or VTVM

1. Measure the plate voltage of a tube with a VOM
2. Measure the plate voltage of a tube with a VTVM
3. Measure the control-grid voltage of a tube with a VOM
4. Measure the control-grid voltage of a tube with a VTVM
5. Measure the screen-grid voltage of a tube with a VOM
6. Measure the screen-grid voltage of a tube with a VTVM
7. Measure the suppressor-grid voltage of a tube with a VOM
8. Measure the suppressor-grid voltage of a tube with a VTVM

9. Measure the forward and reverse resistance of a selenium rectifier with a VOM
10. Measure the forward and reverse resistance of a selenium rectifier with a VTVM
11. Measure the forward and reverse resistance of a diode with a VOM
12. Check capacitor for shorts with VOM or VTVM
13. Check capacitor for leaks with VTVM or VOM
14. Check capacitor for opens with VTVM or VOM
15. Check transformers for open circuit with VTVM or VOM
16. Check a transistor with VOM

D. Wide-band oscilloscope

1. Set up oscilloscope to identify a waveform or trace a signal
2. Set up an oscilloscope to measure voltage
3. Check frequency and phase
   a. Check phase relationships with an oscilloscope
   b. Determine an unknown frequency with an oscilloscope
   c. Check modulation waveform with an oscilloscope
4. Use oscilloscope probes
   a. Trace waveforms with an oscilloscope and demodulator probe
   b. Determine an unknown frequency with an oscilloscope
   c. Trace a signal, using the oscilloscope and low-capacity probe

E. Field-strength meter

1. Locate maximum signal for antenna with aid of field-strength meter
2. Adjust signal booster for maximum signal with aid of field-strength meter
3. Check antenna and lead-in installations with aid of field-strength meter

F. Capacitance checker

1. Check an electrolytic capacitor with a capacitor checker for leaks, shorts, opens
2. Check a ceramic capacitor with a capacitor checker for leaks, shorts, opens
3. Check a paper capacitor with a capacitor checker for leaks, shorts, opens

G. Tube tester

1. Test rectifier tubes
2. Test pentagrid tubes
3. Test tetrode tubes
4. Test pentode tubes
5. Test triode tubes
6. Test multisection tubes

H. Signal generator, r-f

1. Set the generator for rf
2. Set the generator controls for modulated rf
3. Set the generator controls for audio frequency (af)
4. Set the generator controls for sweep rf

I. Transistor checker

1. Check transistors for shorts
2. Check transistors for leaks
3. Check transistors for gain

J. Analyst

1. Check the flyback transformer for shorted turns
2. Substitute signals with an analyst
3. Set the analyst for r-f output signal
4. Set the analyst for video output signal
5. Set the analyst for i-f output signal
6. Set the analyst for audio output signal
7. Set the analyst for f-m (4.5) output signal
8. Set the analyst for color-bar pattern output signal
9. Set the analyst for dot-pattern output signal
10. Set the analyst for crosshatch-pattern output signal
11. Set the analyst for horizontal-pattern output signal
12. Set the analyst for vertical-pattern output signal
13. Set the analyst for sync-pulse output signal
14. Set the analyst for vertical-sweep output signal
15. Set the analyst for horizontal-sweep output signal
16. Check the boost voltage

K. Marker generator

1. Calibrate the marker generator
2. Select proper frequencies for marking a band

L. Sweep generator

1. Select frequency for a band
2. Adjust band width
3. Adjust attenuation

M. Marker adder

1. Produce a waveform for alignment of a broad-band amplifier, using a sweep generator, marker, and marker adder and an oscilloscope
2. Combine two waveforms with a marker adder

N. Color bar/dot/crosshatch generator

1. Use the crosshatch generator to set up linearity and size in the absence of a test pattern
2. Use the crosshatch generator of dot-bar generator to generate the following patterns

   a. Dot
   b. Vertical bars
   c. Horizontal bars
   d. Vertical and horizontal bars simultaneously

O. CRT checker: Check the CRT tube

AN EXPLANATION OF TERMS AS THEY ARE USED IN THE SUGGESTED JOBS

A trainee must possess a thorough understanding of the electrical and electronic fundamentals before he can become a competent repairman in the trade.

All of the jobs listed in Part I may not be of the same type that a trainee would perform in industry. However, performance of these jobs and a strong background in the theory of electrical and electronic fundamentals will enable the trainee to become proficient in the radio-television field.

To avoid needless and meaningless repetition, "jobs" of "check and/or replace components" have been omitted under each heading, except where the component is unique or exceptionally important to that circuit. To avoid the impression that there is a complete omission of service to these components, a typical list is given as the first division of Part II.

A review of the listings of jobs in Parts II, III, and IV reveals that the words "build" or "assemble" and "troubleshoot" are frequently used. A word of explanation will show that this frequent use is justified.

First, building or assembling one or more of the representative types of circuits within radios and televisions acts as a focal point for the trainee. He gains not only basic skills, but also an understanding of the place and function of each component within the circuit. Two types of circuit construction are encouraged: (1) The trainee should construct the circuit by mounting and soldering to develop a high degree of skill; (2) he should use the technique of breadboarding and make use of kits to reduce construction time.

Second, employment within the trade calls for constant troubleshooting, which is a systematic, logical approach to determining any fault in the operation of equipment. Thus, the full troubleshooting procedure will involve four steps:

1. Determine the symptoms through customer complaints and/or observing and listening to the unit.
2. Localize the trouble to a functional block or unit, using test instruments.
3. Isolate the specific circuit within the block or unit.

4. Locate the specific trouble within the circuit by testing each component.

The broad use of the term troubleshooting will be applied when dealing with an entire unit, in which case it will be necessary to include all four steps of procedure, as in each of the following jobs:

a. Troubleshoot a dead a-m receiver.

b. Troubleshoot a distorted a-m receiver.

On the other hand, when dealing with a specific circuit, it will be assumed that steps 1, 2, and 3 above have been performed. In such an instance, troubleshooting would involve only the testing of each component within a specific circuit. For example:

a. Troubleshoot the audio circuit

b. Troubleshoot the r-f circuit.

I. SUGGESTED JOBS IN ELECTRICAL AND ELECTRONIC FUNDAMENTALS

A. Ohm's law

1. Assemble a series circuit
2. Assemble a parallel circuit
3. Assemble a series-parallel circuit

B. Meters

1. Construct a circuit for measuring voltage
2. Construct a circuit for measuring d-c current
3. Construct an ohmmeter

C. Inductance

1. Wind a coil with an air core
2. Wind a coil with a ferrous core
3. Wind two coils and connect them in series
4. Wind two coils and connect them in parallel

D. Transformers

1. Construct a step-up transformer with 2:1 turns ratio
2. Construct a step-down transformer with 2:1 turns ratio

E. Capacitance

1. Construct a series capacitive circuit
2. Construct a parallel capacitive circuit

F. Time constant and resonance

1. Construct a series RC circuit
2. Construct a parallel RC circuit
3. Construct a series RL circuit
4. Construct a parallel RL circuit
5. Construct a series RLC circuit
6. Construct a parallel RLC circuit

G. Vacuum tubes

1. Construct a circuit, using a diode tube to determine the static or dynamic characteristics of the tube
2. Construct a circuit, using a triode tube to determine the grid cutoff

6. Build a voltage doubler power supply
7. Build an a-c/d-c power supply for a portable radio
8. Troubleshoot power supplies
9. Check and/or replace filter circuit components

H. Troubleshooting

1. Troubleshoot a dead a-m receiver
2. Troubleshoot a weak a-m receiver
3. Troubleshoot a distorted a-m receiver
4. Troubleshoot an intermittent a-m receiver
5. Troubleshoot a noisy a-m receiver
6. Troubleshoot a receiver for hum
7. Troubleshoot an a-m receiver that squeals or motorboats

I. F-M radio

1. Signal-trace f-m receiver
2. Install an f-m tuner
3. Align the i-f stages
4. Align the detector stage
5. Troubleshoot an f-m receiver
6. Align a multiplex circuit

J. Auto radio

1. Eliminate automobile electrical system noises in auto radio
2. Check and/or replace vibrator troubles
3. Adjust pushbutton tuning
4. Install and remove auto radios
5. Troubleshoot an auto radio
6. Install and check an auto antenna

K. Record changers

1. Clean and lubricate a record changer
2. Repair and adjust turntables of record changers
3. Troubleshoot and repair record changer
4. Check and/or replace a-c motor in record changer
5. Check the speed of record changer

16. Check and/or replace power cord
17. Check and/or replace power plug
18. Check and/or replace batteries

B. R-F section

1. Check and/or replace a gang tuning capacitor
2. Check and/or replace an antenna
3. Check the r-f alignment of a receiver
4. Assemble an r-f amplifier
5. Troubleshoot r-f amplifier

C. Oscillator and converter

1. Assemble an oscillator circuit
2. Troubleshoot an oscillator circuit

D. I-F section

1. Build an i-f amplifier
2. Troubleshoot the i-f circuits

E. Detector

1. Assemble a detector and AVC circuit
2. Troubleshoot the detector and AVC circuit

F. Audio section

1. Assemble and troubleshoot an audio voltage amplifier
2. Assemble and troubleshoot a phase inverter
3. Assemble and troubleshoot an audio power output stage
4. Check and/or replace an output transformer
5. Check the impedance matching of an output transformer
6. Phase a system with two or more speakers
7. Repair speaker cones

G. Power supplies

1. Build a half-wave rectifier power supply
2. Build a full-wave rectifier power supply
3. Build a half-wave rectifier with diode rectifier
4. Build a full-wave rectifier with diode rectifiers
5. Build a full-wave rectifier, using a bridge

3. Construct a circuit, using a pentode tube to determine the dynamic characteristics of the tube

H. Transistors

1. Construct a common base amplifier
2. Construct a common emitter amplifier
3. Construct a common collector amplifier

I. Oscillators

1. Assemble a Hartley oscillator
2. Assemble a Colpitts oscillator
3. Assemble an oscillaotr, using a transistor

J. Amplification

1. Assemble a class "A" amplifier
2. Assemble a push-pull amplifier
3. Couple two amplifier stages together, using RC coupling
4. Couple two amplifier stages together, using capacitive coupling
5. Couple two amplifier stages together, using transformer coupling

II. SUGGESTED JOBS IN RADIO

A. Service to typical components

1. Check and/or replace tubes or transistors
2. Check and/or replace a coil
3. Check and/or replace a ceramic, paper, electrolytic capacitor
4. Check and/or replace a resistor
5. Replace a tube socket
6. Check and/or replace i-f transformer
7. Check and/or replace a power transformer
8. Check and/or replace a selenium rectifier or diode
9. Check and/or replace a volume control
10. Check and/or replace an on-off switch
11. Check and/or replace a tone control
12. Replace a transistor base
13. Check and/or replace speaker
14. Check and/or replace dual cord
15. Check and/or replace dual light

6. Change the needle and/or cartridge of record changer
7. Check and adjust the change cycle of record changer

L. Recorders

1. Troubleshoot and repair tape recorders
2. Check and/or replace a-c motor in tape recorder
3. Check, clean, and demagnetize tape recorder heads
4. Check and adjust the speed of tape recorder
5. Check and troubleshoot erase oscillator

III. SUGGESTED JOBS IN BLACK-AND-WHITE TELEVISION

A. Black-and-white television controls and adjustment

1. Turn on the television set and adjust the operating controls
2. Adjust the service control

B. Cathode-ray tube (CRT)

1. Adjust the ion trap on the CRT
2. Adjust the focus coil
3. Adjust the deflection yoke
4. Remove and/or replace the CRT socket
5. Remove a CRT from the chassis
6. Install a CRT in a chassis
7. Adjust centering devices on CRT
8. Adjust width sleeve
9. Check operating voltage at the CRT

C. Antennas, VHF and UHF

1. Install roof antennas
2. Install ground antennas
3. Check and repair antennas
4. Install lighting arrester
5. Install rotary antenna
6. Check and/or repair rotary motor and control
7. Install signal booster on antenna
8. Check and/or repair signal booster

D. Tuners

1. Install and adjust channel strips
2. Troubleshoot the tuner section
3. Adjust tuner controls
4. Replace and/or repair UHF section of tuner
5. Replace and/or repair VHF section of tuner
6. Check the r-f response of tuner
7. Adjust the r-f oscillator of tuner
8. Adjust and clean loose and dirty contacts of UHF or VHF tuner
9. Troubleshoot the tuners for such defects as direct-drive mechanism
10. Replace wafers on rotary-type tuners

E. Video amplifiers

1. Check video circuits for proper waveforms and voltages
2. Align video i-f transformers
3. Assemble a video stage
4. Check the video-frequency response
5. Adjust the traps
6. Troubleshoot video circuits

F. Audio circuits

1. Assemble audio circuits for television receiver
2. Troubleshoot audio circuit in television receiver

G. Power supply

1. Assemble a low-voltage television power supply
2. Troubleshoot a television power supply

H. Sound i-f circuits

1. Assemble i-f section
2. Check and/or align sound i-f section
3. Troubleshoot i-f section

I. Sound detector

1. Assemble sound-detector circuits
2. Align detector circuits
3. Troubleshoot the sound-detector circuits

J. Horizontal oscillator

1. Assemble a horizontal oscillator
2. Check and align to proper frequency
3. Troubleshoot horizontal oscillator circuit

K. Horizontal output and high-voltage circuits

1. Assemble a horizontal output circuit
2. Check circuit for correct waveforms
3. Check and/or replace the horizontal output transformer
4. Replace filament winding for high-voltage rectifier
5. Change high-voltage rectifier tube socket
6. Troubleshoot high-voltage and horizontal output circuits

L. Vertical oscillator and output circuit

1. Assemble a vertical oscillator and output stage circuit
2. Check for proper waveforms
3. Check for correct frequency of vertical oscillator
4. Troubleshoot vertical oscillator and output circuit

M. Detector

1. Assemble a detector circuit
2. Troubleshoot the detector circuit

N. I-F stages

1. Assemble the i-f circuits
2. Check and/or replace i-f transformer
3. Check and align i-f transformers
4. Troubleshoot the i-f circuits

O. Sync circuits and AGC

1. Assemble sync and AGC circuits
2. Troubleshoot sync and AGC circuits

P. Cabinet and chassis

1. Clean and repair cabinets
2. Clean picture tube
3. Clean the front glass or shield of television cabinet

4. Clean a television chassis

IV. SUGGESTED JOBS IN COLOR TELEVISION

A. Operating controls

1. Adjust hue control
2. Properly adjust fine tuner
3. Properly adjust horizontal oscillator
4. Adjust color saturation control

B. Service controls

1. Adjust high-voltage control
2. Adjust focus control
3. Adjust bias control
4. Adjust color-killer control
5. Adjust screen controls
6. Make conve-gence adjustment - (using dot-and-bar generator, and degaussing coil)

C. Chrominance circuits

1. Troubleshoot chrominance circuit
2. Align chrominance circuit

D. Color-demodulator circuits

1. Check waveform of demodulator circuits
2. Align color-demodulator circuits
3. Troubleshoot demodulator circuits

E. Band pass amplifier

1. Check for proper waveforms and alignment

F. Oscillator, 3.58 MH_z

1. Check crystal
2. Tune oscillator circuit

G. Burst amplifier

1. Check and/or align burst amplifier
2. Troubleshoot the burst amplifier

H. Killer amplifier

1. Check waveform of killer amplifier
2. Troubleshoot the killer amplifier

I. Color amplifiers

1. Check waveform of color amplifier
2. Troubleshoot the color amplifier

J. Color AFC circuits

1. Check waveforms and voltages in color AFC circuit
2. Align color AFC circuit
3. Troubleshoot the color AFC circuit

K. Reactance circuit

1. Align reactance circuit
2. Check waveform of reactance circuit
3. Troubleshoot the reactance circuit

L. Color bar generator

1. Check the color sections of the television receiver, using the color bar generator
2. Adjust the color phasing control, using the color bar generator

RELATED SUBJECTS
for
RADIO & TELEVISION

I. CONSTRUCTION FUNDAMENTALS

A. Soldering and splicing
B. Care and use of hand tools

II. PRINCIPLES OF ELECTRICITY

A. Basic electron theory
B. Electron movement
C. Basic physics
D. Radio symbols
E. Identification of electronic components
F. Color code
G. Electrical energy
H. Measurement of electrical energy
I. Laws of electrical charges

III. MAGNETISM

A. Permanent magnets and magnetic fields
B. Electromagnetism
C. Characteristics of electromagnets

IV. OHM'S LAW

A. Ohm's law in series circuits
B. Ohm's law in parallel circuits
C. Ohm's law in series-parallel circuits

V. INDUCTANCE

A. Induced voltages

B. Alternating and direct currents

C. Phase relationship of voltage and current

VI. TRANSFORMERS

A. Theory of transformer action

B. Turns ratio

C. Impedance matching

D. Transformer losses

E. Transformer rating

F. Power transformers

G. R-F transformers

H. Isolation transformers

I. Instrument transformers

VII. CAPACITANCE

A. Capacitance values

B. Color code of capacitors

C. Capacitance in a-c circuits

D. Testing capacitors

VIII. TIME CONSTANTS AND RESONANCE

A. Capacitors and time constants

B. Inductance and time constants

C. Time constants of RC circuit

D. Time constants of RL circuit

E. Time constants of RLC circuit

F. Resonant frequencies in RLC circuits

IX. VACUUM TUBES

A. Emission in vacuum tubes

B. Electron action in diode tubes

C. Rectifiers

D. Rectifiers and filters

E. Diode tube as detector

F. Triode tube

G. Biasing of triode tube

H. Tetrode tubes

I. Pentode tubes

J. Cathode-ray tube

K. Special-purpose tubes

X. TRANSISTOR

A. Semiconductor theory

B. Diodes

C. Junction transistor NPN

D. Junction transistor PNP

E. Field effect transistor

F. Types of transistors

G. Servicing transistor circuits

H. Test equipment for transistors

XI. AMPLIFICATION

A. Class "A" amplifier

B. Class "B" amplifier

C. Class "C" amplifier

D. Class "A-B" amplifiers

E. Push-pull amplifiers

F. Coupling to amplifiers

XII. OSCILLATION

A. Oscillations

B. Hartley oscillator

C. Colpitts oscillator

D. UHF oscillators

E. Multivibrators

F. Blocking oscillator

G. Transistor oscillators

XIII. RADIO RECEIVERS

A. R-F detectors

B. R-F amplifiers

C. Automatic volume control

D. Frequency modulation

E. Receiver alignment

F. Portable radio receivers

G. Transistor circuits in radio

H. Troubleshooting transistor radios

I. Servicing transistor radios

J. Alignment of transistor radios

K. Superheterodyne receiver

XIV. RADIO TROUBLESHOOTING

A. Signal tracing

B. Printed circuits and etched wiring

C. Power supply

D. I-F stage

E. Local oscillator

F. R-F stage

G. Audio stage

XV. HIGH FIDELITY

A. High fidelity

B. Impedance matching

C. Loudspeakers

D. High-fidelity speaker enclosure

E. Electrical cross-over networks

F. Record players

G. Tape recording and playback

XVI. ADVANCED TEST EQUIPMENT

A. Oscilloscope
B. Sweep and marker generator
C. Crosshatch generator
D. Marker adder
E. Field strength meter
F. Analyst

XVII. TELEVISION

A. Television transmission and reception

1. Transmitting and receiving picture information
2. Transmitting and receiving sound information
3. Scanning
4. Vertical and horizontal scanning frequencies
5. Television channels
6. Standard of transmission

B. Scanning and synchronizing

1. Sawtooth waveform
2. Standard scanning pattern
3. Blanking
4. Interlacing
5. Waveforms encountered in TV
6. Synchronizing pulses

C. Picture carrier signal

1. Negative transmission
2. Vestigal side-band transmission
3. Line-of-sight transmission
4. Television broadcasting

D. Television receivers

1. TV receiver block diagrams
2. Receiver circuits
3. Sound take-off circuits

4. Localizing troubles to a receiver section

E. Picture tubes

1. Deflection, focusing, and centering
2. Types of picture tubes
3. Electron beam
4. Focusing the electron beam
5. Magnetic deflection
6. Picture-tube precautions
7. Picture-tube troubles

F. Power supplies

1. Full-wave rectifier
2. Half-wave rectifier
3. Heater circuits
4. Voltage doublers
5. Transformerless low-voltage power supply
6. Stacked B+ circuits
7. Rectifier ratings
8. High-voltage power supplies
9. High-voltage safety precautions
10. High-voltage troubles
11. Low-voltage power supply troubles

G. Video amplification

1. Video signal
2. Picture reproduction
3. Amplification of video signal
4. Manual contrast control
5. Video frequencies
6. Frequency and phase distortion
7. Video amplifier circuit
8. Transistorized video amplifier
9. Trouble in the video section

H. Brightness control and d-c clamping

1. Brightness control

2. D-C component and average value of the video signal
3. Clamping action of grid-leak bias and diode clamping circuit
4. Trouble in the brightness control and d-c clamping circuits

I. Video detector

1. Detection
2. Video detectors load resistance and filters
3. Detector diodes
4. Video detector diodes
5. Troubles in video detector circuits

J. Automatic gain control

1. Requirements of the AGC circuit
2. How the AGC bias controls gain
3. Advantages of AGC for picture signal
4. Keyed AGC circuit
5. AGC level adjustment
6. AGC troubles
7. AGC bias for transistor amplifiers

K. Sync separation

1. Vertical synchronization of the picture
2. Horizontal synchronization of the picture
3. Separating the sync from the video signal
4. Integration of the vertical sync
5. Noise in the sync
6. Sync separator circuits
7. Sync and blanking bars on the kinescope screen
8. Sync troubles

L. Deflection oscillators

1. The sawtooth deflection waveform
2. Producing sawtooth voltage
3. Blocking oscillator and discharge tube
4. Analysis of blocking oscillator circuit
5. Deflection generators with blocking oscillator and discharge tube
6. Deflection oscillator controls

7. Synchronizing the blocking oscillator
8. Multivibrators
9. Plate-coupled multivibrator
10. Cathode-coupled multivibrator
11. Multivibrator sawtooth generator
12. Synchronizing the multivibrator
13. Frequency dividers
14. Trapezoidal voltage waveshape
15. Incorrect oscillator frequency

M. Horizontal AFC circuits

1. AFC requirements
2. Push-pull sync discriminator
3. Circuit of multivibrator controlled by sync discriminator
4. Single-ended sync discriminator
5. D-C control tube (synchro-guide)
6. Sine wave oscillator with reactance tube (synchro-lock)
7. Hold-in range and pull-in range
8. Filtering the d-c control voltage
9. Phasing between horizontal blanking and flyback

N. Vertical deflection circuits

1. Triode vertical output stage
2. Vertical output transformers
3. Vertical linearity
4. Internal vertical blanking
5. Vertical deflection circuit with blocking oscillator
6. Combined vertical oscillator and output circuit
7. Transistorized vertical deflection circuit
8. Vertical deflection troubles

O. Horizontal deflection circuits

1. Functions of the horizontal output circuit
2. Horizontal amplifier circuit
3. Damping in the horizontal output circuit
4. Horizontal scanning and damping
5. Boosted B+ voltage

6. Flyback high voltage
7. Horizontal deflection controls
8. Deflection yokes
9. Horizontal output transformers
10. Analysis of horizontal output circuit
11. Typical horizontal deflection circuit
12. Transistorized horizontal deflection
13. Troubles in the horizontal deflection circuits

P. Picture i-f amplifiers

1. Picture i-f response
2. The intermediate frequency
3. I-F amplification
4. Double-tuned i-f amplifiers
5. Single-tuned i-f amplifiers
6. Stagger-tuned stages
7. Wave traps
8. Picture i-f alignment
9. Picture i-f amplifier circuits
10. Transistorized i-f stage
11. Troubles in the picture i-f amplifier

Q. The r-f

1. Operation of the r-f tuner
2. The r-f amplifier stage
3. R-F amplifier circuits
4. The mixer stage
5. The local oscillator
6. R-F alignment
7. Conversion methods for UHF channels
8. Types of r-f tuner circuits
9. UHF tuner circuit
10. Receiver noise

R. Antennas and transmission lines

1. Resonant length of an antenna
2. Definition of antenna terms

3. Ghosts
4. Straight dipole
5. Folded dipole
6. Broad-band dipoles
7. Long-wire antennas
8. Parasitic arrays
9. Multiband antennas
10. Stacked arrays
11. Transmission lines
12. Characteristic impedance
13. Transmission-line sections as resonant circuits
14. Impedance matching
15. Antenna installation
16. Multiple installations
17. Troubles in the antenna system

S. The f-m sound signal

1. Frequency changes in a f-m signal
2. Audio modulation in an f-m signal
3. Definition of f-m terms
4. Reactance-tube modulator
5. Advantages and disadvantages of AM
6. Receiver requirements for an f-m
7. Triple-tuned discriminator
8. Center-tuned discriminator
9. The limiter
10. Ratio detector
11. Quadrature-grid f-m detector
12. Complete sound i-f circuit
13. ~~Sound~~ i-f alignment
14. Intercarrier sound
15. Intercarrier buzz

T. Receiver servicing

1. Receiver adjustments
2. Types of ghosts
3. R-F interference

4. External noise interference in the picture
5. Sound in the picture
6. Localizing hum troubles
7. Testing scanning linearity with bar patterns
8. Signal injection
9. Localizing receiver troubles
10. D-C voltage measurements
11. Oscilloscope measurements
12. Alignment precautions
13. Typical receiver circuit

U. Color television system

1. Color signals
2. Color addition
3. Definition of color television terms
4. Y signal
5. Types of color video signals
6. Q signal
7. I signal
8. R - Y signal
9. B - Y signal
10. G - Y signal
11. Desaturated colors
12. The transmitted chrominance signal
13. Matrix circuits
14. Color subcarrier frequency
15. Color synchronization
16. Colorplexed composite video signal waveforms
17. Vector addition of color signals
18. Chrominance section
19. Chrominance amplifier circuits
20. Burst amplifier circuits
21. Color AFC circuits
22. Automatic color control (ACC) bias
23. Color-killer circuit
24. Color-demodulator circuits

25. Color picture tubes
26. Kinescope setup adjustments
27. Convergence procedure
28. Color controls and adjustments
29. Schematic of color section of receiver
30. Color troubles

XVIII. MATHEMATICS

1. Arithmetic
2. Decimals
3. Fractions
4. Percentages
5. Powers and roots
6. Graphs
7. Algebraic addition and subtraction
8. Algebraic division and multiplication
9. Simple equations
10. Ratio and proportion
11. Powers of ten
12. Special products and factoring
13. Equation containing fractions
14. Graphs and sets of linear equations
15. Exponents and radicals
16. Logarithms
17. Basic trigonometry
18. Tables of trigonometric functions
19. Vectors

NOTE: All of the above topics should be taught with applications as applied to the Radio, Television, and Electronics trade

XIX. SAFETY

1. Personal
2. Hand tools and materials
3. Working with high voltages

4. Electrical shock treatment
5. Administering first aid

RADIO-TV EQUIPMENT LIST

ITEM NO.	QUANTITY	DESCRIPTION
1.	1	Electronics Lecture Demonstration Unit (To include console)
2.	1	Electronics Fundamentals Unit (Accessory to Item #1)
3.	1	Transistor Lecture Demonstration Unit
4.	1	Voltage Regulator Demonstration Unit
5.	1	Frequency Modulation Demonstration Unit
6.	1	Accessories Storage Drawer
7.	1	Oscilloscope, wide-band (Dual Trace)
8.	1	Square-wave Generator
9.	1	Vacuum-Tube Voltmeter (Lab Type)
10.	1	Audio Oscillator (Lab Type)
11.	1	R-F Signal Generator
12.	1	Master Antenna Distribution System (To include antenna)
13.	1	Power Line Monitor

STUDENT EQUIPMENT

14.	8	Fundamentals Units (Breadboarding)
15.	8	Regulated Power Supply
16.	8	Volt-ohm-milliameters
17.	8	Vacuum Tube Voltmeters
18.	8	Oscilloscope (Wide-band)
19.	8	R-F Signal Generator
20.	8	Audio Oscillator (Sine-Square Wave)
21.	8	Isolation Transformer
22.	8	Demodulator Probes (Brand to be same as VTVM)
23.	8	Bench Lamps (Fluorescent)
24,	2	Sweep Generator
25.	2	Marker Generator
26.	2	Marker Adder
27.	2	Color Bar/Dot/Crosshatch Generator
28.	2	Pattern Generators
29.	2	Yoke Substitution Unit (Universal)

ITEM NO.	QUANTITY	DESCRIPTION
30.	2	Substitution Box (Resistor, Capacitor, Rectifier)
31.	2	Capacitor Analyzer
32.	2	High-Voltage Probes (25KV) (Brand to be same as VOM)
33.	2	High-Voltage Probes (50KV) (Brand to be same as VOM)
34.	8 lots	Test Harness
		SPECIAL EQUIPMENT
35.	2	Transistor Radio Analyzer
36.	2	Tube Checkers
37.	1	Multiplex Generator
38.	1	CRT Checker
39.	1	Field-Strength Meter
40.	1	Degaussing Coil
41.	2	Power Supply, DC (0-SV @ 10A; 0-16V @ 6A)
42.	1	Microphone (Dynamic)
43.	1	Microphone (Crystal)
		SHOP EQUIPMENT AND HAND TOOLS
44.	8	Soldering Guns, 145-210W
45.	8	Pliers, Long nose, 6"
46.	8	Pliers, Diagonal, 5"
47.	8	Pliers, Combination, 6"
48.	8	Screwdrivers, 2" x 1/8"
49.	8	Screwdrivers, 6" x 1/4"
50.	8	Screwdrivers, 3" x 3/32"
51.	8	Screwdrivers, Phillips #1
52.	8 sets	Nut Drivers
53.	8	Alignment Kits
54.	1	Vise, Machinist (4" Jaw, 6" Opening)
55.	1	Drill Press, Bench model, 1/2", Jacobs Chuck
56.	1 set	Chassis Punch, Round
57.	1 set	Chassis Punch, Square
58.	1	Circle Cutter

ITEM NO.	QUANTITY	DESCRIPTION
59.	1 pr.	Tin Snips (Aviation, 10")
60.	2	Wire Strippers
61.	1	Square, Combination
62.	1	Wrench Set, Open-end, 1/4" to 13/16" by 16ths
63.	1	Adjustable Wrench, 8"
64.	1	Hammer, Ball-peen, 8 oz.
65.	1 set	Punches (Center, Pin, Prick)
66.	1	Hacksaw, 12", Adjustable
67.	2	File Sets, Mill (6", 8", 10")
68.	1	Drill, Electric, 1/4", Heavy duty
69.	1	Tap and Die set, Electrician's
70.	1	Reamer, 1/8" Tip, 5-1/2" long
71.	1	Twist Drill Set, 1/16" through 1/2" by 32nds

OTHER SPECIAL EQUIPMENT

72.	Analyst
73.	Impedance bridge

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RECOMMENDED TEXTS:

A definite text has not been selected at this time. Some of the reasons for this are the rate at which new electronic devices are being employed in the electronic field and their effect upon different types of circuitry. The trainee must receiver training in the fundamentals of electricity and electronics, radio, black-and-white television and color television; therefore, several texts are necessary to cover the complete field. Some of the texts being used by the radio and television instructors are listed below.

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GENERAL BUSINESS

UNIT: THE INFLUENCE OF AUTOMATION ON BUSINESS AND PERSONAL LIFE

Major Teaching Objective

To develop an understanding of the basic principles, the social and economic implications, and the occupational opportunities important in automation and technological change

Learnings (Competencies) to be Developed

1. To understand what automation is and how it influences our daily lives
2. To trace the historical development of automation and data processing
3. To understand the social and economic implications of automation and technological change--its influence on job life and worker employability
4. To become aware of the jobs specifically related to automation
5. To understand the basis of the electronic computer and punched-card equipment

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

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Prepared by
Mrs. Mavis C. Sparks
Specialist in Business and Office Education

Instructional Materials Laboratory
Division of Vocational Education
College of Education
University of Kentucky

October, 1966

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MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) Dr. George L. Luster (Agency) Instructional Materials Laboratory

(Address) Room 151, Taylor Ed. Bldg., University of Kentucky, Lexington, Ky. 40506

DATE: July 26, 1967

RE: (Author, Title, Publisher, Date) Mrs. Mavis C. Sparks,

"The Influence of Automation on Business and Personal Life"

Supplementary Information on Instructional Material

Provide information below which is not included in the publication. Mark N/A in each blank for which information is not available or not applicable. Mark P when information is included in the publication. See reverse side for further instructions.

(1) Source of Available Copies: Not available to teachers outside Kentucky -- one or two copies will be supplied to the professional staff in vocational education in each State that is responsible for teaching materials. (ERIC only).
Agency
Address
Limitation on Available Copies
Price/Unit
(quantity prices)

(2) Means Used to Develop Material:
Development Group Individual authorship
Level of Group State level -- specialist in business & office education
Method of Design, Testing, and Trial Designed by subject matter specialist; to be revised upon recommendations by classroom teachers after first or second year of use.

(3) Utilization of Material:
Appropriate School Setting area vocational school and high school
Type of Program high school class
Occupational Focus "generally applicable across job categories"
Geographic Adaptability applicable generally
Uses of Material course and lesson planning
Users of Material teachers

(4) Requirements for Using Material:
Teacher Competency business and/or distributive education
Student Selection Criteria background

Time Allotment sophomore +

Supplemental Media --
Necessary ____
Desirable X
(Check Which)

Describe P

Source (agency)
(address)

GENERAL BUSINESS

UNIT: THE INFLUENCE OF AUTOMATION ON BUSINESS AND PERSONAL LIFE

Plan for Teaching Time

Group teaching:	Topic	Periods
In classroom, at school	_____	_____
Outside classroom, at school	_____	_____
Field trips, away from school	_____	_____
	Total	_____

Individual Projects:

_____ _____

_____ _____

Month(s) to be taught _____

Place of the Unit in the Course of Study

Everyone's life is affected in some way by the use of automated equipment. A broader back ground is needed to enter the business world. Business saves time, money, and manpower by using data processing machines. Society receives better services at lower costs. Each of us must continually adapt to progress and continue his education to up date his skills throughout his employable life. These realities of modern society, government, business, and industry demand that the student have some basic understanding of automation and technological advance.

Since general business deals with business skills and knowledge important in everyday life, and gives the background for study of more advanced business courses, it is the appropriate course in which to include an exploratory unit on automation. The unit fits best near the end of the course, before the unit on "Successful Economic Citizenship," which deals with choosing a career and preparing for employment. Before this unit, the students should have a background of business services, a knowledge of business organization, and an understanding of his role as a producer and consumer. He will also have an awareness of a few automated and mechanical processes. This knowledge will facilitate his understanding of this unit.

A minimum of five to six class periods is suggested. The topic may be studied in greater depth by uses of special projects outside the classroom and the use of practice sets. Study time may be shortened by leaving the study of the specific job titles related to automation until the careers unit.

Suggestions for Introducing the Unit

Deciding What Is to be Taught

The content suggested is to provide the student with a general knowledge of automation. The study may be broadened to specific applications to office work by the working of a practice set, such as Automation Office Practice by Wanous and Wanous published by South-Western Publishing Company, or the use of a programmed text, such as Kahn's Business Data Processing published by Gregg.

The topics outlined for study in this unit are given briefly below. They are developed in greater detail in the unit.

a. What automation is and how it influences our daily lives

--Definition of automation

--Machines that are automated

--Difference between technology and automation

--Office equipment that is automated

--Factory machinery that is automated

--Examples of automation outside the business community

b. Historical development of automation and data processing

--Early inventions contributing to modern automation

--Development of computers

--Beginnings of automation in industry

--Factors influencing its growth

c. Social and economic implications of automation and technological change

--Effect on business

--Effect on employment

--Effect on office personnel

--Effect on school dropouts

--Assistance for workers in meeting the problems of technological change

--Effect on industry

--Expected social changes

d. Jobs specifically related to data processing

--Classification of jobs

--Preference toward men or women

--Basic requirements

--Some of the more common job titles

e. The electronic computer and punched card equipment

--Speed

--Uses

--Kinds

--How they solve problems

--How they do arithmetic

Presenting the Unit to the Class

The unit should be packed with realism and concrete examples. The following approaches or a combination thereof may be helpful in giving the class a clearcut first view:

a. Display pictures of computers. "Posters on Computers," a new bulletin board collection that covers computers from the abacus to the latest equipment in use, is available from J. Weston Walch, Publisher, Box 1075, Portland, Maine. It contains 18 posters, 8½ by 11 inches, printed on heavy-stock paper. Cost is $1.50 per set.

b. Display data processing equipment "software" for "hands on" experience. Obtain punched cards, program sheets, tapes, and data sheets from punched card and computer installations for the students to see and touch. A visit to a business using automated data processing will provide an opportunity to collect these. University and college computing centers and your own personal business transactions will yield examples for display.

c. Use films and/or filmstrips to give an overall view and to set the scene.

--"Have I Told You Lately I Love You," (16 min., sound, B & W, 20 min.), University of Sourthern California, Los Angeles, California; and University of California, Berkley, California.

This film tells the story of a modern family who are enslaved by automatic gadgets in home and business. They go through days with no real person-to-person contact because everything is done automatically. Emphasis is placed on life being more than a robot existence. The Machine Age's noncommunicative family life is dramatically and forcefully pointed out, even if somewhat exaggerated.

--"The Information Machine," (16 mm. or 35 mm., sound, color, 10 mm.), International Business, 590 Madison Avenue, New York 22, N. Y.; and local offices.

This is a sophisticated, sometimes amusing account of the development of the electronic computer beginning with primitive men and ending with the advent of machine simulation. Colorful and imaginative, this film is effective in explaining the nature of data processing. It is suitable for junior and senior high-school students and adults.

--"The Challenge of Electronic Data Processing," filmstrip, 87 frames, color, sound, 10 min.), The Association for Bank Audit, Control and Operation, 205 Touhy Ave., P.O. Box 500, Park Ridge, Illinois 60068.

This filmstrip explains the development of modern day data processing techniques and traces the history of record keeping from stone tablets to the computer. It explains what computers can and cannot do, how they may be used for business management decisions, and how they may be applied to large volume record keeping. Automation in banking is shown.

--"This Is Automation," (16 mm., sound, color, 30 min., rental $1), University of Georgia, Athens, Georgia; and University of Wisconsin.

Examples are given, ranging from the manufacture of cookies to cars. Some are complex (machining automobile engine blocks), and others are as simple packaging nuts and bolts. The film is produced by General Electric.

d. Use transparencies throughout the unit to illustrate important points.

--"Story of Computer," (Science No. 32). A pictorial presentation of computers and their abilities. Printed originals, Cat. No. 278, $1; prepared color transparencies, Cat. No. 778, $30. 3M Company, Visual Products Division, 2501 Hudson Rd., St. Paul, Minnesota 55119.

--See also transparency masters attached to back of this unit.

Learnings (Competencies) to be Developed

1. **To understand what automation is and how it influences our daily lives.**

This approach starts with the student's experiences and gives him a background on which to build understanding of the unfamiliar to follow. If one or more of the visual aids previously suggested is shown at the beginning of the class period, this discussion may serve as a summarization of important points.

Suggested Content

a. What is automation?

--Words sometimes used interchangeably with automation are: technology, technological change, mechanization, electronic data processing, scientism, electronics, and advanced instrumentation.

--A general definition often used "any mechanical device or system which reduces mental or manual effort," actually defines technology or mechanization.

--Technology includes mechanical or electro-mechanical devices which are paced and controlled by men who operate them as well as machines that are automatic or self-directed.

--A more accurate definition of automation is the repetition of machine functions through self-directed control. This embraces the principle of feedback or self-correction.

b. What are some machines that control themselves?

--Some examples are the transfer machine in a Detroit automobile factory, the control panel in an oil refinery, and the electronic computer in the business office.

--The amount of work produced is not limited by the abilities of the human operator, but by the capabilities of the machine itself.

--The operator provides the machine with its instructions or program; but once these have been given, the machine is self-acting.

c. What are some machines that are self-correcting?

--Two devices that are self-correcting are a windmill and a heating system controlled by a thermostat.

--The wind turns the mill which lifts the water. When the wind changes direction, the tail fan repositions the fan wheel so

that it continues to face into the wind. Because of this automatic control, the mill can pump water for years without interruption.

--When the heating system in a home is thermostatically controlled, the thermostat tells the furnace to return the room to the desired condition when the temperature gets too high or too low. The correct temperature is thus maintained through feedback; that is, through the furnace feeding back the heat needed to return the room to the desired temperature. The furnace is self-directed, no human effort is required unless a different temperature is desired.

d. What does one think of first when he hears the words technology and automation?

--One thinks almost immediately of the computer.

e. Is there other equipment in the business office that falls in these catagories?

--Yes, there are typewriters, desk calculators, duplicators, integrated data processing equipment, and punched-card equipment.

--This equipment can keep inventory records, compile sales figures, handle payroll accounts, prepare income tax returns, and make time studies. Some can even translate languages. Railroads and airlines use it for making seat reservations. A central computer keeps a record of available space on future flights. All flight and seat information is stored in coded form in its memory unit. When a ticket agent pushes a series of buttons, the computer checks its memory unit and tells the agent whether a seat is available on a particular flight. The agent can then reserve the seat by pushing another series of buttons. The reservation systems of several airlines can be interelated on one network.

f. What equipment do factories have of this type?

--They have machines which perform operations, control operations, move materials from one operation to the next, inspect products, maintain inventories, and fill orders.

--Since this type of automation is much used in the automobile industry it is often referred to as "Detroit Automation."

--An example is the application used by the Ford Motor Company, Cleveland, Ohio. It processes complete engine blocks with automation. It takes only 14.6 minutes for a series of 530 automatic operations to produce finished products. The key unit in the system is the toolmeter, a tool control board which looks like a big switch board and tells the operator

when to replace worn tools in the engine-block line. A light flashes on at the moment a tool needs changing. It can be replaced without halting production.

g. Is automation confined to the business community only?

--No, the armed forces, have guided missiles, space vehicles, supersonic aircraft, and automatic atomic submarines. Computers were used in preparing Telstar and placing it into orbit.

--The home has automatic washers and dryers, stoves with control panels that resemble the cockpit of a jet airliner, and electric can openers.

--Automobiles may have automatic transmissions, power windows, brakes, and steering.

Teaching-Learning Activities

a. Ask the students for their own definition of automation. Make it a part of a bulletin board display, with pictures of automatic machines.

b. Ask the students to list, from their own experience, all the mechanical devices they can that reduce physical or mental human effort. Record these on the chalkboard.

c. Ask the students to list as many devices as possible that are self-directed.

d. Have the students list what they would like to learn about automation. Use these items in planning future lessons.

e. Alert students to the timeliness and importance of automation by having them bring to class for discussion at least one article from a newspaper or magazine concerning some phase of automation.

f. Have the students keep a vocabulary notebook of automation terms. From this lesson they may define the following:

automation	data processing
technology	computer
electro-mechanical	"Detroit Automation"
feedback	

g. Have students bring evidence to class to show that automated equipment is being used in business. (punched tags on clothes, punched card bills, mark sensed credit card receipts, etc.)

Suggested References

a. For the student

--"Data Processing and Introduction for Students: What Is Data Processing All About?" by Merle W. Wood and Robert G. Espegren. An article published in the October, 1964, issue of the Business Education World, pp. 15-18. Reprints are available at 50¢ per copy (26-50 copies cost 45¢ each; 51-100 copies, 40¢; 101 and over, 35¢). Write: Reprint Department, Business Education World, 330 W. 42 St., New York, N. Y. 10036.

--"Electronic Data Processing Written for the Layman: Book 1. What Is Data Processing?" National Cash Register Company, Dayton, Ohio. Free.

b. For the Teacher

--Data Processing for Business Education Department in Pennsylvania's Public Schools (Bulletin 276). Department of Public Instruction, Commonwealth of Pennsylvania, Harrisburg, Pa. Free. pp. 6-17.

This booklet has been prepared to give business teachers a background in data processing. Most of the information can be used as a reference in preparing daily lesson plans. It explains what rather than how.

--"Automatic Data Processing Glossary," U. S. Government Printing Office, Washington, D. C. 20402. 40¢

--"Automation Dictionary," Minneapolis-Honeywell Regulator Co., Information Service Department, 60 Walnut Street, Wellesley Hills, Massachusetts 02181. $1

2. To trace the historical development of automation and data processing.

Since work began, man has tried to reduce his efforts through use of tools and machines. Notable inventions through the centuries which have lead to today's electronic computers and automated factories are the wheel, pulley, levers, steam power, gas power, electrical power, conveyor belts, and assembly lines. Some developments more directly related to modern day automation and data processing with which the student should be acquainted are given below:

Suggested Content

a. What were some early related inventions which lead to the development of modern automation?

--The ancient Greeks, Romans, and Chinese developed and used the abacus as a counting device. It is still in use today.

--Blaise Pascal, a famous French mathematician and philosopher, built some "arithmetic machines" 1642-1643.

--Jacques de Vaucanson, a French inventor, built a mechanical loom for manufacturing figured silks in 1741. Its pedals were moved automatically by means of a drum pierced with holes.

--Oliver Evans, an American inventor, built a completely automatic flour mill near Philadelphia in 1784.

--James Watt invented and used a flyball governor, a feedback device to control the speed of his famous invention, the steam engine.

--Joseph Marie Jacquard, a Frenchman, adapted De Vaucanson's ideas into an automatic loom operated by punched cards much like those used in today's electronic office machines in 1801.

b. When were computers developed?

--Business data processing, a product of the nineteenth century, came into being in 1822 when Charles Babbage developed a "different engine" for calculating mathmetical tables. Later improvements lead to the first internally stored program computer in 1833.

--Some feel that the work of Dr. Herman Hollerith beginning in 1887, the application of punched cards in recording, compiling, and tabulating the 1890 U. S. Census, is more significant as a beginning date for business data processing. By 1900 Hollerith had developed an automatic electric sorting machine that could sort at the rate of 300 cards a minute, a semi-automatic unit tabulator, and a key punch machine. Later he left the Census Bureau and formed the Tabulating Machine Company, out of which emerged Remington Rand Corporation and IBM, today's top computer manufacturers.

--In the 1940's electronic computers were developed and used to solve acute military problems such as gunfire control. The winning of World War II can be attributed in some measure to their use.

--It wasn't until after 1950 that computers were used for the solving of problems outside the fields of engineering and science.

--The first all-electric computer was developed by John W. Mauchly and J. Presper Eckert at the University of Pennsylvania (1943-45). Their efforts lead to the development of the Univac, which became the world's first commercial electronic data processing machine. It was made available commercially in 1951. A significant feature of Univac over its forerunners was its ability to handle alphabetics and certain typewritten characters as well as numerics.

--In 1952 the eyes of the American people were opened when a computer, after receiving some early returns of the Presidential election between Eisenhower and Stevenson, accurately predicted the outcome of the election.

--By 1954 the first computer was installed in private industry. Another development during the 50's was the introduction and use of medium-sized and small computers. Small computers generally cost less than $50,000; medium-sized computers cost from $50,000 and $500,000; and large computers over $500,000.

--Early computers were operated by means of vacuum tubes which were bulky and demanded considerable power. Early in 1964, tiny transistors were used in their place. This was a considerable step forward since these units require less power and occupy less space in the computer.

c. Where and when did automation begin in industry?

--Electronic devices were first adapted for use in factories during the production boom following World War II.

--The automobile industry was the first major industry to make widespread use of automatic machines.

--Automatic control systems were developed to regulate chemical and oil-refining processes. These systems greatly increased the quality and quantity of the products produces.

--By 1954 automatic machines were producing television sets.

d. What factors have influenced the growth of automation?

--The increased needs created by our tremendous population growth and greater per-capita demand for consumer goods have been factors.

--American business and industry are trying to reduce per unit costs to offset what management views as excessive labor wage rates. This is to prevent loss of profits.

--Many U. S. businesses are trying to cut costs in order to compete with foreign producers in both domestic and foreign markets.

--The increasing demand of government for more records (income tax, unemployment benefits, social security) has accelerated the introduction of automation in the business office.

--Other factors are increased competition, increased complexity of products, and the demand by management for more quantitative information to aid in decision making.

-- Generally, the need is to produce more information faster than ever before.

Teaching-Learning Activities

a. Demonstrate the abacus.
b. Discuss the industrial revolution and why automation is sometimes called the second industrial revolution. Contrast the operation of the machines developed in each.

c. Discuss the history of the typewriter as an example of the impact of machines on work in the business office.

d. Demonstrate sorting cards with a keysort to show how a simple mechanical device will save time and effort.

e. Illustrate the window envelope as a simple automated device.

f. Have the students add the following names and terms to their automation vocabulary list:

Blaise Pascal	abacus
Jacques de Vaucanson	vacuum tubes
Oliver Evans	transistors
James Watt	industrial revolution
Joseph Marie Jacquard	second industrial revolution
Charles Babbage	IBM
Dr. Herman Hollerith	Univac
Remington Rand	

Suggested References

a. For the student

-- Read articles in encyclopedias on automation, the industrial revolution, and the typewriter. Reports may be prepared on these subjects.

b. For the teacher

-- Data Processing for Business Education Department in Pennsylvania's Public Schools, pp. 18-20.

-- "Automation: A Must Unit for General Business," by Gunder A. Myran, pp. 6-9, 31-32. Business Education World, Vol. 43, June, 1963.

3. To understand the social and economic implications of automation and technological change.

In the long-run, automation is expected to increase production, give us more and better jobs, and improve our standard of living. As we

look around us, we see that these blessings are coming, but not without making old jobs obsolete and eliminating the demand for certain skills. A willingness to work and a strong back are no longer good enough even for many "unskilled jobs." In order for the high-school student to understand the ramifications of data processing, he should know the effect it has on the business world, on present and future employment, on present and prospective office employees, and on his future, especially if a high-school education is not attained.

Suggested Content

a. What has been and will be the effect of data processing on business?

--In inquiry and reply--preparing and sending letters, reports, memorandums, etc.--where ability to make decisions is needed, data processing may not offer much relief.

--In the field of recordkeeping, it is changing not only the work being done but also the jobs of those employed. The magnitude and complexity of business, government reports, increasing payroll deductions, limited supply of properly trained clerical workers, and the demand for better services have increased the volume of office work so manual and mechanical filing, collecting, and retrieving information is no longer possible or desirable.

--It allows management to receive the information needed to make decisions shortly after the close of the quarter, month, or year. With manual processing, management would often receive their report for one month at the end of the next month. Punched card equipment speeded up the process to the middle of the next month but the computer made this information available the second day of the following month.

--More businesses have access to computers. Cheaper and more compact computers are available which are now within the reach of small businesses. Service bureaus and cooperative data processing centers have been established by firms with similar operations.

b. How will data processing affect employment?

--A 45 percent increase in clerical workers is expected between 1960 and 1975. This is how the second largest occupational group in the nation employs about 10.5 million people. The rate of growth is increasing faster than the work force as a whole. This is true irrespective of the development and use of office machines that can do work in minutes that formerly took weeks to accomplish.

--Sixty million jobs will change in character in the next generation. There will be many new jobs created that have not previously existed.

--It will not be necessary to hire a large number of temporary employees for short periods of time.

--The percentage of factory workers will decrease and the percentage of office and laboratory workers will increase.

--The managerial, technical and professional groups are rapidly overtaking the semi-skilled machine operator groups in employment.

c. How will office personnel be affected?

--Some employees will have to be retrained. Others will have to broaden their background and gain additional understandings and competencies.

--Fewer employees will work in accounting departments in branch offices and a greater number will be employed in a centralized office. Banks with suburban branches are examples of this. Often a person working in a branch office does not want to move to a centralized office of the same company.

--The percentage of men working in offices will increase. Women do not like to work at night, and computers will be operating 24 hours a day because of their high rental.

d. What happens to those who drop out of school?

--Competition in many entry occupations, especially lower level clerical jobs will increase. Vocational competency will be needed to acquire, adjust to, and move ahead in a job.

--There will be fewer jobs for those who have little formal academic or vocational education. Clerical jobs requiring no specific skill are found only in offices that haven't automated. Work that involves repetitive or routine tasks is disappearing from the business office because it is being done by machines.

e. What is being done to help workers meet the problems caused by technological change?

--Government programs are increasing unemployment benefits.

--Industrially depressed areas are being redeveloped (Area Redevelopment Act).

--Programs of retraining unemployed and underemployment workers are being initiated (Manpower Development and Training Act).

--New educational and training programs are becoming available in schools, colleges, and industries. For example, The Armour

Company has set up a fund for studies to find opportunities for employment for workers displaced by automation and to inaugurate training programs. One cent per hundred pounds of meat shipped is contributed to this fund.

--Displaced workers may be moved to other industries.

f. What influences the economic effect automation will have from industry to industry?

--The kind of automation technique being employed--electronic data processing, Detroit automation, process control, or machine tool control--influences the increase or decrease in the number of workers and how old employees will be integrated in the new systems.

--The strength of labor-management relations often decides the welfare of the employees.

--The versatility of the work force, age levels, and education levels are influential. Some employees may not be capable of learning the new skills that would be required of them.

--Some companies may need more workers because they are able to turn out a better product at lower prices.

g. What social changes can we expect?

--Automation is the key to a shorter work week. There is an unmistakable trend toward less work and more leisure. Forced idleness or unemployment should be avoided. Will we be able to adjust to having more leisure time?

--Automation brings about lower prices.

Teaching-Learning Activities

a. Discuss the effect of data processing on office work, in terms of communication and recordkeeping.

b. Describe how management depends upon data processing.

c. Discuss the effect of data processing on office employment.

d. Discuss reasons why the installation of a computer eventually necessitates the hiring of a greater number of clerical employees.

e. Obtain U. S. Department of Labor employment statistics for discussion.

f. Invite a representative of the state employment service to discuss employment trends.

g. Invite a representative of a large factory to discuss automation and employment in his plant.

h. Have your school's guidance counselor discuss curriculums designed to meet the demands that society and the business world will impose on the student.

i. Have students be on the alert for magazine articles and newspaper accounts of the effect of automation on employment.

Suggested References

a. For the teacher

--Data Processing for Business Education Departments in Pennsylvania's Public Schools, pp. 22-28.

--"Automation (Implications for the Future)," edited by Morris Philipson, (V-46, $1.95). Vintage Books, Random House, Inc., New York, New York.

This pocketbook contains a series of articles in the implications of automation for industry, labor, theory, government, the social sciences, education, and leisure. Each article is written by a specialist in the field and each is very enlightening. There are eighteen articles in all.

--Adjustments to the Introduction of Office Automation (Bulletin 1276, $.50). Published by the U. S. Department of Labor. Superintendent of Documents, Washington, D. C. 20402.

This is a study of some of the implications of the installation of electronic data processing in 20 offices in private industry, with special reference to older workers.

Instructional Materials

a. Films

--"Technology and You," (16 mm., sound, color, 13 min.). Rental $4.50. University of Michigan, Ann Arbor, Michigan; and University of Wisconsin, Madison, Wisconsin.

Technology is defined. Examples of its application in transportation, architecture and automation; its use in electrical, atomic and solar power; and its use in research are given. Vocational opportunities for students and the importance of preparation for employment are emphasized.

--"Technique for Tomorrow," (25 min., B & W). Produced by Ford Motor Company. Available from Business Screen Magazines, Inc., 7064 Sheridan Road, Chicago 26, Illinois.

Automatic control of machinery and the mechanical transfer of materials are described as a modern industrial revolution. The positive results of automation are shown to be high productivity with less human effort and a new standard of living for all.

b. Transparencies (See masters attached at back of unit.)

4. <u>To become aware of the jobs specifically related to data processing.</u>

There are many jobs that are automated or affected by automation. In this unit, however, study will be confined to job titles directly related to automation. This portion of the unit could be combined with a careers unit, rather than being included at this time.

<u>Content to be Included</u>

a. How are automated (computer orientated) jobs classified?

--Computer orientated jobs may be classified as professional technical, and clerical.

--The professional require four years of college or the equivalent, the technical require six months to two years of post high school education or equivalent, and the clerical require a high-school education or equivalent.

--Some positions cross categories.

b. Are men likely to be given preference to women for these positions?

--Yes, men may be given preference in hiring.

--The expense of renting or purchasing equipment is heavy and computer installations are frequently operated 24 hours a day.

--Men are more likely than women to remain in a position for a longer period of time after they have been trained for their job.

--They are more willing to work at nights because of family obligations.

--Labor laws in some states restrict the number of hours and the time of day that women may work.

c. What are some of the basic requirements for the jobs?

--Since one error can be carried through an entire process and make the end result worthless garbage, accuracy in reading, figuring, speaking, spelling, and writing is a must.

--Skill to operate a typewriter and a keypunch is necessary since these are basic machines to the system.

--A knowledge and understanding of bookkeeping and accounting, business organization, filing, and business communications (including mailing procedures, office procedures, business forms, and reference materials) is especially helpful.

--Some general characteristics a person must have in addition to knowledge are: the ability to see relationships, maturity to judgment, ability to analyze problems before solving them, efficient work habits and methods, good business ethics, and ability to adapt to change.

d. What are some of the common jobs? (See Dictionary for Occupational Titles for addition information. Reference numbers are given.)

--Key punch (card punch) operator. (D.O.T. 1-25.62) A keypunch operator must be able to type with a high degree of accuracy. He will find a knowledge of ten-key adding machine operation helpful as his machine's keyboard combines the features of both the electric typewriter and the ten-key adding machine.

His job includes typing (punching) data from source documents such as sales slips and time cards into punched cards. He is responsible for loading and unloading the machine, preparing program cards, and detecting faulty operation. He may also operate other unit record equipment. It takes about a week of intensified training to learn the fundamentals for this position and about 120 hours to develop vocational competency.

--Peripheral (auxiliary or unit record) equipment operator (D.O.T. 1-25.60 and 1-25.98). This person is responsible for operating all the machines that prepare material for the computer. He may not be required to operate a key punch, but in some installations he may be called upon to wire a control panel.

About six weeks of specialized training is required. The operator must be able to identify incorrectly punched cards or tapes and recognize situations which might cause the system not to operate properly. If he desires to advance to computer-operator, he needs a knowledge of accounting, algebra, business organization and management, and data processing principles.

--Console (Computer) operator (D.O.T. 1-25-17). The computer operator's chief function is to put into operation the instructions given by the programmer and to operate the computer while it carries out these instructions. If the computer stops running, gives faulty information, or needs new directions, he may type-in new instructions. He needs the ability to think rapidly and make quick decisions as he must do his work while the computer runs. About two to six months of concentrated training is necessary to maintain this position.

--Tape librarian (D.O.T. 1-20-04). The tape librarian maintains files of magnetic tapes, punched cards, paper tapes, and decks of punched cards for use by the console and auxiliary equipment operators. She prepares a reference card for each set which gives the information contained, purpose of the program, and date generated.

A knowledge of filing, accuracy, and ability to get along with others is important in this position.

--Programmer (D.O.T. 0-69.981). The programmer prepares the instructions for the computer. He first determines what information is needed and from whom it may be obtained. He then prepares a complete description of the job in the form of a flow chart or block diagram. From this the instructions are converted into machine language. He also organizes and directs the people who do the work.

He must have a general knowledge of business organization and management, plus a specific background in the business in which he is working. He must also have a knowledge of algebra, and a thorough understanding of the machine functions and characteristics on which he is preparing a program. He needs an insight into both computers and unit record equipment.

--Systems analyst (D.O.T. 0-69.985). The systems analyst coordinates the work of the other departments with the data processing facility. This is one of the most responsible data-processing positions.

Teaching-Learning Activities

a. Refer to a copy of the Dictionary of Occupational Titles with the class to locate other automation job titles.

b. Invite someone who works with data-processing equipment to describe his work to the class.

c. Visit a computing center to observe people at work in data-processing activities.

d. Discuss places where one may prepare for or receive training in data-processing work. Have students study college catalogues, business offerings, area vocational school offerings, and company training ads in newspapers.

e. Have the students prepare a block diagram of how to work a long division problem, how to get home from school, how to study, etc., to illustrate the planning phase of the programmer goes through in doing his work.

f. Add the following to the vocabulary notebook:

professional	console operator
technical	tape librarian
clerical	programmer
key punch operator	systems analyst
peripheral equipment operator	computing center

References

a. Business Data Processing, pp. 67-70.

b. Understanding Modern Business Data Processing, pp. 282-299, (Excellent illustrations with each description).

c. Dictionary of Occupational Titles

d. Data Processing for Business Education Departments in Pennsylvania's Public Schools, pp. 39-45.

Instructional Materials

a. Films

--"Careers in Business Data Processing," (16 mm., sound, color, 13 min., $5 rental). University of Southern California, Los Angeles, California.

--"Computer Programming," (16 mm., sound, 26 min.). System Development Corporation, 2500 Colorado Avenue, Santa Monica, California.

A good film to show to logically minded programmers or those interested in knowing what a programmer does.

b. Transparencies (See masters at back of unit.)

5. To understand the basis of the electronic computer and punched card equipment

This learning deals with only a general overview of computer operation. It is provided in order that the student may gain an insight into the capacity of an automated device and because computers and automation are synomymous in the minds of many. It will also assist students in developing a background for the study of electronic data processing as it applies to office work.

Content to be Included

a. What are computers?

--They are electronic or mechanical devices that solve mathematical problems and perform clerical tasks.

--They can add, subtract, multiply, and divide.

--Although they are sometimes referred to as electronic brains, they lack the ability to think out things for themselves. All they can do is carry out the instructions that their human operators give.

b. How fast do they operate?

--Their electronic circuits can act 1,000 times faster than a nerve cell in the human brain.

--They can do 8,000 additions or subtractions in one second. They have solved in one minute a problem that would take a man 2½ years to figure with pencil and paper.

c. How are they being used?

--Business uses them to prepare payrolls, write bills for customers, do accounting, take dictation, write letters, read incoming mail, figure taxes, keep inventories, keep records of deposits, and keep records of subscriptions.

--Manufacturing uses them to control the flow of oil through tanks and to transfer mixtures from one processing vat to another. Other uses are to run machines and control production lines in some automobile plants and factories.

d. What kinds are there?

--There are two basic kinds: digital and analog.

--Digital computers give results by counting numbers. The numbers can be used to represent anything that can be measured. These computers are used by industries and business firms to make precise calculations and are the most widely used of the two types. They can do arithmetic and such logical operations as comparing, selecting, matching, and sorting information. Some simple digital computers are our hands, the abacus, and cash registers. They determine how many.

--Analog computers are faster than digital computers but are less exact. They are used frequently by scientists for research projects that do not require highly exact solutions. They must be designed to fit the needs of the particular problem to be solved. They are built to be an analogy or physical likeness of the problem that they are designed to solve, but they may use far different physical qualities to arrive at their solution. Simple analog computers are clocks, thermometers, and weighing scales. They determine how much.

--Our discussion will be confined to digital computers.

e. How do computers solve problems?

--Let's think first of how an individual solves a problem with a calculator. (1) He has the calculator to do his arithmetic. (2) He has a piece of scratch paper to keep track of intermediate steps and the order of work. (3) He has tables to calculate square root, interest, etc. (4) His mind controls the entire operation.

--The computer has (1) an arithmetic unit to correspond to the calculator, (2) a control unit to direct the operation and keep track of the steps, (3) a control memory or storage unit to take the place of the reference book of tables, (4) input units to give the right kind of information, and (5) output units to provide the result obtained to its human operators.

--The arithmetic unit performs all the computations. It does adding, subtracting, multiplying, and dividing. In addition it makes such logical decisions as distinguishing between positive, negative, and zero values. It can tell whether one value is greater than, less than, or equal to another value.

--The control and unit directs and coordinates the entire system as a single multipurpose machine. It takes data from storage and operates on instructions given by the programmer.

--The storage or memory unit is like an electronic filing cabinet. It may be a part of the computer system or an auxiliary device such as magnetic disks, drums, and tape.

--The input unit accepts the initial information required to solve the problem. It can receive information from punched cards, paper tape, magnetic tape, magnetic ink characters, or from the typewriter keyboard connected to the computer.

--The output unit give the results of the computer operation. It may give the results on cards, magnetic tape, paper tape and/or printed or typed forms.

f. How do computers do arithmetic?

--Computers have thousand of circuits, resembling electric-light switches, that can be either off or on indefinitely.

--They make use of the binary system in solving arithmetic. This is a two-digit system using one 1 and 0; one is represented by on; zero by off. These are referred to as bit values. Combination of 1 and 0 can be used to represent any number letter or symbol that is to be handled by the computer. Single and multiple-digit decimal numbers are expressed by the position of the bit symbols (1 and 0) which are based on the progression of powers of two: the unit position of a binary number has the value of 1, the next 2, the next 4, the next 8, etc.

Decimal Number	Binary Coded Decimal (Binary Value)							
	128	64	32	16	8	4	2	1
1	0	0	0	0	0	0	0	1
2	0	0	0	0	0	0	1	0
4	0	0	0	0	0	1	0	0
8	0	0	0	0	1	0	0	0
16	0	0	0	1	0	0	0	0
32	0	0	1	0	0	0	0	0
64	0	1	0	0	0	0	0	0
128	1	0	0	0	0	0	0	0

Decimal Digit	Binary Notation
0	0000
1	0001
2	0010
3	0011
4	0100
5	0101
6	0110
7	0111
8	1000
9	1001

On the basis of place value, the following decimal numbers would be expressed:

Decimal Number	Binary Equivalent
15	000001111
96	001100000
130	010000010

Teaching-Learning Activities

a. Have students prepare a punched card showing their name, address, and telephone number. Have them mark off the card in fields and "black-in" the spaces where the holes would be punched.

b. Obtain a mathematics textbook and have the students work addition, subtraction, multiplication, and division problems using binary arithmetic.

c. Visit a business which uses data processing to do accounting.

d. Have the students add the following to their vocabulary study:

computer	bits
digital computer	binary arithmetic
analog computer	paper tape
arithmetic unit	magnetic tape
control unit	punched card
storage unit	nine edge
input unit	twelve edge
output unit	zone punch

References

a. For the student

--"Book 3: What is EDP," National Cash Register, Dayton, Ohio 45409.

--"Book 2: What is Binary Arithmetic?" National Cash Register, Dayton, Ohio 45409.

--Encyclopedia articles on the computer.

b. For the teacher

--Data Processing for Business Education Department in Pennsylvania's Public Schools, pp. 55-89.

--Business Data Processing, pp. 34-66.

--"Automatic Digital Computers," Los Alamos Scientific Laboratory, Public Relations Office, P.O. Box 1663, Los Alamos, New Mexico 87544. Limit of 100 copies. Free.

--Understanding Modern Business Data Processing, pp. 64-191. (Has excellent illustrations.)

--General Information Manual: Introduction to Data Processing Systems, (F22-6517). IBM, Data Processing Division, 112 East Post Road, White Plains, New York.

--Applied Business Mathematics, "Section 79: Binary System of Numeration," pp. 487-494.

--20th Century Bookkeeping and Accounting, "Appendix A: Automation in Bookkeeping and Accounting," pp. 511-524.

Instructional Materials

a. Films

--"What is EDP?" (15 min., color, 16 mm.) International Business Machines, Data Processing Division, White Plains, New York. (Free--call local representative.)

This film discusses the basic principles of electronic data processing. It explains the provisions for input, storage, processing, and output of data. It deals briefly with punched cards, paper and magnetic tape, magnetic ink, and magnetic drum, disk, and tape storage. It is designed for those of high school level and above who have some interest and background in the subject.

b. Transparencies (See masters at the back of the unit.)

References

Adjustments to the Introduction of Office Automation (Bulletin 1276). U. S. Department of Labor, Washington, D. C.: U. S. Government Printing Office, 1960.

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MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
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FROM: (Person) GEORGE L. LUSTER (Agency) INSTRUCTIONAL MATERIALS LABORATORY FOR VOCATIONAL EDUCATION
(Address) DIVISION OF VOCATIONAL EDUCATION, COLLEGE OF EDUCATION, UNIVERSITY OF KENTUCKY, LEXINGTON, KY. 40506

DATE: JUNE 9, 1967

RE: (Author, Title, Publisher, Date) JOY HILL, "UNIT: SURGICAL ASEPTIC TECHNIC," INSTRUCTIONAL MATERIALS LABORATORY FOR VOCATIONAL EDUCATION (KENTUCKY), DECEMBER, 1966

Supplementary Information on Instructional Material

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(2) Means Used to Develop Material:
Development Group Specialist in Health Occupations in IML
Level of Group Specialist in Health Occupation
Method of Design, Testing, and Trial Material is new. As teachers use it, it will be revised. Material is needed now -- no time for testing

(3) Utilization of Material:
Appropriate School Setting Vocational Schools
Type of Program Adult for persons preparing to be Surgical Technicians
Occupational Focus To prepare persons as surgical technicians
Geographic Adaptability Not limited geographically
Uses of Material To help teacher prepare to teach
Users of Material By Teachers

(4) Requirements for Using Material:
Teacher Competency Qualified to teach surgical technicians
Student Selection Criteria adults who are able to benefit from instruction
Time Allotment will vary with student needs and the situation -- perhaps 15 days

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SURGICAL TECHNICIAN

UNIT: SURGICAL ASEPTIC TECHNIQUE

Major Teaching Objective

To develop understandings and skills in the principles and application of aseptic technics to prevent and control infections in the operating room

Learnings (Competencies) To Be Developed

1. To understand the development and principles of aseptic technic
2. To prepare the operating room for action
3. To give preoperative care of skin
4. To put on sterile gown and gloves
5. To set up sterile tables and drape patients
6. To handle and dispose of infectious and contaminated material

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Prepared by
Joy Hill
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Instructional Materials Laboratory
Division of Vocational Education
College of Education
University of Kentucky

December, 1966

VT 02792

Place of Unit in Course

Surgical aseptic technic is based upon the unit "Sterilization and Disinfectants." This unit deals with the principles and technics necessary to maintain the sterile field after the equipment and supplies have been sterilized.

The importance of surgical asepsis cannot be stressed enough in view of the potential danger from infection to patients and personnel. The presence of pathogenic organisms or practice of faulty technic can result in serious consequences to patients following surgery. For this reason the student should be made aware of his/her responsibility to maintain rigid control of asepsis at all times.

Several hours of clinical experience are needed during this unit. They will give an opportunity for the student to gain experience in procedures included in each learning. An attempt has been made to arrange the learnings in a logical sequence necessary to effective practice during a surgical procedure. However, the teacher should feel free to arrange the learnings to best suit the students' needs.

Suggestions for Teaching the Unit

This unit requires much class activity to practice skills included in each learning before going into the clinical area.

Before each practice session is held the teacher might use transparencies or slides to help demonstrate the procedure. The teacher should emphasize specific points and allow time for discussion and questions while slide or transparency is viewed. Real supplies and equipment should be available for use by the students. Films on aseptic technic should be used to summarize the learning.

Since aseptic technic is only as good as the most careless member of the team, have students evaluate the ability of other students to use correct procedures and techniques. This might be done by having the students list errors, and the results which may occur when there is a break in good technic.

Introducing the Unit to Class

The teacher may begin the unit with a short review of microbiology and how disease is transmitted. Since the students will have some clinical experience, the teacher may ask each student to prepare a report of how sterile goods is stored in the local operating room.

Learning (Competencies) To Be Developed

1. To understand the development and principles of surgical aseptic technic

   Surgical aseptic technic is the total effort of every person in the operating room to keep the area free from bacteria. Since it

was first demonstrated that micro-organisms were responsible for disease, medical science has searched for ways to make the operating room safe.

a. Louis Pasteur (1857) first demonstrated that organisms could be killed by heat.

-- This would prevent germs from entering wounds.
-- Would help to prevent high death rate among surgical cases
-- Joseph Lister followed with theory that germs came from outside the body and grew under certain conditions.
-- It was discovered that bacterial growth could be retarded or killed by use of antiseptic carbolic acid
-- It was also believed that air was a source of contamination.

b. Discovery of sterilization by heat proved to be a very practical method of killing bacteria before they came in contact with a wound.

-- Skin has a natural power of self protection against bacteria.
-- Antiseptics protect against infection while asepsis is without infection.
-- Antiseptics may decrease natural resistance of skin to bacteria.

c. Every person in contact with the operating room has an obligation to maintain rigid asepsis.

-- Good health is essential; minor skin infections or colds can menace the patients progress.
-- Cleaniness is of utmost importance: shoes and uniforms worn in operating room should not be worn outside of hospital.
-- Hair should be clean and completely covered.

d. Discovery of antibiotics has tended to cause some laxity in adhering to aseptic technics.

-- Bacteria can become resistance to antibiotics. This is especially true of Staphylococcus aureus.
-- Research shows that Staphylococcus organisms can live indefinitely and can be harbored by humans without causing infection.
-- They can be carried from one person to another by improper care of linen, equipment, supplies, and by individual contact.
-- Most susceptible individuals are new-born infants, debilitated persons and new surgical patients.
-- Every effort must be made to identify source of "Staph" infections, by frequent tests to determine bacteria in air.

-- Special care of operating room is essential in cases of skin infections, burns, or surgery involving severely infected areas.

e. All sterile goods, instruments and supplies are stored in the area designated for this purpose only.

-- Includes prepackaged supplies
-- Sterile supplies dated. Must be checked at intervals and resterilized if outdated.
-- Indicator tape shows when sterilization is effective.
-- Sterile supplies must be kept dry. Moisture results in contamination of packaged contents.
-- After a package has been opened, remove its contents from sterile storage area. Never return an opened package to sterile storage area.

f. Contamination of articles occurs when:

-- The article is touched by hands or unsterile instruments
-- They become wet when ampules are broken over sterile table or area
-- An unsterile object is dropped on sterile area
-- A person reaches across the sterile area
-- Infectious material from wounds contact them
-- Airborne sources of bacteria are present

Suggested Teacher-Learning Activities

a. Obtain a petri dish with culture media and place on desk for a short period. Arrange with laboratory to prepare slides to show students how this airborn bacteria grows.
b. The students may prepare written reports of post-operative hospital infections. Have students identify how these can be avoided.
c. Use of a film on principles of surgical aseptic technic.

Suggested References and Instructional Materials

a. References

Medical and Surgical Nursing, pp. 36-37, 236-237
Practical Nursing, pp. 135, 143
The Operating Room Technician, pp. 1-42
A Manual of Operating Room Technology, pp. 3, 44, 93, 94, 97
"Staphylococcal Disease and Related Subjects," pp. 27-29

2. Preparation of operating room for action

The surgical unit must be kept in readiness for immediate action upon notification. At the same time operating-room personnel must coordinate actions to meet the needs of the surgeon preceeding

surgery and during the surgical process. To facilitate planning, all surgical cases are scheduled except those which are deemed emergencies.

The attention given to preparation of the operating theater is of utmost importance. The post-operative convalescent period is influenced by conditions in the operating room. Hospitals may be held legally responsible for negligence where post-operative complications are traced to errors in technic.

Furniture, equipment, lights, walls, and floors must be dust free. Equipment and lights must be checked for safety factors and function. Supplies must be available for instant use, and in the designated place.

a. Most operating rooms are constructed with tile walls for easy cleaning.

   -- Previous to time surgery is scheduled, walls are washed with germicidal solution.
   -- Furniture, lights and large equipment are wiped free of dust with damp cloth.
   -- Floors are cleaned after each case.
   -- Germicidal floor mats may be placed at entrance.

b. The danger of static electricity is eliminated.

   -- All personnel dressed in cotton clothing
   -- Static free shoes
   -- Hospital provides surgeons scrub suits, gowns. Nurses are provided scrub dresses, headgear and mask.
   -- Hospital provides special static-free boots for personnel to wear during time surgical procedures are performed.

c. Before preparing the surgical rooms for action, identify the type of surgery to be performed and what room will be used by each surgeon.

   -- All necessary articles essential to the type of surgery should be available so that the circulating nurse does not need to leave the room during the surgical procedure.
   -- Oxygen supply must be adequate, and equipment ready for administration.
   -- Anesthetic machines are usually the responsibility of the anesthetist, however, equipment such as airways, suction tubes, syringes, needles and masks must be checked by operating room nurse, and be ready for use.
   -- Supply cupboards in O.R. contain extra sterile goods, sutures, Bard Parker pans for knife blades and scissors, antiseptic solutions, stimulants, syringes and needles. Other supplies deemed necessary for efficient operation of theater may be kept in this area.
   -- Sterile packs and packages obtained from the sterile supply room and placed in proper area ready to be opened.

-- Adequate amount of solutions for external use are placed in a convenient area.
-- Solutions for intravenous infectious and blood transfusions are available, with proper tubing for administration.

d. Allow adequate time to open sterile packages and packs before patient is brought to the operating room. Once the sterile article is opened, great care must be exercised to avoid contaminating the contents.

-- Large packs are usually opened first on the nurse's work table.
-- The wrapper covers the table with the inside making a sterile field for linens, sutures, sponges and instruments.
-- The "scrubbed" technician will arrange sterile articles, after putting on sterile gown and gloves.
-- Additional supplies may be placed on sterile area by use of a sterile pick-up forcep or by dropping sterile articles on the area.
-- When using sterile pick-up forceps be sure that forceps do not touch the sides of the container. Always keep forcep blades downward.
-- Do not wave sterile article in air or touch table with forcep.

e. Once opened, sterile supplies must be covered until ready for use.

-- The sterile cover is folded back so that only the inside touches the contents on the table.
-- When opening or handling sterile articles be sure to keep hands above the waist line.
-- Contaminated articles demand immediate replacement of the entire sterile field.

f. Sterile covered containers should be opened only when necessary, and the lid replaced as soon as possible. The lid should be held in such a way that the sterile undersurface is downward. If it becomes necessary to set the lid down, the sterile undersurface should be upward.

-- Possibility of airborne contamination.
-- Dust particles fall downward.
-- Do not return unused sterile objects to sterile container.

g. Basins for various types of solutions and specimans are wrapped separately or in sets.

-- Large basins for antiseptic solutions used by surgeons and assistants to dip hands after scrubbing.
-- Small basins for solution to moisten sponges, for specimans, discarded sponges and to break sutures encased in glass ampule.

Suggested Teacher-Learning Activities

a. Use slides to show how to unwrap sterile packs and packages. Discuss with student what to look for.
b. Obtain supplies from hospital operating room and demonstrate how to open sterile packs and packages. Have each student demonstrate using technic observed in slides and by demonstration of teacher.
c. The teacher may purposely contaminate an area and have students show how such contamination may be avoided by keeping the sterile article where it can be seen at all times.
d. A problem may be developed on the effects of poor aseptic technic, results to patient, and how the staff is involved.

Suggested References and Instructional Materials

a. References

Aseptic Technique for Operating Room Personnel, pp. 26-27
The Operating Room Technician, pp. 34-41
A Manual of Operating Room Technology, pp. 93-94, 11-122, 159-163, 179
A Textbook of Medical and Surgical Nursing, pp. 36-37
"Infection Control: The Law and The Nurse," pp. 103-104
"Nursing and Asepsis in the Modern Hospital, pp. 54-55

3. Preoperative care of skin

The preparation of the skin is dependent upon diagnosis, anticipated surgical procedure and condition of the patient. While the major portion of preoperative care is the responsibility of the nursing unit, the surgical technician will often be responsible for proper preparation of the skin around the surgical area.

Skin preparation is usually carried out the evening before scheduled surgery to avoid disturbing the patient after pre-operative medications have been given. This also avoids delay in the surgical schedule.

When emergency surgery is scheduled the patients skin is prepared immediately before the preoperative sedation is given and the patient is taken to operating room.

Each hospital has established procedures for skin preparation that supplement the basic rules.

a. The skin is a protective organ that covers the body for protection, absorption, elimination, sensory, and temperature-control purposes.

-- Skin and hair harbor micro-organisms that may become pathogenic when there is a break or cut in skin.

-- Condition of skin varies according to age, color, nutritional factors and exposure.
-- Persons with blond coloring tend to have more sensitive and delicate skin.

b. Before skin preparation of patient is started, the technician should be aware of open lesions or breaks in the skin.

-- May lead to post-operative infections
-- May require special treatment and preparatory procedures
-- Alert operating room supervisor of patients skin condition, if open lesions or breaks in skin are observed.

c. When entering the room to prepare the patient's skin, the manner of approach can have a definite effect on the patients attitude towards pending surgery.

-- The patient may have many fears which may be intensified if technician is inconsiderate.
-- Always explain procedures to allay fear of the unknown.
-- Approach patient with understanding attitude.
-- Use caution and tact when talking with patient. Discussion of surgical treatment and prognosis is up to the patients physician.
-- Learn to listen to the patient. This may bring out valuable information that can affect progress during surgery.
-- Respect the patient's desire for privacy. Expose only the area being prepared.
-- The patient is an individual, and consideration should be given to his desires.
-- When surgery involves the cranial area, make certain a permit has been signed before hair is cut and scalp shaved.

d. The objective of preparing the patient's skin before surgery is to make it as free as possible of bacteria, without causing irritation or impairing its natural protective function which might interfere with healing.

-- Diagnosis determines area of preparation.
-- Some procedures are for diagnostic reasons.
-- Equipment for skin preparation is assembled on tray and kept in constant readiness. Equipment includes basins, cotton or sponges, razor with new blade.
-- Adhesive, ointments, and grease must be removed first with benezene or ether.
-- The operative field may be cleansed with cleaning agent such as phiophex, surgical soap and water before shaving.
-- Approximately 10-12 inches on each side and at the top and bottom of the site of incision should be cleansed and shaved.
-- All hair must be removed from area.
-- Avoid causing small scratches or cuts with razor.

-- Do not allow excess solution to trickle down the sides of the patient, the groins or folds of fat.
-- When shaving procedure is completed cover the area with a sterile towel, or follow the procedure of the local hospital.
-- The operative area is cleansed with disinfectant after the patient is brought to operating room.
-- Depilatory cream may be substituted for shaving method.

e. In some surgical cases a 24-hour skin preparation may be required.

-- Every surgeon has special instructions for preoperative preparation for orthopedic, skull, skin graphs and eye surgery. Other areas such as heart and lung may be included.
-- When amputation is to be done be sure to check extent of area involved before beginning skin preparation

f. For purpose of adequate skin preparation, the body is divided into operative fields.

-- Cranial area (may involve entire skull)
-- Neck and thyroid area
-- Chest area (includes breast amputation)
-- Abdominal area
-- Inquinal area
-- Perineum and anal area
-- Spine
-- Kidney
-- Extremities

g. When skin graft is scheduled, obtain instructions from supervisor as to what area will be used for grafting purposes.

-- Most common area is the anterior thighs.
-- Abdomen sometimes used
-- Depends on extent of damaged skin and amount of healthy skin

<u>Suggested Teacher-Learning Activities</u>

a. Transparencies may be used to show extent of operative fields.
b. A problem may be developed which deals with the approach to a patient who must have preoperative skin preparation and is apprehensive of the surgical procedures.
c. Clinical experiences should be arranged to allow the student experience in preparing the patient's skin.
d. Slides may be used to demonstrate skin preparation before clinical experience.

e. Role playing may be an effective teaching-learning experience to stress approach to the very frightened patient, and the patient who is reluctant to be exposed for skin preparation

f. Develop problems with students. For example-- How effective is skin preparation in preventing Staph infections? What may be the results when skin is scratched during the preparatory procedure?

Suggested References and Instructional Materials

a. References

A Manual of Operating Room Technology, p. 137
The Operating Room Technician, pp. 44-45
Aseptic Technic For Operating Room Personnel, pp. 51-53
"Human Hair A Reservoir of Staphylococcis, p. 757

4. To put on sterile gown and gloves

Skin preparation by the surgeon and his assistants previous to the surgical procedure is carried out to make the hand and arms as free of bacteria as possible. These individuals are referred to as "scrubbed" and will wear sterile gowns and gloves during the procedure. This lessens the danger of wound infections.

Once the hands and arms are scrubbed, the gown and gloves put on, the individual is limited only to the work area which is considered sterile.

a. The scrubbing procedure involves three steps: 1) to remove surface dirt and organic matter from skin, 2) to remove normal oily film, 3) degerm clean skin. Before procedure begins, the hair must be completely covered and the mask be in place.

-- Water adjusted at scrub sink to temperature and flow. Must be continous during scrubbing.
-- Nails should be kept short. Stainless steel nail files are provided to clean around and under nails during the scrub process.
-- Use firm bristle brush from sterile dispenser at scrub sink.
-- Average length of scrub is ten minutes.
-- Lather hands and arms below elbow well and rinse frequently. Make sure hands and arms below the elbow do not touch sink.
-- Following scrub, immerse hands in antiseptic solution for one minute.
-- Dry with sterile towel. Drop towel away from sterile area.
-- Transient skin flora easy to remove from skin surface, however, bacteria which inhabit the deeper layers, pores, and hair follicles of skin are a more difficult to remove.

-- Hands must be free of cuts, abrasions, or dermitities. These are a potential source of danger to patient.
-- While the newer soaps or compounds provide bacteriostatic action on skin for hours, the initial scrubbing time cannot be reduced.

b. After completing the scrubbing process, the sterile gown is put on. The scrub nurse will assist the surgeon in the gowning procedure after she has completed putting on her sterile gown and gloves.

-- The sterile gown may be obtained from the open laparotomy pack, or be handed to the "scrubbed" person.
-- Hold the neckband and gently let the gown unfold so armholes face the wearer.
-- Hands should be kept up when gown is put on.
-- The circulating nurse can assist by reaching inside and pulling the gown on, typing tapes at back.
-- Knit cuffs should partially cover hands to aid in covering the cuff with the sterile gloves.
-- Gowns remain sterile only as long as they are dry.
-- Once gowned the scrub nurse must face sterile areas. The back of the gown is considered unsterile.

c. Sterile gloves are put on last. Small containers of powder or glove lubricant are sterilized with each glove package so hands can glide more easily into the gloves. Hands should be powdered away from sterile area to avoid the spread of powder dust particles. Only the inside of the glove may be touched with the clean hand.

-- The left hand is gloved first by grasping the inside cuff of the glove and slipping hand into glove. Cuff remains turned down until right hand is gloved.
-- Slip gloved left hand inside of cuff on right hand glove and slip right hand into glove.
-- After both hands are gloved, fold gown cuffs and pull gloves over the cuffs.
-- Gown cuffs should not pull out when reaching for an object.
-- If glove is torn at any time discard it immediately and request new package of gloves.
-- The area of contamination is the inner cuff of the glove which may contact the skin surface before the gown cuff is covered.

d. The scrubbed nurse usually assists the surgeons during the gown and gloves process.

-- Holds gown by neck band and gently shakes out gown to full length
-- Make a cuff of the neck area to protect gloved hands.
-- Outside of gown faces assistant
-- Surgeon slips into gown facing assistant
-- Circulating nurse pulls gown on from back and ties tapes
-- Pours powder or lubricant on hands

-- Holds right hand glove with fingers on inside of turned back cuff, palm of glove toward surgeon and stretch cuff to allow him to introduce his hand
-- Keep thumbs outward to avoid touching surgeons hand

Suggested Teaching-Learning Activities

a. The teacher may use slides to show the gowning and glove procedure. These should be shown before practice. Have students identify how the gown is picked up and opened, why cuffs are left well down on hand, and how gloves are put on.
b. Develop this problem-- How effective is hand scrubbing as compared with the various cleansing agents now used in the O.R.?

Suggested References and Instructional Materials

a. References

Textbook of Medical and Surgical Nursing, pp. 239-242
A Manual of Operating Room Technology, pp. 89-94
The Operating Room Technician, pp. 56-57
Aseptic Technique for Operating Room Personnel, pp. 58-60
"Surgical Hand Scrubbing," pp. 75-77

5. To set up a sterile table

Shortly before the patient is brought to the operating room all work tables should be draped with sterile covers. Linens, instruments, basins, sutures, and other supplies should be arranged for fast and efficient use. The scrub nurse and the circulating nurse work together to set up tables and solution basins.

a. The scrub nurse will drape all tables, solution pans and doctor's instrument tray.

-- Air currents carry contaminants, and linens should not be shaken or flourished when handled.
-- Make a cuff or turn corners over gloved hands to avoid contact with unsterile surface.
-- Table is draped so that the side near the scrubbed person is draped first.
-- Only the top of the table is considered a sterile area, and the part of drape that falls below this is considered unsafe.
-- If drape shows any holes, tears or worn places, discard at once and replace with another.
-- Drapes should not be held too high or be allowed to touch floor.

b. Upon completion of the draping procedure the scrub nurse organizes the nurse's work table.

-- Linens arranged in order of use
-- Instruments required for type of operation arranged for easy accessibility
-- Knife blades placed in handles
-- Sutures and ligatures prepared and placed in sterile towel
-- Each piece of equipment checked for good working order. This includes instruments, sutures, needles, and suction tip, and others.
-- Count number of sponges on hand with circulating nurse. Each sponge must be accounted for before incision is closed.
-- Circulating nurse will pour solutions at the request of the scrub nurse. All solutions must be sterile. Hold containers high from sterile recepital. Avoid spilling or splashing solution.
-- The surgeon's instrument table is prepared by placing only the necessary instruments, sponges and ligatures needed to begin the operation.

c. After patient has entered the operating room, sterile drapes are placed in such a way that the patient is completely covered with the exception of the face and head.

-- The circulating nurse must keep close observation of sterile areas and persons for break in technic.
-- Never hesitate to tell physician or assistants immediately when a break in technic has been observed.
-- Conversation should be kept at a minimum.

Suggested Teacher-Learning Activities

a. Overlay transparencies demonstrating each step of setting up the nurse's work table may be used in this learning. This gives the student a concept of how the procedure starts and the appearance of the table when procedure is completed.
b. Develop this problem-- How could Staph infection occur during the surgical procedure and with good aseptic technic?

Suggested References and Instructional Materials

a. References

Aseptic Technique for Operating Room Personnel, pp. 58-60
A Manual of Operating Room Technology, pp. 90-92
"Evaluation of Draping Technique in Prevention of Surgical Wound Contamination," p. 292
"Porous Paper Drapes Block Bacteria," p. 54
"Disposable Drapes Provides Effective Bacterial Barriers," pp. 86-87

6. <u>To handle contaminated or infectious material</u>

Surgical cases are divided into two categories: 1) clean, 2) contaminated or "dirty." Clean cases are those in which no known infection is present at the time the patient is brought to the operating room. Contaminated or "dirty" cases are those in which gangrene or pus is associated with a frank infection. Negligence in handling contaminated articles from either type of case can result in serious consequences throughout the hospital. Patients with tuberculosis should wear masks to operating room.

a. Unless a known infection exists, a surgical case is assumed to be clean, however, an infectious condition may be discovered after the incision is made.
b. Contaminated articles should be handled as little as possible. A small area should be limited to contaminated articles.
c. All equipment and supplies used for surgical procedure are considered contaminated when operation is completed and the patient is removed from operating room.

-- Drapes checked by scrub nurse for instruments
-- Sterile tables dismantled by scrub nurse and linens disposed to linen hamper. Plastic material discarded.
-- Instruments, equipment, and supplies accounted for and removed to clean-up room
-- All instruments-- must be opened and washed in solution basin before being placed in instrument-washer sterilizer
-- Gloves should be worn when handling contaminated material.
-- Unused large gauze sponges are sent to the laundry or discarded.
-- Small unused sponges may be returned to unsterile stock for counting and resterilization.
-- Gloves should be rinsed off before stripping from hands.
-- Used sponges, broken ampules, discarded in plastic liners of kickbucket should be taken to incinerator.
-- Suction bottles are flushed with germicidal solution before being prepared for sterilization.
-- Anesthesia equipment is cleaned with germicidal detergent solution between each case.
-- Care must be taken to avoid cuts or pricks on hands from knife blades and needles which have been used.
-- Floor is cleaned with germicidal solution and set-up for next case.

d. Known contaminated or "dirty" cases require special precautions in the cleaning process.

-- All used linen is placed in bags, marked contaminated and sent immediately to laundry.
-- Unused linens, dressings, and sponges are placed in bag and sterilized before laundried or processed.
-- Procedure for cleaning gloves, instruments and other equipment is the same as that used in clean cases.
-- Room is disinfected. Floors are cleaned with germicide.

-- When forceps are used to pick up contaminated material, they must be sterilized before used again
-- Room need not be quarentined if careful cleaning procedures are followed.
-- Wear gloves when handling infected or contaminated article.

Summary

a. In light of new data about micro-organisms, the methods of control in all surgical cases should be considered potentially dirty.
b. Involuntary actions and habits of staff must be replaced with deliberate actions to prevent contamination.
c. Staff must develop concern for P. aerogenes, gram-negative and gram-positive bacteria, and the virus of homologous serium hepatitis, as a potential contaminant in all surgery.
d. Infectivity and resistance to Staph infection still unsolved.
e. All organic debris, sponges, etc., that fall on wall should be treated immediately with germicidal solutions.

Suggested Teacher-Learning Activities

a. Develop this problem-- How would you manage the operating room cleanup if the surgical case assumed to be "clean" was found to be infectious?
b. Develop this problem-- How may bacteria from used sponges and debris be prevented from becoming airborne during a surgical procedure?

Suggested References and Instructional Materials

a. References

Aseptic Technique for Operating Room Personnel, pp. 27-29
A Manual of Operating Room Technology, pp. 86-108
"The Cleanup is as Important as the Setup, pp. 105-106
"O.R. Personnel Must Recognize Any Case Can Become Dirty," p. 110
"Clean and Dirty Areas Should Be Separate," p. 16

Evaluation of Unit

1. Teacher-student evaluation of performance in skills and related activities included in this unit.

a. Preparation of operating room for surgery
b. Clean-up procedures in the operating room
c. Preparation of patients skin
d. Gown and glove procedure
e. Set up for operation

2. Two methods may be used to evaluate the students skill development

   a. Teacher observation of individual student's preformance in the operating room
   b. The teacher may use the overhead projector with transparencies which show the articles and equipment used in these skills. The transparency should not be labeled. The student may identify the articles and equipment and the skills related to the illustration on the screen.

3. An objective test on basic knowledge

4. Subjective evaluation by student and teacher to determine change in behavior.

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DENTAL ASSISTANT

A Course of Study

Designed for
Cooperative Part-time Students
Employed as Dental Assistants

Issued by

Department of Industrial Education
College of Education
University of Missouri
Columbia, Missouri

In Cooperation with

Industrial Education Section
State Department of Education
Jefferson City, Missouri

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MEMORANDUM

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DATE: July 10, 1967

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FOREWORD

This course of study, consisting of an analysis of DENTAL ASSISTANT, together with assignment sheets covering the related (occupational) information to be taught by the school, has been prepared for teaching dental assistants on an individual basis in a cooperative part-time program.

The original analysis was developed in 1950 by Mrs. Marion Hoblit, Coordinator of Cooperative Occupational Education, Senior High School, Springfield, Missouri. The original manuscript was edited by Emil H. Rohlfs, Coordinator of Cooperative Occupational Education, Normandy Senior High School, St. Louis County, Missouri. Special credit is due to Mr. William F. Van Trump, Research Assistant in Industrial Education at the University of Missouri, who prepared the present revision of the analysis and the assingment sheets.

We wish to acknowledge our indebtedness to Dr. H. H. London, Professor of Industrial Education at the University of Missouri, who supervised the preparation of the material, and to Mr. James B. Karnes, Instructor in Industrial Education at the University of Missouri, who edited the manuscript. We acknowledge the assistance of Dr. J. F. Burge, Dentist, Columbia, Missouri and (Mrs.) Edna Trower, Past President of the Missouri Dental Assistant Association and member of the Board of Directors and Consultant in Dentistry Practice Administration, for their advice in connection with the selection of the content of the course of study. Credit is due Dr. H. Pat Wardlaw, Assistant Commissioner of Education, Mr. Merton C. Wheeler, Director of Industrial Education, and other staff members of the State Department of Education for their efforts in the development of the Industrial Education Curriculum Series of which this course of study is a part.

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INTRODUCTION

In preparing this course of study, it has been assumed that the attainment of occupational competency in any type of work involves three different, yet closely related, types of learning. They are:

1. Mastery of the practical job skills and procedures performed by the worker in the occupation.

2. Comprehension of the technical and related information basic to an intelligent understanding and practice of the occupation.

3. Development of those personal-social traits which are essential for the successful worker.

The first group of these "learning units" -- the job skills and procedures -- has been arranged in the analysis under the heading of "Job Training". The second group of learning units -- the technical and related information -- has been arranged under the heading of "Related Information". And the third group -- the personal-social traits -- has been listed under "Personal-Social Traits Essential for the Dental Assistant" in the introductory section addressed to the student.

In a cooperative educational program it is necessary for both cooperating agencies -- the school and the employer -- to understand clearly just what each is to be responsible for in the training of the student-worker. Experience has shown that most of the practical job skills and procedures of an occupation can best be learned through supervised work on the job. Experience has shown also that the school can best teach most of the technical and related occupational information needed by young student-workers. This division of responsibility has been made in the arrangement of the course of study; that is, it is expected that the student-worker will master the job skills and procedures through practical work on the job under the immediate supervision of the employer, and that he will receive instruction in related occupational information in the school under the direction of the coordinator.

Skills and related information are matters for direct instruction, but personal-social traits are acquired only through practicing them during the process of acquiring skills and information and in one's daily conduct. Therefore, both the employer and the school, as well as the home, must assume responsibility for developing in the student-worker those habits, attitudes and character traits which are essential for success in his occupation and in life. Both the employer and the school should be constantly on the alert to see that the student-worker places desirable interpretations on his experiences and that he does not practice habits and exhibit character traits detrimental to his success.

Since the coordinator's class will be made up of fifteen or more students, each differing from the other significantly, studying a dozen or more occupations which differ markedly in their requirements, it follows that it will be impossible for him to teach, through the group method, the occupational information which relates to the specif job of each student worker. In order to be effective, this type of instruction must be individualized. There is, of course, some relatec information, such as occupational health and safety, workmen's compen: tion, wage hour laws, fair labor standards, unemployment compensation, and the like, which is of common interest and concern to all student-workers, and may be effectively taught by the group method. But if the coordinator is to make a real contribution to the in-service vocational education of his students, he must devote a major portion (his classroom instruction to content which deals specifically with the work of each boy and girl enrolled.

With this requirement in mind, and in order to facilitate indivi dual instruction, these assignment sheets have been prepared. Each contains certain record data as to number and range of units covered, introductory paragraphs designed to develop interest, explain the importance of the assignment, and to convey to the student what he is expected to learn, specific assignments including reading, learn acti vities and a series of new type questions designed to check his attai ment.

Obviously, it is desirable to teach the related information in tl school at the time it will be used most advantageously on the job. This means that the two phases of the student-worker's training shoul parallel each other in a progressive manner. The coordinator will fir the assignment sheets well adapted to this end. He can select from da to day the assignment which covers the informational units related to the work being done on the job. With this arrangement, the coordinat will become, during a major portion of his classroom time, a supervis study and helping teacher.

In selecting books for the course, an effort has been made to restrict the number to an adequate coverage of the material, and to select those of recent publication so that current practices can be consistently presented. It is recommended that copies of these books be secured and kept in the coordinator's classroom for ready use by the student.

The key sheets available in a separate manual, have been prepare to enable the coordinator to score quickly the objective tests which are a part of each assignment sheet. These key sheets give the corre answers to the questions, as well as the reference and the page on which each answer can be found. The key sheets should be kept in the coordinator's possession.

TO THE STUDENT WORKER

The vocation of dental assisting has steadily advanced through the past years. It has developed from a position of a glorified cleaning woman to a skilled technician who understands the problems and techniques of the dentist she serves. A great deal of credit for this development goes to Juliette Southard and others like her, who organized the American Dental Assistants Association. This organization has pioneered the education of dental assistants. Each girl who proves her proficiency as a dental assistant, by completing a certification course and examination prepared by the Certification Board of the American Dental Assistants Association, is granted the privilege of using the title, Certified Dental Assistant.

Opportunities for Dental Assistants

Dental assistants can find employment with private general practitioners, a group of dentists, the Verteran's Administration, The U.S. Public Health Service, and in the Armed Forces of our country. The large majority of assistants are employed by private general practitioners.

The salary paid dental assistants varies with the locality in which they are employed and their experience. A beginning part-time worker would earn, generally, $1.00 per hour. Full-time assistants who are in their initial training period earn approximately $40.00 per week while full-time, trained assistants will earn from $175 to $300 per month, depending upon the ability of the assistant and the responsibility of the position.

Personal Qualifications of the Dental Assistant

The practice of dentistry is extremely important to the health and welfare of the individual, the family, the community, and the nation. The dental assistant has an important part in providing dental service. Before a person decides to enter training as a dental assistant, she should understand what is expected of her. Among the more important personal-social traits required of a dental assistant are:

Cheerfulness. The ability to appear cheerful has a desirable infectious influence on other people.

Friendliness. The assistant manifests her friendliness by having a sincere and genuine interest in the welfare of each patient who comes into the office.

Dependability. The dependable assistant is always on time, regular in her work habits, and does her work well.

Initiative. The ability to see for oneself what ought to be done and to go ahead and do it is a desirable trait in all occupations.

Intelligence. Average or above intelligence is necessary to successful performance.

Appearance. Suitable dress, wise use of cosmetics, appropriate coiffure, and satisfactory grooming pay dividends in any field of endeavor. A scrupulously clean uniform and a carefully groomed assistant add much to the professional atmosphere of an office.

Cooperation. It is essential that the assistant work harmoniously with her doctor, the patients, and the other employees.

Accuracy. This trait is of extreme importance in a dental office where diagnosis and treatment depend upon absolute accuracy of tests, information, and the preparation of material and equipment.

Poise. The assistant should have satisfactory control of her emotions and good carriage.

Orderliness. Effective and consistent work habits and correct procedure and techniques employed on the job can mean the difference between success and failure.

Courtesy. The courteous assistant is civil and polite in all situations.

Professional Attitude. Professionalism is revealed by a deep and sincere respect and interest in your work.

REFERENCE FOR DENTAL ASSISTANT

1. Schwarzrock, L. H. and S. P. Schwarzrock, Effective Dental Assisting, Second Edition, Wm. C. Brown Co., 135 South Locust, Dubuque, Iowa, 1959, $8.00.*

*Subject to educational discount on quantity orders.

ANALYSIS OF DENTAL ASSISTANT

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
		Orientation
	1	1. The importance of dentistry
	1	2. The job of the dental assistant
	1	3. History of dentistry
	1	4. The purpose of dentistry
5. Conduct oneself in a professional manner	1	5. Ethics and conduct
6. Speak correctly	1	6. The importance of pleasing speech
7. Walk and stand properly	1	7. The value of proper posture
8. Converse with patients	1	8. Office conversation techniques
9. Practice office etiquette and courtesy	1	9. Factors in developing good public relations
10. Maintain a neat and well-groomed professional appearance	1	10. Acceptable dress and grooming
		Reception Procedures
1. Give information on the phone	2	11. Common telephone courtesies and techniques
2. Receive information on the phone	2	12. Kinds of business calls
3. Greet patients and other callers	2	13. Correct and accepted ways to greet patients
4. Assist in establishing a proper relationship between the child patient and the dentist	2	14. Psychology involved in dealing with children
5. Dismiss the patient	2	15. Accepted procedures for dismissing the patient

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
16. Collect and record personal information on patients	3	16. Kinds of information to collect from the patient
	3	17. Importance of collecting and recording personal information
18. Present cases to patients	3	18. Case presentations
19. Make appointments	3	19. Procedures for keeping the appointment book
20. Remind patients of appointments	3	20. Problems incurred in arranging appointments
21. Recall patients periodically	3	21. Advantages of recalling patients periodically
	3	22. Types of patient recall systems
Dental Office Management		
23. Write receipts	4	23. Value of receipts
24. Maintain the day sheet	4	24. Keeping the day sheet
25. Prepare bank deposits	4	25. Methods of preparing bank deposits
26. Check deposit slips	4	26. Methods of checking bank deposits
27. Handle petty cash fund	4	27. Items for which petty cash can be used
28. Check and file invoices	4	28. Methods for handling invoices and statements
29. Type and send statements		
30. Write checks	4	30. Procedures to follow in writing checks and paying bills
31. Reconcile bank statements	4	31. Method for reconciling bank statements

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
32. Collect delinquent accounts	4	32. Problems encountered in collecting accounts
33. Check credit ratings of patients	4	33. Methods of checking credit ratings
34. Maintain supply control record system	4	34. Procedures for supply control
35. Perform office maintenance duties	5	35. Values of office task control cards
36. Handle incoming and out going mail	5	36. Types of mail encountered
37. Type letters	5	37. Factors and problems involved in mail handling
38. Pay office bills	5	38. Methods for handling dental office bills
39. Arrange convention and travel reservations	5	39. Factors to consider when making convention and travel reservations
40. Arrange flowers	6	40. Flower arrangements and plant care
41. Ventilate, dust, regulate heat and light, tidy up rooms and furniture	6	41. Daily housekeeping duties
42. Close office	6	42. Things to check in closing the office
43. Clean draperies, furniture and rugs	6	43. Ways to clean draperies, furniture and rugs
44. Clean and care for sterilizers and autoclaves	6	44. Methods of caring for sterilizers and autoclaves
45. Sterilize handpieces and contra-angles	6	45. Methods for sterilizing handpieces and contra-angles
46. Lubricate handpieces and contra-angles	6	46. Methods for lubricating handpieces and contra-angles

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
47. Clean and maintain equipment finishes	6	47. Materials to use to care for finishes on equipment
48. Clean and maintain the dental unit	6	48. Considerations for maintaining the dental unit
49. Clean and maintain the Vacudent or Airdent unit	6	49. Steps for maintaining the Vacudent and Airdent unit
50. Clean and maintain the dental chair and cabinets	6	50. Things to maintain on the dental chair and cabinets
51. Attach handpieces to shaft	6	51. Types of handpieces
52. Clean and maintain laboratory and equipment	6	52. Care of laboratory and equipment
53. Talk intelligently about parts of the head and mouth	7	53. Anatomy of the head
	7	54. Names and locations of the teeth
	7	55. Means for identifying the parts of the teeth
56. Talk intelligently about caries	8	56. Common causes of caries
	8	57. Common dental diseases
58. Talk intelligently about types of cavities	8	58. Methods of classification of cavities
59. Instruct patient in choice of food for proper diet	8	59. Importance of diet on prevention of cavities
	8	60. Vitamins common to various foods
	8	61. Effect of bacterial action
62. Instruct patient in care of teeth	9	62. Principles of good oral hygiene
63. Demonstrate proper tooth brushing technique	9	63. Approved procedure for brushing teeth
	9	64. Values of tooth brushing

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
	9	65. Kinds of tooth brushes
	9	66. Common causes of tooth stain
67. Stimulate gum tissues	9	67. Proper technique for massage of gums
68. Talk intelligently about orthodontics	9	68. Principles of orthodontics
69. Solder and spot weld appliances	9	69. Procedure for soldering and spot welding
Operating Room Procedures		
	10	70. Methods of sterilization
71. Sterilize instruments	10	71. Need for and uses of sterilized articles
72. Clean and sort burrs	10	72. Types of burrs
73. Assist with anesthesia	11	73. Kinds of anesthesia
74. Assist in meeting emergencies such as hemorrhage and loss of consciousness	11	74. Common first aid processes
75. Seat the patient	12	75. Things to be done to properly seat the patient for treatment
76. Prepare patient for treatment		
77. Bring out patient's records		
78. Adjust dental chair		
79. Care for patient's appliances	12	79. Procedure for caring for the patient's dental appliances
80. Provide dentist with proper instruments	12	80. Importance of selecting proper tools and materials for work to be performed

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
81. Arrange instruments	12	81. Value of proper arrangement of tools and materials
82. Assist with recall prophylaxis and examination	12	82. Preparation of basic set-up for recall prophylaxis and examination
	12	83. Types of mandrels and polishers
84. Hold mirrors for dentist	12	84. Kinds of mirrors
	12	85. Kinds of explorers
	12	86. Kinds of scalers
87. Conduct oneself in a professional manner	12	87. The dental assistant's conduct in the operating room
88. Secure and arrange tools	12	88. Sequence of tool operations in making a preparation
89. Assist with each step of the preparation		
90. Assist with installation of rubber dam	12	90. Uses for rubber dam
	12	91. Kinds of rubber dam clamps
[illegible]. Assist with pulp testing process	12	92. Purpose of pulp testing
93. Assemble and fill syringes	12	93. Types of syringes
94. Sterilize syringes	12	94. Care of syringes
95. Prepare cements	13	95. Kinds of cements
96. Clean cement mixing equipment	13	96. Uses of the various cements
97. Mix silver amalgam	13	97. Method for preparing silver amalgam
98. Assist with inserting amalgam restorations	13	98. Procedure for inserting amalgam restorations
	13	99. Types of cutting instruments

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
100. Mix synthetic porcelain	13	100. Method for preparing synthetic porcelain
101. Assist with inserting synthetic porcelain restorations	13	101. Procedure for inserting synthetic porcelain restorations
102. Polish synthetic porcelain restorations	13	102. Method for polishing synthetic porcelain restorations
103. Prepare acrylic filling material	13	103. Procedure for preparing acrylic restorations
104. Assist with inserting and finishing acrylic fillings	13	104. Method of inserting and finishing acrylic fillings
105. Assist with gold foil fillings	13	105. Procedure for gold foil fillings
	13	106. Types of instruments for gold foil work
107. Make wax patterns	13	107. Method for making wax patterns for gold castings
	13	108. Materials available for making individual tooth impressions
109. Assist with fitting steel crowns	14	109. Procedure for fitting steel crowns
110. Assist with fitting gold inlays	14	110. Procedure for fitting gold inlays
111. Assist with three-quarter and full gold crown construction	14	111. Procedure for three-quarter and full gold crown construction
112. Assist with jacket crown construction	14	112. Procedure for jacket crown construction
113. Assist with bridgework construction	14	113. Procedure for bridgework construction
114. Assist with setting gold inlays, crowns, bridges, and jacket crowns	14	114. Method for setting gold inlays, crowns, bridges, and jacket crowns

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
115. Prepare hydrocolloid impression materials	14	115. Set-up for hydrocolloid impressions
116. Chill hydrocolloid impression materials	14	116. Kinds of materials used to make hydrocolloid impressions
117. Clean impression trays	14	117. Types of trays used to make hydrocolloid impressions
118. Make dies	14	118. Method for making individual tooth impressions for dies
119. Assist in treating oral diseases	15	119. Procedure for the treatment of pyorrhea
	15	120. Types of prophylaxis instruments
121. Prepare patient for surgery	15	121. Considerations preliminary to surgery under anesthesia
122. Assist with suturing	15	122. Types of surgical needles
123. Assist with surgical processes	15	123. Procedure for oral surgery
1. Arrange surgical instruments	15	124. Kinds of instruments used in oral surgery
125. Assist with devitalization process	15	125. Procedure for tooth devitalization
	15	126. Materials required for endodontic procedures
127. Assist with apico-ectomy	15	127. Procedure for apico-ectomy
	15	128. Materials required for apico-ectomy
129. Assist with tooth removal	15	129. Procedure for removal of teeth
130. Select instruments for tooth removal	15	130. Instruments used in tooth removal
131. Mix alginate	16	131. Kinds of impression trays

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
132. Clean impression trays	16	132. Methods of cleaning impression trays
133. Assist with taking compound impressions	16	133. Procedure for taking a compound impression
134. Prepare articulator	16	134. Process of articulation
135. Assist with articulation	16	135. Care of articulators
136. Assist with full denture construction	16	136. Process for full denture construction
137. Assist with partial denture construction	16	137. Process for partial denture construction
138. Adjust dentures	16	138. Ways of adjusting dentures
139. Assist with orthodontic appliance installation	16	139. Orthodontic procedures
140. Assist with orthodontic appliance adjustments		

Laboratory Procedures

	17	141. Types of spatulas
142. Mix plaster of Paris	17	142. Method for preparing plaster of Paris
143. Mix artificial stone	17	143. Method for preparing artificial stone
144. Pour models and casts	17	144. Care to be exercised in pouring models
145. Separate models	17	145. Steps in separation of casts from impression materials
146. Trim models	17	146. Equipment used in trimming casts
	17	147. Types of dentures
148. Make dies for gold castings	17	148. Methods of making dies
	17	149. Types of materials for making dies

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
150. Make a wax pattern	17	150. Steps in making a wax pattern
151. Cast gold for inlays	17	151. Kinds of casting equipment
	18	152. Danger of radiation exposure
153. Prepare machine for x-raying	18	153. Procedure for adjusting an x-ray machine
	18	154. Safe dosage rates
155. Prepare patient for x-raying	18	155. Position of the head for the various dental x-rays
156. Assist in taking radiograms	18	156. Importance of proper positioning of the film for the various dental x-rays
157. Ready film for exposure	18	157. Kinds of x-ray film
158. Read radiograms	18	158. Uses of dental radiograms
159. File x-rays	18	159. Systems for filing x-rays
160. Develop x-ray film	18	160. Kinds of developing solutions
	18	161. Relationship between temperature of developing solution and time needed for developing
162. Fix x-ray film	18	162. Time element in fixing x-ray film
163. Dry x-ray film		
164. Mount x-ray film	18	164. Methods of mounting film

Assignment
Sheet No. 1

Covering
Units 1-10

INTRODUCTION TO THE DENTAL PROFESSION

Dentistry is a profession which has a universal need for its services. It is interesting work and provides an opportunity for service to one's fellow man. The dentist and his assistant are expected to exhibit professional and ethical conduct in keeping with the requirements of the profession.

Knowledge of good speech, posture, grooming and how to meet the public is of great importance to success as a dental assistant. These can be developed through reading and a conscious effort to practice and improve.

In this assignment you will have the opportunity to become acquainted with the dental profession, and with what will be expected of you as a professional employee.

Assignment:

1. Read the reference listed below.
2. Answer the questions below and turn in this assignment by _____.

Reference:

A. Schwarzrock, Effective Dental Assisting, pp. 1-21; 180-185.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The dental student must study many of the same subjects as the student in a medical school; however, the instruction is largely concerned with the oral cavity and the head.

T F 2. In order for a dentist to maintain professional status he must keep his knowledge and skill freshened by continuing his education.

T F 3. A dental assistant relieves the doctor from duties which do not require professional training.

T F 4. The ratio of the number of people per dentist is steadily decreasing.

T F 5. Dental assistants should attempt to learn several operating procedures at the same time.

T F 6. The dental assistant should make a deliberate effort to read about dental procedures.

T F 7. The main purpose served by a dental assistant is to save the dentist's time.

T F 8. The dental assistant should adjust the routine of the dental office to fit her training.

T F 9. A knowledge of psychology applied to the handling of people is of importance to both the dentist and his assistant.

T F 10. An active dental assistant should join the Dental Assistants' Association.

T F 11. The need for dental services is greater in a civilized society than in a primitive society.

T F 12. A person's teeth are important factors involved in the digestive process.

T F 13. The personal records the dentist keeps on each patient are the property of the patient.

T F 14. The dentist can use the information in the patient's files for any use he may desire.

T F 15. Patients have the right to examine their personal files at any time.

T F 16. Ethics requires that no personal information an assistant learns in the office be mentioned outside that office.

T F 17. Records should be placed so it is inconvenient for the patient to try to read them.

T F 18. The dental assistant learns a great deal about the personal life of the dentist.

T F 19. Dentists prefer that their assistants "forget" about any details of their family life that may arise.

T F 20. The nature of dental work produces little friction between the dentist and his assistant.

T F 21. Familiarity can breed contempt.

T F 22. First names should not be used between the dentist, his assistant, and his wife.

T F 23. If the assistant has the appearance of lightness on her feet, a cheery smile and a friendly eye, people she contacts will enjoy being near her.

T F 24. People draw impressions about us by observing the rapidity with which we speak.

T F 25. When a person inhales, the lungs fill with air and the diaphragm is pulled up.

T F 26. Upper chest breathing results in a deep, loud voice.

T F 27. Diaphragmatic breathing can be achieved by practice.

T F 28. By practicing inhaling and slowly exhaling, upper chest breathing can be achieved.

T F 29. When a person speaks, air rushes between his vocal cords causing them to vibrate and thus produce sound.

T F 30. Once air from the lungs has been resonated, it must be formed into words.

T F 31. Clear speech depends upon the ability to easily open the mouth widely.

T F 32. A high-pitch voice is considered most pleasant.

T F 33. When speaking intensely, a person speaks with loudness.

T F 34. Conversation in an office should be expressed with force or energy.

T F 35. Rate of speech is determined by pauses between words or phrases.

T F 36. A good conversationalist is a good listener.

T F 37. The dental assistant should engage in conversation with the patient for as long a period as the patient desires to talk.

T F 38. The assistant should attempt to be informed about all subjects of current interest.

T F 39. Uniforms should be changed twice a week.

T F 40. Cost of white shoes and hose are deductible from income tax.

T F 41. The use of perfume is a good way to keep down body odors.

T F 42. Early records indicate that there was less separation between medicine and dentistry than today.

T F 43. Early treatments for disease often consisted of sacrifices or the application of some special remedy.

T F 44. The Etruscans developed dental appliances before the founding of Rome.

T F 45. Paul Revere was a practicing dentist.

T F 46. A method of dental prophylaxis introduced in 1852, consisting of separating the teeth and filing away portions of the approximal surfaces of the crowns to prevent and arrest caries, was called "Arthurizing."

T F 47. Cocaine was first used as an injection anesthetic in dentistry in 1867.

T F 48. W. K. Roentgen began the practical application of x-rays to dental uses.

T F 49. The German botanist, Link, first isolated and studied penicillin mold in 1929.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The specialist in dentistry who engages in the process of straightening teeth is known as a (an) _____.

2. The primary responsibility of the dental assistant is to save the dentist time and to directly aid in the production of _____ _____ _____ at the chair.

3. The specialty of replacing lost or missing teeth with removable substitutes is known as _____.

4. Conversation should be centered on the _____, and should serve to make _____ one of his interests.

5. The first people who were to be associated with the treatment of disease were _____ _____.

6. As a dental assistant, you are a member of a _____ profession.

7. People seek dental treatment for three main reasons: _____ _____, _____ _____, and improve _____ _____.

8. The dental assistant should keep all information concerning the patients strictly _____.

9. The patient's first impression of the dental office is when he enters the _____ _____ and talks with the _____ _____.

10. When we speak, the _____ of our voice frequently implies more than the words we say.

11. A patient's posture suggests something about his _____ _____.

12. A good posture suggests _____.

13. Good voice production involves _____ sections of the body

14. Good breath control is attained by _____, _____.

15. The large muscle dividing the thorax from the abdomen is the _____.

16. If a person, after speaking for a length of time, finds his throat aching and tired, he knows he has been using the _____ _____ _____ method.

17. When people lie down and relax, the body automatically breathes using the _____ method.

18. Most women are _____ _____ breathers.

19. The air, as it comes from the lungs, passes through the "voice box" properly known as the _____.

20. Located in the "voice box" are two _____ _____.

21. The articulators are the _____, _____, _____ _____, _____, _____, _____, _____, _____, and _____.

22. Beautiful diction is produced by careful use of the _____.

23. The relative highness or lowness of a person's voice is referred to as _____.

24. Speaking too rapidly tends to cause poor _____ and interferes with _____.

25. If the assistant asks the patient a question in a normal conversation, she should appear _____ in the answer.

26. The design of the assistant's uniform should be _____.

27. Some assistants confine loose hair in a _____ _____

28. Gold jewelry is seriously affected by _____.

29. Early attempts at replacing teeth consisted of wrapping bands of _____ around _____ _____ and around the natural teeth.

30. In earliest times teeth were removed by _____ them out.

31. Galen spoke of removing caries with a _____.

32. Marco Polo told about the people of China covering their teeth with plates of _____.

33. A method for casting gold into molds was invented by _____ _____, an Italian gold worker.

34. The first dental school was founded in the city of _____ in the year _____.

35. The use of vulcanized rubber as a base for artificial dentures was begun by _____ _____ in the year 1848.

36. The first relationship between mouth bacteria and the decay of teeth was demonstrated by Dr. _____ _____.

37. The first local anesthetic to be used was _____.

38. The idea of using antiseptic procedures was introduced by _____ _____.

39. _____ years were required to train a dentist in 1942, indicating a trend toward longer period of training for dentistry.

40. In 1905 synthesized procaine was introduced under the name _____.

41. Ever since the action of sulfanilamide was demonstrated, the field of _____ has developed rapidly.

42. Vulcanite has been replaced by various types of _____ for use as a denture base material.

43. The dental profession requires high _____ and _____ conduct from its members.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. If the personalities of the dentist and his assistant clash, the assistant should (A) try to change herself; (B) try to change the dentist; (C) find a new job; (D) serve only as receptionist.

_____ 2. In order to speak with a good voice tone for long periods of time, the speaker should learn to breathe using the (A) upper chest method; (B) diaphragmatic method; (C) lower chest method; (D) pharynx method.

_____ 3. When the sound of vibrating vocal cords is resonated, the sound is (A) increased in volume; (B) decreased in volume; (C) raised in pitch; (D) lowered in pitch.

_____ 4. Resonance is produced by the (A) larynx; (B) uvula; (C) vocal cords; (D) pharynx.

_____ 5. Articulation refers to (A) increasing the volume of sound; (B) reducing the breathy quality of sound; (C) resonating sound; (D) forming words.

_____ 6. If a person speaks in a monotone he is speaking in (A) a high tone; (B) low tone; (C) one tone; (D) many mixed tones.

_____ 7. Quality of voice is largely determined by (A) resonators; (B) articulators; (C) trachea; (D) lips.

_____ 8. An assistant can know what the patient is thinking by (A) examining his record; (B) observing him closely; (C) asking the dentist; (D) talking about sports.

_____ 9. The earliest person to describe the maxillary sinus was (A) Benvenuto Cellini; (B) Leonardo da Vinci; (C) Galen; (D) Marco Polo.

_____ 10. The first post-graduate school of orthodontia was established by (A) Kingsley; (B) van Foreest; (C) Angle; (D) Franklin.

_____ 11. The man who was outstanding for promoting preventive dentistry was (A) Black; (B) Long; (C) Cellini; (D) Leyden.

_____ 12. The Crawcour Brothers introduced in the United States (A) cavity preparation; (B) filing instruments; (C) a textbook on dentistry; (D) amalgam filling.

_____ 13. The American Society of Dental Surgeons was organized in (A) 1739; (B) 1779; (C) 1839; (D) 1879.

_____ 14. Drs. C. W. Long and C. T. Jackson introduced (A) gold fillings; (B) ether anesthesia; (C) gas anesthesia; (D) novocaine.

_____ 15. The first dental engines were powered by (A) treadle; (B) steam; (C) electricity; (D) gas.

_____ 16. The resin now widely used as a base material for artificial dentures is (A) polyvisol; (B) vulcanite; (C) bakelite; (D) acrylic.

Assignment
Sheet No. 2

Covering
Units 11-15

WORKING WITH THE PUBLIC

The dental assistant is the dentist's representative in his relationship with all visitors to the office. The assistant usually makes the first contact with patients and other visitors, and the reactions of the public toward the dentist are greatly affected by these first impressions.

The dentist and his staff work as a team to efficiently carry out their duties. Each member of the team must possess specialized skills and technical knowledge that are gained through study and work experience.

In this assignment you will have the opportunity to learn about the role of the dentist and his assistant, dental ethics and conduct, and personal qualifications of the dental assistant.

Assignment:

1. Read the reference listed below.
2. Answer the questions below and turn in this assignment by _____.

Reference:

A. Schwarzrock, Effective Dental Assisting, pp. 22-58.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The assistant can safely assume that the patient will do what she wants him to do.

T F 2. Praise and flattery can be used by the assistant to get patients to do what she wants them to do.

T F 3. Dental assistants should not disagree with a patient's ideas.

T F 4. Public relations refers to soliciting new patients.

T F 5. Planning and effort are necessary to develop good public relations.

T F 6. Dentists are likely to have unpleasant relationships with a few patients.

T F 7. If a dental office is run in a very businesslike manner, good public relations will follow.

T F 8. The peculiarities of patients should be remembered by the assistant.

T F 9. When an unpleasant situation arises and the patient is under emotional strain, the best thing the assistant can do is to postpone the discussion until a later time.

T F 10. The dental assistant should be in complete control of her emotions.

T F 11. When the dentist is working with a patient, the assistant should enter their conversation frequently.

T F 12. If the next patient must be kept waiting beyond his appointment time, tell him the delay will be only a few minutes.

T F 13. Dentists like to know the name of the person who referred the patient to their office.

T F 14. When speaking on the phone, it is best to talk as if the person were standing in the room with you.

T F 15. If a patient should become abusive over the telephone, the assistant should hang up.

T F 16. If an assistant is caring for a patient and the telephone rings, she should stop what she is doing and take care of the telephone call first.

T F 17. If the dentist is working in the laboratory or otherwise busy when a patient telephones to speak with him, the assistant should say he is with a patient and ascertain what the caller wants.

T F 18. It is easy to give out information over the telephone that need not have been revealed.

T F 19. Prices for dental work should not be given over the telephone.

T F 20. It is courteous to hang up first when a telephone conversation is completed.

T F 21. If an appointment is canceled, the assistant should try to make another for a later time.

T F 22. Mothers appreciate assistance in putting coats and hats on their children.

T F 23. Some materials for entertaining children should be available in the waiting room.

T F 24. If a new potential patient enters the office and is apparently in pain, give him the earliest open appointment left in the appointment book.

T F 25. Salesmen should be allowed to see the dentist at their convenience.

T F 26. If another doctor enters the office, take him to the dentist wherever he may be working, immediately.

T F 27. If a visitor to the office refuses to give his name and business, the assistant should call the dentist for assistance.

T F 28. Assistants should not ask the patient calling on the telephone if he is having pain.

T F 29. If an assistant has difficulty making an appointment for the time desired by the patient, she should place the patient's name on a call list.

T F 30. It is important for the dentist and his assistant to know if a child patient objects to seeing the dentist.

T F 31. Children have a natural inborn fear of dental offices.

T F 32. The dentist will expect the assistant to know about child psychology.

T F 33. Children should be brought to visit a dentist before they reach the negative stage common to young children.

T F 34. Many children never get to visit a dentist until they experience pain in the oral cavity.

T F 35. A child can tell if the assistant is only pretending to be sympathetic toward him.

T F 36. If a child misbehaves while in the dental chair, any toy or gift should be withheld.

T F 37. The dentist is responsible for the proper dismissal of patients.

T F 38. The assistant should assist the patient in removing any debris from his face.

T F 39. The patient should be dismissed in such a way that he does not feel rushed.

T F 40. The assistant should tell the departing patient good-by as he leaves the operating room.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Two of man's basic needs which can be used effectively in human relationships in the dental office are their desire for _____ _____ and need for _____.

2. The most important reason people neglect their teeth is _____.

3. Patient comfort is conditioned by _____ _____ set by the office staff.

4. Learning how to make the patient _____ is important to the long-range success of the office.

5. People will generally respond more favorably to a(an) _____ approach than to a(an) _____ approach.

6. Psychological studies would indicate that the individual exists in a continual state of _____.

7. _____ differs at various age levels.

8. A child will develop his small body muscles between the ages of _____ and _____.

9. A negative attitude is characteristic of the _____-year-old child.

10. The _____ child is extremely self-conscious.

11. A feeling of personal worth can be gained through attending to the _____ _____.

12. When the indirect approach is used in working with the patient, you increase his feeling of _____ and _____.

13. The text suggests calling the preliminary registration form a(an) _____ form.

14. To most effectively speak over a telephone, use a(an) _____ voice tone.

15. If the dentist is busy and a patient telephones and asks to talk with him, the assistant should record the caller's _____ and _____ _____ and have the dentist call him back later.

16. Overdue accounts should be discussed only with the _____.

17. Every telephone conversation should be closed with a pleasant "_____ _____."

18. If a telephone call is received that cannot be delayed, the assistant should notify the dentist by showing him a ____ ____

19. Outgoing telephone calls should be _____ so that incoming calls can be received.

20. The assistant must retain the _____ in contacts with patients or else the patients will exert pressure for special considerations.

21. When previous patients enter the waiting room, the assistant should call them by _____.

22. When someone enters the waiting room, the assistant should respond as _____ as possible.

23. When a new potential patient enters the waiting room, the assistant should greet him and have him complete the _____ _____.

24. It is best to offer the patient only _____ choices as to the hour of the appointment he desires.

25. If the new patient being registered is a child, the _____ name should be recorded along with the child's name.

26. Children enter a stage of negative behavior at about _____ years of age.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. A good course to take to learn about people and pleasant ways of dealing with them is (A) pathology; (B) anatomy; (C) psychology; (D) physiology.

_____ 2. Selfishness is a characteristic most often associated with the (A) adult; (B) three-year-old; (C) seven-to-eight-year-old; (D) adolescent.

_____ 3. Self-consciousness is a characteristic most often associated with the (A) adult; (B) three-year-old; (C) seven-to-eight-year-old; (D) adolescent.

_____ 4. The time dental appointments are made depends upon (A) the convenience of the patient; (B) the convenience of the dentist; (C) the order in which patients call; (D) the time stated on your acquaintance card.

_____ 5. Friendliness of manner can be expressed in your voice over the telephone by (A) speaking softly; (B) speaking loudly; (C) smiling while you talk; (D) holding the telephone mouthpiece by your chin.

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
100. Mix synthetic porcelain	13	100. Method for preparing synthetic porcelain
101. Assist with inserting synthetic porcelain restorations	13	101. Procedure for inserting synthetic porcelain restorations
102. Polish synthetic porcelain restorations	13	102. Method for polishing synthetic porcelain restorations
103. Prepare acrylic filling material	13	103. Procedure for preparing acrylic restorations
104. Assist with inserting and finishing acrylic fillings	13	104. Method of inserting and finishing acrylic fillings
105. Assist with gold foil fillings	13	105. Procedure for gold foil fillings
	13	106. Types of instruments for gold foil work
107. Make wax patterns	13	107. Method for making wax patterns for gold castings
	13	108. Materials available for making individual tooth impressions
109. Assist with fitting steel crowns	14	109. Procedure for fitting steel crowns
110. Assist with fitting gold inlays	14	110. Procedure for fitting gold inlays
111. Assist with three-quarter and full gold crown construction	14	111. Procedure for three-quarter and full gold crown construction
112. Assist with jacket crown construction	14	112. Procedure for jacket crown construction
113. Assist with bridgework construction	14	113. Procedure for bridgework construction
114. Assist with setting gold inlays, crowns, bridges, and jacket crowns	14	114. Method for setting gold inlays, crowns, bridges, and jacket crowns

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
115. Prepare hydrocolloid impression materials	14	115. Set-up for hydrocolloid impressions
116. Chill hydrocolloid impression materials	14	116. Kinds of materials used to make hydrocolloid impressions
117. Clean impression trays	14	117. Types of trays used to make hydrocolloid impressions
118. Make dies	14	118. Method for making individual tooth impressions for dies
119. Assist in treating oral diseases	15	119. Procedure for the treatment of pyorrhea
	15	120. Types of prophylaxis instruments
121. Prepare patient for surgery	15	121. Considerations preliminary to surgery under anesthesia
122. Assist with suturing	15	122. Types of surgical needles
123. Assist with surgical processes	15	123. Procedure for oral surgery
1. Arrange surgical instruments	15	124. Kinds of instruments used in oral surgery
125. Assist with devitalization process	15	125. Procedure for tooth devitalization
	15	126. Materials required for endodontic procedures
127. Assist with apico-ectomy	15	127. Procedure for apico-ectomy
	15	128. Materials required for apico-ectomy
129. Assist with tooth removal	15	129. Procedure for removal of teeth
130. Select instruments for tooth removal	15	130. Instruments used in tooth removal
131. Mix alginate	16	131. Kinds of impression trays

T F 7. Patients prefer short appointments to long appointments.

T F 8. Patients having appointments the following day should be reminded by telephone of their appointment.

T F 9. New patients should not be reminded of the time for their appointment.

T F 10. The daily time schedule is posted in the waiting room and each operating room.

T F 11. The folders for the patients for the next day should be removed from the file and placed in the operating room before the assistant leaves for the day.

T F 12. As soon as a new appointment book is received, the assistant should mark off all holidays and other days the office is closed.

T F 13. Dentists customarily close their offices on each school holiday.

T F 14. During the new patient's last appointment he should be encouraged to accept the recall service offered by the dentist.

T F 15. Children should receive preference in appointments on school holidays.

T F 16. Saturdays should be reserved for the working-class people.

T F 17. The dental assistant should be sure that everything pertaining to the patient's examination and diagnosis is made available before the patient enters for the case presentation.

T F 18. Dentists are required by law to register patients and record in detail their personal history.

T F 19. The dental assistant should not ask a patient how to pronounce his name.

T F 20. The preliminary information the assistant obtains from a patient includes the dento-medical history of the patient.

T F 21. The minimum information requirements include the home and business phone numbers of the patient.

T F 22. If acquaintance forms are used, each item should have an explanation recorded for the patient to read.

T F 23. Dentists request the name of the person responsible for paying the account in order that the wrong person will not be billed.

T F 24. Dentists do not exchange x-rays or information concerning prior treatments given to a patient.

T F 25. Treatment given in an emergency need not be recorded on a patient's individual record card.

T F 26. Complete details of each treatment should be recorded on the patient's record card.

T F 27. A married woman's given name is not recorded on her personal record card.

T F 28. Patients' records are filed alphabetically according to the patient's last name.

T F 29. If the dentist has several patients having the same last name, it makes no difference in what order they are filed.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Dental work that requires the most concentration and effort should be scheduled in the _____.

2. Recall appointments for prophylaxis and examination are best scheduled in the _____ _____ hours.

3. First appointments with new patients for discussion of necessary work are best scheduled in the _____ _____ hours.

4. The time schedule for the next day should not be typed until all _____ have been verified.

5. All entries in the appointment book should be written with _____.

6. When the dentist has finished presenting the case to the patient the assistant should be ready with the _____ _____.

7. The most accurate way to get a personal information form completed is to have the _____ record the information desired.

8. In order that a dentist can reach a patient as rapidly as possible, both the _____ and _____ phone numbers should be listed.

9. Pre-school children should receive dental appointments only in the _____ _____.

10. Frequently the first appointment consists of _____ and _____ _____ _____ and a recording of the case history.

11. When the dentist discusses the findings from the first examination with the patient, it is referred to as a _____ _____.

12. The best place to discuss dental needs with a patient is in a _____ _____.

13. Before a dentist treats a minor, he must get the consent of his _____.

14. A good protection against claims of malpractice is a complete _____ _____.

15. Since they must be changed occasionally, addresses and telephone numbers should be written on the patient's record with _____.

16. The patient's x-rays and individual record card are protected by placing them in a(an) _____.

17. The file containing the records of the patients whose work is in progress and not completed is called the _____ file.

18. Patient records are the property of the _____.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. Appointments for operative work, bridgework, and dental impressions should be scheduled in the (a) morning; (B) noon; (C) early afternoon; (D) late afternoon hours.

_____ 2. The appointment book should be large enough to use for (A) one month; (B) six months; (C) one year; (D) two years.

_____ 3. School children under ten years of age should receive dental appointments (A) before noon; (B) afternoon; (C) only on Saturdays; (D) only on school holidays.

_____ 4. Your responsibilities in office management include (A) delegating duties to members of the staff; (B) keeping your dentist busy; (C) soliciting new patients; (D) referring patients to specialists.

_____ 5. Recent research studies indicate that there is greater economy in (A) short appointments; (B) no appointments; (C) long appointments; (D) frequent appointments.

_____ 6. The new patient's examination and diagnosis card measures (A) 2 x 4; (B) 4 x 6; (C) 6 x 9½; (D) 8½ x 11 inches.

_____ 7. If the work for a patient has been completed but he has not paid, his file is placed in the (A) active file; (B) dead file; (C) accounts receivable file; (D) expenditures file.

_____ 8. If a patient indicates that he will not return to the office as a patient, the assistant should (A) throw away his records; (B) place his records in the dead file; (C) give the records to the patient; (D) send the records to his new dentist.

_____ 9. The length of time the dentist should keep patients records is determined by (A) the choice of the dentist; (B) the statute of limitations; (C) desires of the patient; (D) storage facilities.

Assignment
Sheet No. 4

Covering
Units 23-34

MAINTAINING BUSINESS RECORDS

Most medical and dental offices do not have elaborate systems of bookkeeping, but business records must be kept so that it is possible to determine the financial status of the office at any given time. Practically every office and every business will have a different method of keeping books, but in the main the fundamentals are the same regardless of the system.

Also, the problem of inventory and control of supplies frequently is delegated to the assistant.

In this assignment you will have the opportunity to study some general bookkeeping procedures and supply control systems.

Assignment:

1. Read the reference listed below.
2. Answer the questions below and turn in this assignment by _____.
3. Prepare a one page paper explaining the difference between patient records and business records.

Reference:

A. Schwarzrock, Effective Dental Assisting, pp. 85-118, 142-143.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is flase, draw a circle around the letter " F".

T F 1. Most dental offices follow very similar bookkeeping systems.

T F 2. In some cities accounting firms can be found which will take over all bookkeeping duties.

T F 3. Receipts should be made for payments received through the mail.

T F 4. Every cash payment received requires a receipt be given the patient.

T F 5. Receipts should be made out to the individual responsible for paying the account.

T F 6. The carbon paper in a receipt book must be changed frequently.

T F 7. Some day sheets provide space for entering the amount of actual time each patient spends in the chair.

T F 8. At the end of a day the total cash and checks on hand should equal the total amount of charges made for that day.

T F 9. Deposit slip books should be changed yearly.

T F 10. It is not necessary to keep a record of expenditures from the petty cash fund.

T F 11. At the beginning of each month the petty cash fund is brought up to its original balance.

T F 12. The petty cash fund is used for making change for patients paying cash.

T F 13. All income from the dental office is deposited in the dentist's personal checking account.

T F 14. It is possible for the dentist to make arrangements to have the assistant sign checks to pay the bills of the dental office.

T F 15. It is the best practice to make out a check before filling in the check stub.

T F 16. Reconciliation in office work refers to the process of determining the correctness of the bank statement as compared with the checkbook stubs.

T F 17. Some banks have a service charge for handling checking accounts.

T F 18. The bank's monthly statement of the checking account should always agree with the figures on your last check stub.

T F 19. If it seems impossible to reconcile the bank statement, it is best to accept the bank's figure.

T F 20. It is considered best practice to type monthly statements.

T F 21. According to law, dental offices close their books on the 25th of each month.

T F 22. Systematic and routine collection follow-up of all delayed accounts facilitates their successful collection.

T F 23. A running inventory of supplies is accomplished by keeping an accurate set of supply control cards.

T F 24. The patient's service and account record is actually a combination of two records.

T F 25. The total of all the balances on all the patient's account records should equal the total amount of money for which you will send statements.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Receipts should be filled out in _____.
2. The patient receives the _____ copy of the receipt.
3. The daily record of the financial affairs of the office is called the _____ _____.
4. The total amount of all receipts for a day is ascertained by adding the _____ column and the _____ _____ _____ column of the day sheet.
5. The total amount of actual charges for the day is ascertained by adding the _____ column and the _____ column of the day sheet.
6. Bank deposit slips should be made in _____.
7. Bank deposit slips are obtained from the _____ in which the dentist has his account.
8. Dental office expenditures of a minor nature are paid from a _____ _____ fund.
9. The assistant should package together all statements and invoices collected over a period of one _____.
10. The person usually responsible for making out checks for the expenses of the dental office is the _____.
11. Office records should be written with a _____ ink.
12. The balance remaining in the dental office checking account can be found by examining the _____ _____.
13. Procedures for collecting delinquent accounts should be decided by the _____.
14. A supply control card contains the name of the item, its _____, the _____, and where _____.
15. Supply control cards should be arranged alphabetically by the _____ name.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. When a dentist speaks of "chair time" he is referring to (A) the hour of the appointment; (B) the amount of time the patient is in the chair; (C) the age of the dental chair; (D) the time required by the assistant to maintain the chair.

_____ 2. It is best practice to deposit cash and checks in a bank (A) daily; (B) twice a week; (C) weekly; (D) every two weeks.

_____ 3. A check that has tiny holes punched in it has been (A) voided; (B) canceled; (C) returned because of insufficient funds; (D) incorrectly endorsed.

_____ 4. Checks that were written against the office checking account but are not received by the bank at the end of the month are referred to as being (A) bad; (B) lost; (C) voided; (D) outstanding.

_____ 5. Considerable saving can be made in the purchase of dental office supplies by purchasing (A) in the bulk; (B) single items; (C) only items needed immediately; (D) items by the half-dozen.

_____ 6. Properly kept supply control cards will indicate (A) the quality of the item; (B) the length of time for delivery; (C) the invoice number; (D) the most desirable quantity to purchase.

_____ 7. The fact that supplies need to be reordered is reported by the (A) supply control cards; (B) running inventory; (C) ledger; (D) day sheet.

Assignment
Sheet No. 5

Covering
Units 35-39

MANAGING THE OFFICE

Opinions and attitudes are formed as a result of first contacts, whether this contact is made in the office, by correspondence or by telephone. Impressions are modified by the subsequent contacts that are made while the person is a patient and even after he is discharged.

Your efficiency in handling the day-by-day problems that arise in the office should greatly please the dentist, and will certainly build a good feeling on the part of the patient toward the dentist.

In this assignment you will have the opportunity to study office routines such as handling the mail, answering correspondence, and making conference arrangements.

Assignment:

1. Read the reference listed below.
2. Answer the questions below and turn in this assignment by _____.
3. Prepare an outline of your duties that pertain to managing the dental office where you are employed.

Reference:

A. Schwarzrock, Effective Dental Assisting, pp. 118-139, 543-546.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. Economy in the purchase of stationery for the dental office should be given first consideration.

T F 2. Most letters can be considered sales letters, and should utilize a high level of persuasion.

T F 3. The pattern of stereotyped expressions in business letter writing should be avoided.

T F 4. Business letters can be a means of developing good public relations.

T F 5. The opening statement in a business letter is a formality of little importance to the letter.

T F 6. The opening statement in a business letter should be about you--the writer of the letter.

T F 7. Most collection letters are examples of how to maintain good public relations through correspondence.

T F 8. The business letter should be no longer than is necessary to say what is necessary to be said.

T F 9. The climax of the letter should come in the middle.

T F 10. The business letter should be ended with alternate proposals whenever possible.

T F 11. The margin at the bottom of a business letter should be slightly larger than the margin at the top.

T F 12. The last paragraph of the business letter is called the complimentary close.

T F 13. A recall control card contains the age and salary of the patient.

T F 14. After a patient has been sent a recall notice, his recall card is placed behind the index tab of the month preceding the appointment.

T F 15. The dental assistant should insist that the patient have his name put on recall.

T F 16. If a patient voluntarily has his name placed on recall, he will most likely come to the office for a recall.

T F 17. The profession of dentistry is morally responsible for teaching good oral habits and care.

T F 18. Office task control cards should be written with pencil.

T F 19. Maintenance tasks which must be performed daily need not be recorded for reference purposes.

T F 20. The waiting room should be dusted and magazines arranged before patients begin to arrive.

T F 21. The foot-rest on the dental chair should be scrubbed daily.

T F 22. The assistant should make a daily check on the supply in the medicine bottles.

T F 23. Children seldom appreciate receiving birthday cards from their dentist.

T F 24. Birthday control cards should be the same color as the appointment recall cards.

T F 25. Letters written to the dentist by other doctors should not be opened by the assistant.

T F 26. Any letters of complaint from patients should be placed in the patient's record file after they have been answered.

T F 27. If a letter is received with a "permit" postage mark, the assistant should know that it contains advertising matter.

T F 28. The assistant should be sure to pay the dental office bills promptly.

T F 29. It is of extreme importance that the assistant attach an identifying tag on each dental case as it is removed from the protective wrapper.

T F 30. Before the assistant makes convention reservations for the dentist, she should carefully read over the convention folder.

T F 31. If the assistant is asked to make travel arrangements for the dentist, she arranges for him to use the fastest means of transportation available.

T F 32. Airline tickets should always be picked up in advance of the flight date.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. A good business letter should use the technique of _____ rather than _____.

2. Good business letters should not be written in _____ language.

3. The opening of a business letter should capture the reader's _____, the middle is the _____, and the close should be designed to get _____.

4. A new trend in formal business letter writing is to drop the meaningless salutation and substitute one which is both _____ and _____.

5. The _____ is the appropriate book to use when you are not sure of the spelling of a word.

6. It is preferred practice to write " _____ _____" notes by hand rather than on the typewriter.

7. The handling of incoming mail should be accomplished with _____ and _____.

8. Reminders for equipment maintenance, recall control and birthday card lists are best obtained by using a _____ -_____ _____ file.

9. The recall control card is filed in the come-up card file _____ _____ before the time noted for the recall.

10. The recall notice of an appointment should be sent to the patient _____ _____ before the actual appointment date.

11. The cards in a come-up card file having to do with maintenance of the dental laboratory are called _____ _____ _____ _____ cards.

12. The name of the piece of equipment to be serviced is placed in the _____ _____ _____ corner of the task control card.

13. The day a maintenance task is scheduled to be performed is recorded in the _____ _____ of the task control card.

14. Acrylic cases should be unwrapped as soon as they are received from the laboratory and placed in _____.

15. Items received in the dental office from the dental laboratory which do not require immersion should be stored in _____.

16. First-class travel by train is more commonly called _____ travel.

17. Hotel reservations are made by writing to the _____.

18. A brief statement including all information concerning travel, reservations, and convention meetings, is called a(an) _____.

19. Duties such as handling mail and answering correspondence are referred to as _____ _____.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. A come-up card file must be checked (A) hourly; (B) daily; (C) weekly; (D) monthly.

_____ 2. Come-up cards used for any one type of reminder should be the same (A) weight; (B) thickness; (C) color; (D) width.

_____ 3. The recommended size for come-up cards is (A) 2 x 4; (B) 4 x 6; (C) 6 x 8; (D) 8 x 11 inches.

_____ 4. The dental office should be thoroughly aired (A) hourly; (B) daily; (C) weekly; (D) monthly.

_____ 5. The assistant should prepare the birthday cards for the next month at about the (A) first of the month; (B) first of the preceding month; (C) daily as they occur; (D) near end of the preceding month.

_____ 6. The assistant should never open (A) personal mail; (B) letters from other doctors; (C) letters from patients; (D) announcement of meetings.

_____ 7. Letters containing advertising matter usually have (A) handwritten addresses; (B) postage stamps affixed; (C) a tucked-end flap; (D) no return address.

_____ 8. All checks received in the dental office should be (A) endorsed by the dentist; (B) endorsed by the assistant; (C) stamped with a bank stamp; (D) given to the dentist for safekeeping.

_____ 9. When hotel reservations are made, the hotel manager wants to know (A) the number of pieces of luggage to expect; (B) if the dentist will eat in the hotel dining room; (C) the credit rating of the dentist; (D) the number of nights the room is needed.

Assignment
Sheet No. 6

Covering
Units 40-52

HOUSEKEEPING AND MAINTAINING EQUIPMENT

Cleanliness of the office is essential for the health of the patient. Also, it is another factor in creating a favorable attitude from first impressions. The new patient will be quick to judge your dentist's work by the manner in which the housekeeping is performed.

In addition to the care of the office, the dental assistant is usually responsible for the care of the dental equipment in the office, keeping it clean, oiled, and in operating condition at all times. Much of the success of the dentist's work depends on how well the dental assistant does this phase of her work.

In this assignment you will have the opportunity to learn about caring for the dental office and the various pieces of equipment.

Assignment:

1. Read the reference listed below.
2. Answer the questions below and turn in this assignment by _____.
3. Prepare a list of the maintenance duties you perform periodically. Divide the list into groups, such as daily, weekly and monthly, or as suggested by your employer.

References:

A. Schwarzrock, Effective Dental Assisting, pp. 144-179.
B. Information Sheet No. 1.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Some plants live with only artificial illumination as a source of light.

T F 2. Potted plants should be watered regularly.

T F 3. Short cut-flowers are best arranged in a tall, narrow vase.

T F 4. Chrysanthemums are used in arrangements which stress the line of the individual flower.

T F 5. The dental office should be aired every day.

T F 6. Everything in the office, operating room, and laboratory should be dusted daily.

T F 7. All switches and main valves should be turned off before leaving the office at the close of the day.

T F 8. Equipment manufacturers usually provide an instruction booklet for care of their equipment.

T F 9. Soap and water are good for cleaning stainless steel.

T F 10. Enamel surfaces are cleaned with Bon-Ami and water.

T F 11. If the enamel is chipped, the assistant should employ a painter to touch up the spots.

T F 12. Wax on wood surfaces should be removed at regular intervals.

T F 13. Once a piece of wood furniture becomes scratched, it must be refinished to cover the scratch.

T F 14. Most plastic surfaces can be cleaned with kitchen cleanser and water.

T F 15. Draperies and curtains should be cleaned as soon as the first signs of soil appear.

T F 16. Detergents are available for removing spots from upholstered furniture.

T F 17. Slipcovers wear longer if they are kept clean.

T F 18. Floor cleaner-waxes are suitable for all types of floor covering materials.

T F 19. Excess water may be harmful to linoleum and asphalt tile floors.

T F 20. The water level in the water sterilizer should be checked several times each day.

T F 21. The water sterilizer should contain enough water to fully cover the tray in its lower position.

T F 22. If exceptionally hard water is used in a water sterilizer, the boiler should be cleaned daily.

T F 23. As the oil in an oil sterilizer evaporates, more should be added.

T F 24. The oil sterilizer should be warmed before it is emptied.

T F 25. The autoclave should be drained and cleaned every week.

T F 26. The autoclave should be scrubbed with soapy water and run through several cycles every six months.

T F 27. The autoclave contains discharge screens which require cleaning.

T F 28. The hand piece requires oiling daily.

T F 29. The outer shell of the handpiece is called the "sheath."

T F 30. The handpiece is not removed from the oil sterilizer until it cools.

T F 31. After replacing an oil sterilized handpiece on the engine arm, run the engine wide open to throw out excess oil from the wrist-joint assembly.

T F 32. Come-apart, right-angle handpieces should be dis-assembled while they are still hot from the sterilizing process.

T F 33. Come-apart, contra-angle handpieces should be re-assembled while they are still hot from the sterilizing process.

T F 34. Oil remaining on the surface of the contra-angle handpieces after sterilization should be left as a rust preventative.

T F 35. Regular types of contra-angles can be sterilized in the oil sterilizer or in special cleansers recommended by the manufacturer.

T F 36. The dental unit should be wiped down daily.

T F 37. The cuspidor bowl should be cleaned twice a week.

T F 38. The tension on the engine belt should be relieved after each patient has been dismissed.

T F 39. If the brushes in a foot controller of a dental engine have begun to cut into the plates, the assistant should send the unit out for repairs.

T F 40. The guide ways of the hydraulic mechanism of the dental chair should be wiped lightly with an oiled cloth each week.

T F 41. X-ray machines require considerable time for maintenance purposes.

T F 42. All medicament bottles should be labeled.

T F 43. The tops of dental cabinets should be protected with wax.

T F 44. Instruments stored in the dental cabinet are kept sterile.

T F 45. The assistant should be sure to shut off the motor to the Vacudent unit whenever it is not in use.

T F 46. The filter bag in a Vacudent unit assists in the separation of water from air.

T F 47. The debris collected in Vacudent filter bags should be discarded.

T F 48. If the switch to the Vacudent unit refuses to stay on this indicates a leak in the air line.

T F 49. A full filter bag on a Vacudent unit tends to decrease suction.

T F 50. Diamond instruments should be cleaned immediately after use.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. A good way to minimize the amount of time spent on equipment maintenance is to prepare a written _____ for the work.

2. Before waxing enamel surfaces, clean the surfaces with _____ _____.

3. The text recommends waxing wood furniture _____.

4. Leather surfaces can normally be cleaned with _____ _____ and water.

5. The most satisfactory way to clean rugs is by sending them to a _____ _____.

6. Corrosion, rust and staining of steel instruments in a water sterilizer is prevented by adding _____ _____.

7. Water boiler scale that cannot be removed with normal cleaning can be removed by boiling a _____ per cent solution of _____ _____ in the boiler.

8. After emptying, the oil sterilizer should be scoured with _____-_____ before it is refilled.

9. The reservoir of the autoclave should be filled with _____ water.

10. The reservoir of the autoclave should be kept ____-____ full.

11. The reservoir of the autoclave should be scrubbed with _____ and lukewarm _____.

12. If steam escapes from the door of the autoclave, replace the _____ _____ inside the door.

13. If the sheath on the handpiece is removable, the sheath can be sterilized in a(an) _____ or a cold sterilizing solution.

14. The sterilization of a handpiece in an oil sterilizer requires _____ minutes from a cold start.

15. After removing the sterilized handpiece from the oil sterilizer the sheath should be wiped with _____.

16. Freshly sterilized contra-angles and right-angles should be placed _____ the other angles on the storage tray.

17. The cuspidor bowl is cleaned with _____ soap or _____.

18. The saliva ejector screen should be cleaned every _____.

19. The contents of the cuspidor trap should be placed into the _____ _____ jar.

20. Dental engines require oiling every _____ weeks.

21. Before removing the water supply screen for cleaning, turn off the _____ _____ _____.

22. The foot controller on a dental unit should be lubricated every _____ months.

23. The levers operating the motor chair should be oiled every _____ months.

24. The tilting lock under the seat of the dental chair should be oiled every _____ months.

25. Every six months the _____ _____ of the motor on the dental chair should be filled to the proper level.

26. The only parts of the x-ray requiring oiling are the _____ and the _____ _____.

27. The recommended way to tape labels on bottles is with a strip of _____ _____.

28. Bottles should not be filled with over _____ inch of medicament.

29. The amount of medicament in each bottle should be checked _____.

30. Cement bottles should be stored in the same drawer as the cement _____ and _____.

31. The shelves of the surgical cabinet are covered with autoclaved _____.

32. Sterilized towels are moved from the autoclave by gripping them with sterile _____.

33. The surgical cabinet should be cleaned and all instruments re-sterilized _____ _____.

34. Spraying bacterial solution into the mouthpiece tends to eliminate _____ growth in the Vacudent filter bag.

35. After every bloody operation, the Vacudent unit should be flushed with _____.

36. Used Vacudent filter bags are best stored in _____.

37. The Vacudent filter tank should be cleaned once a _____.

38. The Vacudent power unit filter paper should be changed every _____ days.

39. If a Vacudent valve sticks, it can be loosened by _____ the system with _____.

40. Leaking air connections on a Vacudent unit can be remedied by coating the connections with _____.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. Enamel surfaces should be waxed every (A) week; (B) two weeks; (C) month; (D) two months.

_____ 2. Leather surfaces are cleaned with (A) Bon-Ami; (B) soap powder and water; (C) castile soap; (D) alcohol.

_____ 3. When upholstered furniture is too soiled for spot cleaning, it should be cleaned by (A) dry cleaning; (B) washing with soap and water; (C) vacuum cleaning; (D) washing with saddle soap.

_____ 4. Under normal conditions the water sterilizer should be emptied and scoured at least once a (A) day; (B) week; (C) month; (D) year.

_____ 5. The capacity of the oil sterilizer is one (A) ounce; (B) pint; (C) quart; (D) gallon.

_____ 6. Each week the entire handpiece assembly should be sterilized in a(an) (A) autoclave; (B) alcohol sterilizer; (C) oil sterilizer; (D) cold sterilizer.

_____ 7. The gas-burner cup of wax drippings should be cleaned with (A) turpentine; (B) water; (C) Bon-Ami; (D) chloroform.

_____ 8. The saliva ejector hose is cleaned by flushing it with (A) cold water; (B) alcohol; (C) very warm water; (D) chloroform.

_____ 9. The cuspidor trap should be cleaned (A) several times a day; (B) once a day; (C) once a week; (D) once a month.

_____ 10. When oiling a dental engine, inject into each oiling hole (A) two drops of oil; (B) one-half teaspoon oil; (C) two drops of Vaseline; (D) two ounces of linseed oil.

_____ 11. Water supply screens should be cleaned every (A) week; (B) three weeks; (C) month; (D) three months.

_____ 12. The foot control unit on a dental unit should be lubricated with (A) linseed oil; (B) motor oil; (C) machine oil; (D) Vaseline.

_____ 13. The sliding channels of the chair back should be lubricated (A) daily; (B) weekly; (C) monthly; (D) yearly.

_____ 14. The lock assembly on the head rest of the dental chair requires oiling every (A) month; (B) three months (C) six months; (D) year.

_____ 15. Dental cabinet tops should be cleaned with (A) liquid wax; (B) paste waz; (C) Clorox; (D) Bon-Ami.

_____ 16. Instruments that must be kept sterile are stored in a(an) (A) surgical cabinet; (B) mobile dental cabinet; (C) stationary dental cabinet; (D) autoclave.

_____ 17. Vacudent filter bags should be changed (A) weekly; (B) monthly; (C) every six months; (D) yearly.

Assignment Sheet No. 7

Covering Units 53-55

ANATOMY AND TECHNICAL TERMS

Many medical and technical terms are used by the dentist. If an assistant is to fulfill the duties of her job to the fullest, she should be thoroughly familiar with the anatomy of teeth.

Some of the terms used in the textbook are not always used by all dental schools and, therefore, are not always used by dentists. If the dental assistant is familiar with the terms used in this lesson, any adjustment that must be made to fit a dentist's vocabulary will not be difficult.

In this assignment you will have the opportunity to become familiar with the common anatomical terms used in dentistry.

Assignment:

1. Read the reference listed below.
2. Answer the questions below and turn in this assignment by _____.
3. Prepare a list of words pertaining to dentistry, used by your employer, with which you are not familiar. Write a definition for each.

Reference:

A. Schwarzrock, Effective Dental Assisting, pp. 185-205.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The upper jaw moves when a person chews or talks.

T F 2. The arched portion of the cheek bone is located above the ramus of the mandible.

T F 3. The chewing motion of the jaws is activated by muscles.

T F 4. Each side of the head contains a complete set of the muscles of mastication.

T F 5. Human lips are composed of gristle covered with skin.

T F 6. The vermillion border is found in both humans and other warm-blooded animals.

T F 7. As people age, the nasolabial groove gets shallower.

T F 8. When most people just barely part their lips, the edge of their front teeth shows just below the upper lip.

T F 9. The maxillary tuberosity is located behind the lower teeth.

T F 10. When making a cast of the mouth, the maxillary tuberosity must be included in the cast.

T F 11. When the gum is in healthy condition it is a deep red color.

T F 12. The mucosa lining of the cheeks and lips is usually a deeper red color than the gums.

T F 13. The gum is attached to the base of the teeth.

T F 14. Beneath the tongue, the lingual frenum is found.

T F 15. The complete set of lower teeth is referred to as the lower arch.

T F 16. Enamel occurs in the same thickness over the entire crown.

T F 17. Enamel is made up of microscopic rods which point approximately perpendicular to the dentine.

T F 18. Many nerve fibers infilter the dentine material.

T F 19. Dentine is weak and crumbly.

T F 20. The gingivae is attached to the tooth at the cervical line.

T F 21. The cementum directly contacts the bone tooth socket in the jaw.

T F 22. Mandibular teeth erupt before the maxillary teeth.

T F 23. Each arch of teeth is divided into four quadrants.

T F 24. In a complete set of teeth there are four teeth with the same name.

T F 25. Short cuts are commonly used by dentists for the identification of teeth.

T F 26. The official nomenclature adopted by the American Dental Association classifies the teeth according to quadrants.

T F 27. The surface of the tooth toward the tongue is known as the mesial surface.

T F 28. The mesial surfaces of the two central incisors are next to each other.

T F 29. While the adult has 32 teeth in a complete set, the child has only 26 primary teeth.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The lower jaw swings on two joints called the _____ - _____ joints.

2. The bone comprising the lower jaw is called the _____.

3. The portion of the lower jaw bone that extends from near the ear downward toward the chin is called the _____.

4. The portion of the lower jaw bone that forms the angle of the chin is called the _____.

5. The cheek bone is formed by a bone called the _____ _____.

6. The muscle used in mastication that passes under the arch of the cheek bone and fans out in a large area on the side of the head is the _____ muscle.

7. The muscle which is attached along the lower edge of the zygomatic arch is the _____ muscle.

8. The muscle that lies on the inner surface of the ramus of the mandible and helps to close the jaws is the _____ _____.

9. Some dentists used the word _____ to denote above and _____ to denote lower.

10. The inside of the human mouth is covered with a lining called _____ _____.

11. The folds of the membrane in the corners of the mouth are called the _____ _____.

12. The little portion of skin connecting the inner lip and gum in the midline of the mouth is called the _____.

13. The space inside the mouth enclosed by the lips, cheeks, palate, and floor of the mouth is referred to as the _____ _____.

14. The mouth opening to the oral cavity is called the _____ _____.

15. The technical name for the gums is _____.

16. The trough between the gums and the inner surface of the cheek is referred to as the oral vestibule or _____ - _____ _____.

17. The red membrane lining of the mouth contains glands that secrete a watery substance called _____ _____.

18. The roof of the mouth contains a hard, bony support called the hard _____.

19. The palatine velum is more commonly called the _____ _____.

20. The little finger-like projection hanging down in the throat from the palatine velum is called the _____.

21. Tonsils lie between the _____ arch and the _____ arch.

22. The heavy arch-like fold that runs from behind the last upper tooth to the retromolar pad behind the last lower tooth is called the _____ fold.

23. The parotid gland produces _____.

24. The parotid duct is more commonly called _____ duct.

25. Beneath the tongue are found two salivary glands called _____ _____.

26. The adult mouth contains _____ teeth.

27. The deciduous dentition in children contains _____ teeth.

28. When a mouth is closed and the teeth are touching, they are said to be in _____.

29. When teeth are closed in a position as though biting with the back teeth, they are said to be in _____ _____.

30. The outer surface of the crown of a tooth is covered with _____.

31. The hardest material in the body is the _____ on teeth.

32. Enamel is made up of _____, _____ _____ _____ and _____.

33. The main body of the tooth is composed of _____.

34. The root of a tooth is covered with a thin, dense material called _____.

35. The process of new teeth entering the mouth is called _____.

36. The six upper and the six lower front teeth are referred to as the _____ teeth.

37. The surface of a tooth that touches its neighbor to the rear is known as the _____ surface.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. Support for the lower teeth is provided by the bone called the (A) ramus; (B) mandible; (C) arch; (D) temporal.

_____ 2. That portion of the upper jaw bone that provides support for the upper teeth is called the (A) maxilla; (B) mandible; (C) pterygoid; (D) cheek bone.

_____ 3. The muscle which is located on the inner side of the ramus and makes the jaw slide in a forward motion is the (A) internal pterygoid; (B) external pterygoid; (C) masseter; (D) temporal.

_____ 4. The line connecting the skin of the lips and mucous membrane is called (A) superior maxilla; (B) inferior maxilla; (C) intersection; (D) vermillion border.

_____ 5. Behind the last tooth is found a rounded little hump called the (A) frenum; (B) maxillary; (C) retromolar pad; (D) buccal hump.

_____ 6. That portion of mucous membrane lining the cheeks is called (A) alveolar mucosa; (B) buccal mucosa; (C) gingiva; (D) frenum.

_____ 7. The gum free margin reaches a depth of approximately (A) 1/16 inch; (B) 1/8 inch; (C) 3/16 inch; (D) 1/4 inch.

_____ 8. Mumps are identified with the (A) dentine; (B) posterior pillar; (C) uvula; (D) parotid gland.

_____ 9. The part of the tooth that is visible is called the (A) crown; (B) dentine; (C) cementum; (D) bone.

_____ 10. The pulp chamber of a tooth is filled with (A) dentine; (B) cusp; (C) nerves; (D) cementum.

_____ 11. That portion of the tooth that lies beyond the enamel crown forms the (A) pulp canal; (B) root; (C) cusp; (D) nerves.

_____ 12. The cervical line is formed by the (A) union of cementum and enamel; (B) enamel fissure; (C) root apices; (D) root bifurcation.

_____ 13. A tooth is supported in its socket by the (A) jaw bone; (B) pulp horn; (C) blood vessels; (D) peridental membrane.

Assignment
Sheet No. 8

Covering
Units 56-61

DIET, DENTAL DISEASE, AND CAVITY CLASSIFICATION

Caries is a disease that is present in almost everyone's teeth at one time or another. It concerns the destruction of the enamel and subsequent decay of teeth.

Patients frequently ask dental assistants questions concerning care of eeth and causes of decay. An alert assistant should be prepared to discuss with interested patients the fundamentals of tooth care, the importance of diet, and kinds of cavities.

In this assignment you will have the opportunity to learn about the causes and treatments for caries, the importance of diet to dental health, and how cavities are classified.

Assignment:

1. Read the reference listed below.
2. Answer the questions below and turn in this assignment by _____.
3. Prepare a drawing of the upper and lower arch with the teeth properly located and identified. Indicate the four quadrants.

Reference:

A. Schwarzrock, Effective Dental Assisting, pp. 205-219, 231-240.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. It is possible for the dentist to classify the types of cavities found in the patient's mouth.

T F 2. Cavities which occur in the proximal surfaces of incisors and cuspids are class-two cavities.

T F 3. Diet and nutrition are one and the same.

T F 4. If your appetite is satisfied, this is a good indication your diet is providing the necessary food elements for good nutrition.

T F 5. If your diet includes foods from each of the basic food groups, you can be reasonably sure it is providing the nutrition which you need.

T F 6. Vitamin C is so important to the diet that precaution should be taken to provide for it daily.

T F 7. Butter and margarine both supply the same vitamins, and are considered to be high energy foods.

T F 8. The diuretic action of coffee and tea retards the elimination of liquids.

T F 9. The calorie is the amount of heat necessary to raise the temperature of one kilogram of water one degree centigrade.

T F 10. Fat foods are slow to digest, but burn quickly and give more than twice as many calories as carbohydrates of protein.

T F 11. Proteins help to regulate body functions as well as build and repair body tissue.

T F 12. Vitamin C is of little value to the health of the supporting tissue of the teeth.

T F 13. Raw apples, celery, or carrot straws are recommended for cleaning the teeth at the close of a meal or snack.

T F 14. Microbiology is the science of the nature, life and actions of microorganisms that are harmful to man.

T F 15. Bacteria are one-celled vegetable microorganisms containing chlorophyll.

T F 16. All bacteria require oxygen to live.

T F 17. Reproduced bacterial cells are exactly the same as the mother cell.

T F 18. The protozoa are essentially one-celled animals.

T F 19. The virus organism can be distinguished from other organisms by use of an ordinary microscope.

T F 20. Children are immune from caries until they reach about five years of age.

T F 21. Our mouths contain considerable numbers of bacteria.

T F 22. Bacterial plaques occur most commonly along the biting edge of the teeth.

T F 23. The acid from the action of bacteria on food reaches its maximum formation within thirty minutes after eating.

T F 24. A proper diet is of help in controlling caries.

T F 25. Ammoniated dentrifices oppose the acid-producing organisms in the mouth.

T F 26. If the growth of the bacterial organisms in the mouth is inhibited, more enzyme production occurs.

T F 27. Modern dentrifices reduce the formation of new carious lesions fifty to seventy-five per cent.

T F 28. Anti-enzyme type dentrifices operate at a different stage in the acid-forming process than the ammoniated dentrifices.

T F 29. Acid formation is inhibited for long intervals by the anti-enzyme type dentrifice.

T F 30. Drugs used in present-day dentrifices have proved their effectiveness.

T F 31. The only method for using fluorine to reduce the number of cavities is by placing it in drinking water.

T F 32. Plaques form thick, large masses and with their enzymes produce acid rapidly.

T F 33. Rinsing the mouth with water after eating aids in the removal of food particles.

T F 34. The dietary list in the textbook excludes hot cereals.

T F 35. Dietary suggestions in the textbook insist that no sugar can be used in any form.

T F 36. Sugar aids in the preservation of canned fruits.

T F 37. Peanut butter and jelly sandwiches are suggested as an in-between meal snack.

T F 38. Proper care of the teeth is a technical subject which the dental assistant should not attempt to discuss with the patient.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. A _____ cavity involves but one surface of a given tooth, while a _____ cavity involves two or more.

2. Improper diet over a long period of time can result in such diseases as _____, _____, _____, and _____.

3. _____ products provide proteins, calcium and minerals in the diet.

4. Absorbing of food by the digestive organs and turning it into living tissue is a process known as _____.

5. The food requirements which we need each day to meet the nutritional demands of our bodies are referred to as the _____ _____.

6. Vitamins are necessary for growth, for regulation of the _____ _____, and for the protection of _____.

7. The supporting tissue of the teeth will not be healthy without an adequate Vitamin _____ intake.

8. All plant and animal life is dependent upon the existence of _____ in the soil.

9. The three general morphologic types of bacteria are _____, _____, and _____.

10. Bacterial cells reproduce by _____.

11. _____ generally require a fluid environment in which to live; therefore, they can usually be found in pools and puddles.

12. Smallpox is an example of a _____disease.

13. The technical term for tooth decay is _____.

14. Caries attacksthe _____ _____ of the teeth.

15. Bacterial plaques can be made visible by painting the teech with five per cent _____ _____ or one per cent _____ solution.

16. Authorities believe bacteria on the teeth produce _____ that cause acids to form which attack the enamel.

17. Mouth acids formed after eating cause a _____ of the enamel.

18. Continued action of mouth acid on tooth enamel causes first a _____ spot, then loss in _____ of the _____, then _____.

19. First pain from caries usually occur when it reaches the _____ _____ junction.

20. Severe pain from caries results when it reaches the _____ tissues.

21. The use of fluorine in the drinking water reduces the cavity rate _____ per cent.

22. A plaque should be removed by brushing the teeth and cleaning between them with _____ _____.

23. Chewing a piece of _____ _____ or _____-_____ gum helps clean the teeth of food particles.

24. The most successful means of stopping a carious lesion is to replace the diseased portion of the tooth with a _____.

25. Early diagnosis of caries can be accomplished by periodic mouth examinations with _____.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. Cavities occurring in the proximal surfaces of a cuspid, involving the removal and restoration of the incisal angles, are: (A) Class I; (B) Class II; (C) Class III; (D) none of these.

_____ 2. The body's daily requirement for energy is met by three types of nutrients: (A) carbohydrates, fats and proteins; (B) fats, proteins and sugars; (C) carbohydrates, vitamins and sugars; (D) proteins, sugar and fats.

_____ 3. The film-like covering of bacteria on teeth is referred to as (A) a film of bacteria; (C) caries; (C) a bacterial plaque; (D) rampant caries.

_____ 4. Food can be removed from the mouth by (A) eating coarse foods last; (B) eating a wet dessert last; (C) eating cake or cookies; (D) eating molasses.

_____ 5. A good diet to aid in caries control should include (A) salad dressings; (B) ice cream; (C) honey; (D) fresh fruits.

_____ 6. A good substitute for sugar is (A) honey; (B) molasses; (C) syrup; (D) saccharine.

Assignment
Sheet No. 9

Covering
Units 62-69

ORAL HYGIENE AND ORTHODONTICS

A beautiful smile is an immeasurable asset to the personality of an individual. The smile is impaired by anything less than a healthy and well-aligned set of teeth. Oral hygiene is the science that deals with the preservation of the health of the hard and soft tissues of the mouth. Orthodontics is the science which has for its object the prevention and correction of malocclusion of the teeth.

The education of the public in this phase of preventive dentistry is the responsibility of the dental assistant as well as the dentist and dental hygienist.

In this unit you will have the opportunity to obtain the information necessary for fulfilling your obligation to inform the public of good dental health.

Assignment:

1. Read the reference listed below.
2. Answer the questions below and turn in this assignment by _____.
3. Prepare a schematic drawing of one tooth and identify the parts and the supporting tissue.

Reference:

A. Schwarzrock, Effective Dental Assisting, pp. 246-263, 521.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Teaching of good oral hygiene is a responsibility of the dental office.

T F 2. Most dental offices are doing an adequate job of teaching dental hygiene.

T F 3. Adults who have been taught proper dental hygiene in school do not have further need for training.

T F 4. You should be able to teach the dental patient the proper method of home care of the teeth.

T F 5. There is some disagreement among dentists as to the proper method of brushing teeth.

T F 6. Mucous glands are present in the lining of the mouth.

T F 7. Smoking is a frequent cause of tooth stain.

T F 8. Stains are commonly removed from teeth by use of chemicals.

T F 9. Oil of peppermint is used in the mixing of flour of pumice and whiting to make the mixture stick together.

T F 10. Flour of pumice is a common ingredient of most commercial dentifrices.

T F 11. For all practical purposes one dentifrice is as good as another.

T F 12. The main reason for brushing the teeth is for the removal of food deposits before calculus begins to form.

T F 13. Tooth brushes made from natural bristles are considered to be better for cleaning than those made from nylon.

T F 14. One of the great advantages of natural bristles is their longer service life.

T F 15. A definite tooth brushing routine should be established in order to insure thoroughness.

T F 16. Teeth should be brushed with a back and forth motion of the tooth brush on the gum line.

T F 17. Care is necessary in the brushing operation not to pierce or injure the gums with the bristles of the toothbrush.

T F 18. The direction of applied pressure is the same when brushing the lower teeth as in brushing the upper teeth.

T F 19. Gum tissues should be stimulated to prevent blood from stagnating in the capillaries.

T F 20. Orthodontics is that science which has for its major objective the treatment of children's teeth.

T F 21. The only purpose of the orthodontist is to improve the appearance of the patient.

T F 22. The dental arch is the horeshoe-shaped curve made by the bony projection, gums and teeth of either the upper or lower jaw.

T F 23. The arch is the same as the dental arch.

T F 24. Rubber bands are frequently used to align the upper and lower teeth.

T F 25. There is no accurate way for the orthodontist to check progress on his patient.

T F 26. It is not unusual for orthodontic treatment to extend over a period of two years.

T F 27. Retainers come in standard sizes and shapes.

T F 28. The dental assistant who works for an orthodontist may need to know how to solder and spot-weld.

T F 29. More secretarial work is usually required for the orthodontist than for the general practitioner.

T F 30. When trimming casts, the art portion should be trimmed parallel to the occlusal plane.

T F 31. Orthodontic work includes some soldering.

T F 32. Methods of radiographic cephalometry are used in orthodontic offices.

T F 33. Orthodontic work involves the keeping of very detailed records.

T F 34. Orthodontic adjustments involve a large number of short adjustment appointments.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The _____ _____ should accept the responsibility of teaching the patient proper home care of the teeth.

2. _____ is a precipitate of saliva.

3. The gelatin-like layer which forms on the surface of the teeth in protected areas is called the _____ _____.

4. Salivary calculus is formed by the depositing of various _____ on the gelatinous matrix of the _____ _____.

5. The white deposit on the neck of teeth near the gum line is _____ _____.

6. A thorough _____ _____ is the best protection against discoloration from smoking.

7. The operation by which hard and soft accretions and stains are removed from teeth is a _____ _____.

8. Pumice when combined with a _____ _____ can be used as an _____.

9. _____ is combined with whiting or flour of pumice in preparing them for prophylaxis use.

10. The retention of the bacterial plaques on the teeth for a prolonged period of time will cause the formation of _____.

11. The length of time and the thoroughness with which the teeth are brushed is more important to the control of dental caries than the _____ used.

12. Nylon filaments of toothbrush quality were introduced in _____.

13. Three factors which have limited the use of natural bristles in toothbrush manufacture are _____, _____, and _____.

14. The recognized interdental brushing method suggested in the reference is called a modified _____ - _____ method.

15. The word _____ means poor positioning of the teeth.

16. Orthodontic treatment seeks to improve the _____ of the mouth and also restore _____ _____ of the complete mouth.

17. A dental assistant in the specialty of orthodontia should memorize the _____ classification of malocclusions.

18. The part of the orthodontic appliance which is cemented to the tooth is called a _____.

19. The part of the orthodontic appliance called the _____ appears to be a wire which follows the shape of the dental arch.

20. Three methods by which the orthodontist can study the progress of a patient is by use of _____ _____, _____ and _____ photography.

21. At the conclusion of active treatment, a _____ is normally worn for an indefinite period of time to hold the teeth in the proper position.

22. A study model consists of two parts, the _____ portion and the _____ portion.

23. The dental specialty which deals with the prevention and correction of irregularities of the teeth is called _____.

24. The most commonly used impression material in orthodontic work is _____.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Three factors of good dental hygiene include:

   (A) _____

   (B) _____

   (C) _____

2. Tools and materials commonly used in performing a dental prophylaxis are:

   (A) _____ (C) _____

   (B) _____

3. The glands which produce the saliva in the mouth are:

   (A) _____ (B) _____ (C) _____

4. The proper procedure for brushing teeth as established by the modified Charters-Stillman method is:

   (A) _____ (D) _____

   (B) _____ (E) _____

   (C) _____ (F) _____

5. In addition to improving the appearance of the patient, orthodonic treatment includes changing the original relationship of:

   (A) _____

   (B) _____

   (C) _____

   _____

Assignment
Sheet No. 10

Covering
Units 70-72

STERILIZATION AND CARE OF DENTAL INSTRUMENTS

Sterilization refers to the process of removing or destroying all microorganisms. Sterilization is essential to the protection of the patient, since the dentist works continually in an area where bacteria thrive; namely, in the warm, moist human mouth.

As the dental assistant you will be expected to sterilize as well as to care for the dental instruments.

In this unit you will have an opportunity to learn the proper technique for sterilizing and care of various dental instruments.

Assignment:

1. Read the references listed below.
2. Answer the questions below and turn in this assignment by _____.
3. Prepare a written report on the subject - "Sterilization Techniques Used in My Employer's Practice."

Reference:

A. Schwarzrock, Effective Dental Assisting, pp. 219-231, 270-280.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". It if is false, draw a circle around the letter "F".

T F 1. The responsibility of the dental assistant for proper sterilization of instruments is limited to her employer.

T F 2. If dental instruments are cared for with a high degree of cleanliness, they will be sterile.

T F 3. An inexperienced person may easily confuse cleanliness with sterility.

T F 4. Once an instrument has been sterilized, it is not difficult to keep it sterile.

T F 5. Some microorganisms are destroyed more easily by one method of sterilization than by another.

T F 6. The tray in which sterile instruments are to be placed should be covered with linen, paper towel, or light-weight muslin.

T F 7. The Castle Speed Clave should be set at 250 degrees Fahrenheit for 13 minutes for sterilizing instruments.

T F 8. A germicide can be used effectively for the sterilization of instruments.

T F 9. All types of instruments can be sterilized together.

T F 10. Steam under pressure is hotter than steam in open air.

T F 11. The Diach Control pellet is used to absorb the excess moisture in the autoclave.

T F 12. Dry heat sterilization is preferred for sterilizing cutting instruments.

T F 13. Higher temperatures are required for sterilizing with dry heat than by autoclaving.

T F 14. Dry heat sterilization is quicker than autoclaving.

T F 15. Aluminum foil can be used successfully for wrapping instruments for sterilization.

T F 16. When sterilizing by the boiling water method, the instruments should be placed on a rack one-half inch above the water.

T F 17. Instruments cannot be sterilized by use of boiling water alone.

T F 18. Time required for hot oil sterilization of instruments should begin when the sterilizer is turned on.

T F 19. Chemical solutions are used for disinfecting rather than for sterilizing.

T F 20. The syringe, if suspended for storage in alcohol, should be wiped with sterile gauze before use.

T F 21. The greatest objection to the use of Ethyl alcohol as a germicide is the fact that it is intoxicating.

T F 22. If instruments are to be sterilized, they do not need to be washed.

T F 23. Blood will stain instruments if it is allowed to harden.

T F 24. Chemical solutions used for sterilization will deteriorate over a prolonged period of use.

T F 25. Instruments boiled in water will not rust.

T F 26. Instruments should be handled with forceps when being removed from the sterilizer tray.

T F 27. Mirrors can be sterilized in an autoclave.

T F 28. A local anesthetic is administered with a syringe.

T F 29. The fluid to be administered with a barrel syringe is obtained in cartridges.

T F 30. The movable plug in an anesthetic cartridge faces the needle when inserted in the syringe.

T F 31. A dull needle should be replaced with a new one after the syringe is autoclaved.

T F 32. A piece of sterilized cotton should be placed over syringe needles before they are autoclaved.

T F 33. Carbide dental burs have some special mark to distinguish them from steel burs.

T F 34. Shanks on dental burs are standardized and can be used interchangeably in different types of handpieces.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. _____ is the removal or destruction of all forms of life.

2. Growth of bacteria can be stopped or inhibited by the use of a(an) _____.

3. Proper sterilization temperatures can be checked by use of a(an) _____ _____ pellet.

4. Temperatures recommended for dry heat sterilizers range from _____ to _____ degrees centigrade.

5. The original purpose of oil sterilization was to avoid _____ of cutting edges, and to provide for _____ of the dental handpiece.

6. Items sterilized in molten metal sterilizers should be immersed approximately _____ seconds immediately before use in the mouth.

7. Formaldehyde preparations are objectionable as disinfectants because they are _____ and _____.

8. The ____-_____ quality of quaternary ammonium compounds makes them more acceptable for disinfecting.

9. Before sterilizing, hand instruments should be brushed with _____ and _____ and thoroughly rinsed.

10. Most offices disinfect instruments with cutting edges in a _____ sterilizer.

11. The sterilizer replacing the water sterilizer is the _____.

12. Cutting instruments to be sterilized in an autoclave should have their cutting edges protected with an _____ _____ coating.

13. Anesthetic syringes should be sterilized in the autoclave for _____ minutes.

14. Items sterilized in molten metal sterilizers should be immersed approximately ten _____.

15. Instruments should be removed from the sterilizer by gripping them with sterile _____.

16. Instruments removed from the sterilizer should be dried with _____ towels.

17. Rubber goods are kept new looking by wiping them with gauze moistened with _____.

18. The hollow passage extending the length of a syringe needle is called the _____.

19. Syringe storage jars should be filled with 70 per cent solution of _____.

20. The syringe needle can be checked for sharpness by drawing it backward over a piece of _____.

21. Before a syringe needle is used, excess alcohol is removed by wiping the needle with _____ gauze.

22. After use all dental burs should be cleaned by brushing with a _____ _____.

23. Syringes should be autoclaved for _____ minutes.

24. Long-shanked dental burs are designed for use in the _____ _____.

25. Sterilization is necessary for the protection of the _____ because bacteria thrive in the moist _____ _____.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. The preferred method of sterilization is (A) dry heat; (B) boiling water; (C) autoclave; (D) hot oil.

_____ 2. Proper sterilization temperature of the autoclave should be checked (A) daily; (B) weekly; (C) monthly; (D) with each use.

_____ 3. Instruments sterilized in a water sterilizer must be boiled for a minimum of (A) 5; (B) 10; (C) 15; (D) 20 minutes.

_____ 4. Materials used in root canal treatment are sterilized in (A) dry heat; (B) oil; (C) water; (D) molten metal sterilizers.

_____ 5. Autoclave loads not containing syringes must be processed for (A) 5; (B) 10; (C) 15; (D) 20 minutes.

_____ 6. Miscellaneous items in the operating room which are touched in the course of treating the patient should be wiped with a cloth moistened with (A) alcohol; (B) benzene; (C) turpentine; (D) soap and water.

_____ 7. The gage number of syringe needles indicates (A) hole diameter; (B) outside diameter; (C) needle length; (D) lumen diameter.

_____ 8. Sterilized syringes are stored in a (an) (A) autoclave; (B) water sterilizer; (C) oil sterilizer; (D) syringe jar.

Assignment Sheet No. 11

Covering Units 73-74

DRUGS, ANESTHESIA, FIRST AID AND EMERGENCY CARE

Much of the preliminary preparation of the patient for treatment is handled by the dental assistant while the dentist is busy with another patient or is working in the laboratory. Since procedures will differ for various treatments, and since dentists will have their own preferences, this part of your training will be received on the job.

To do this job effectively, however, you will need to possess a knowledge of the various drugs and anesthesia used in the office. Your knowledge should include the proper dosage; the precautionary measures to be taken; the expected reaction to the dosage; and emergency care to be applied in the event it is necessary.

This unit will serve to acquaint you with the above information in order that you may be able to respond effectively if and when a situation occurs.

Assignment:

1. Read the reference listed below.
2. Answer the questions below and turn in this assignment by _____.
3. Prepare a list of drugs and anesthesia used by your employer. Outline as follows: proper dosage, precautionary measures, expected reactions and emergency care.

Reference:

A. Schwarzrock, Effective Dental Assisting, pp. 240-245, 263-270.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. A drug is a medicine.

T F 2. Some drugs may be poisonous if used in an excessive quantity.

T F 3. You will frequently prescribe drugs for use by your patients.

T F 4. Patients are sometimes instructed to take a drug at home before a future appointment.

T F 5. Medication to be taken at home, should be accompanied by oral instruction for administering.

T F 6. Tablets taken internally should not be touched with the hand.

T F 7. Most drugs are easy to identify and do not need to be labeled.

T F 8. The patient can be expected to be in a good humor when entering the dental office.

T F 9. Unfavorable reaction of every patient to medication should be anticipated by the dental assistant.

T F 10. Syncope can be brought on by fear or pain.

T F 11. If a patient faints, cold applications to the face assist in reviving him.

T F 12. One sign of a reaction to procaine is bleeding from the nose.

T F 13. If a patient has an unfavorable reaction to procaine, artificial respiration and oxygen are necessary.

T F 14. Hypertension is most commonly found in patients under thirty years of age.

T F 15. Arteriosclerosis is one cause of hypertension.

T F 16. Hemostatic agents induce clot formation.

T F 17. If a patient develops epistaxis, the assistant should call a medical doctor immediately.

T F 18. If a patient has convulsions following the use of a local anesthetic agent, an intravenous administration of pentothal sodium should be given immediately.

T F 19. An overgrowth of the soft tissues of the mouth indicates the patient may have an epileptic history.

T F 20. If a person goes into convulsions, some type of mouth prop must be used to prevent damage to the tongue and lips.

T F 21. Pain is a Greek word meaning penalty.

T F 22. An anesthetic is an agent capable of producing no feeling.

T F 23. Nitrous oxide was discovered as an anesthetic agent by Joseph Priestley in 1772.

T F 24. Nitrous oxide when used with oxygen to produce anesthesia is administered by use of a syringe.

T F 25. The use of chloroform as a general anesthesia is more popular in Europe than in this country.

T F 26. Analgesia is a word which means the same as anesthesia.

T F 27. When the patient begins to pass from analgesia to anesthesia, the assistant must reduce the amount of gas.

T F 28. As a dental assistant, you will never be required to give general anesthesia.

T F 29. Nerves are the means by which communication is maintained between the sense organ and the central nervous system.

T F 30. Messages which the nerves transmit are actually tiny electrical impulses.

T F 31. In general anesthesia the brain and spinal cord are rendered incapable of receiving and transmitting all messages.

T F 32. The local anesthetic does not affect the central nervous system.

T F 33. Novocaine is a frequently used local anesthetic agent.

T F 34. Topical anesthetics are frequently used to take the place of locals.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The science which deals with the nature and properties of drugs is called _____.

2. A good rule to follow when working with drug dosage is - "be _____, do not _____."

3. The book - "_____ _____ _____," by the American Dental Association is a popular reference on pharmacology as it relates to the practice of dentistry.

4. Medication should be handed to the patient in a _____ _____ _____.

5. If a patient becomes pale and his pupils become dilated, the assistant should place the patient's _____ down between his _____.

6. An unfavorable reaction to epinephrine is indicated by a _____ _____.

7. If procaine and epinephrine are used together and an unfavorable reaction occurs from both, the patient's blood pressure will _____ and his pulse will be _____.

8. Before giving a hypertensive patient medication to reduce nervousness, consult the patient's _____.

9. If during surgery the patient bleeds considerably, he is said to have a _____.

10. The most reliable method of inducing a clot is _____ of the investing soft tissues in the area about the injured vessels.

11. Irregular, intermittent and variable muscular contractions involving large areas are referred to as _____.

12. If convulsions occur following the use of a local anesthetic agent, intravenous administration of _____ _____ should be given immediately.

13. If a child has a history of epileptic seizures, it is probable that he will have a _____ following the use of a local anesthetic agent.

14. _____ is a Greek word meaning no feeling.

15. The ingredients of a common mixture used to produce and maintain anesthesia are _____ _____ _____ and _____.

16. The Duke University Inhaler is used to produce analgesia by the use of _____.

17. A dental assistant must know how to _____ _____ equipment used for giving general anesthesia; however, she should never be expected to give _____ _____.

18. _____ anesthesia is the most common form of anesthesia for dentistry.

19. Nerves are connecting links between the _____ _____ and the _____ _____ _____.

20. A _____ is a chemical or drug which shrinks or constricts the blood vessel where the local anesthesia is placed.

21. Topical anesthetics may be obtained either in _____ or _____ form.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. The term, syncope, refers to (A) vomiting; (B) fainting; (C) a dental tool; (D) a cavity filling material.

_____ 2. If a patient faints, the assistant should let him inhale (A) spirits of ammonia; (B) alchohol; (C) ether; (D) hydrogen.

_____ 3. Increased blood pressure is called (A) an allergy; (B) sensitivity; (C) apprehension; (D) hypertension.

_____ 4. An agent used to limit hemorrhaging is (A) oxygen; (B) salve; (C) oxycel; (D) novocaine.

_____ 5. Epistaxis refers to (A) nose bleed; (B) fainting; (C) tremor; (D) pallor.

_____ 6. A gas commonly used for analgesia and general anesthesia is (A) laughing gas; (B) hydrogen; (C) nitrous oxide; (D) helium.

_____ 7. A drug used to produce general anesthesia by injecting it into a blood vessel in the arm is (A) novocaine; (B) propane; (C) trichlorethylene; (D) pentothal sodium.

_____ 8. When using a Duke University Inhaler, the flow of vapor is controlled by the (A) dentist; (B) absorbent wick; (C) patient; (D) assistant.

_____ 9. Nerves are best described as (A) network of small wires which transmit electrical current; (B) no one knows what they are; (C) long cords of whitish, translucent material; (D) invisible messengers between the sense organs and the central nervous system.

Assignment Sheet No. 12

Covering Units 75-94

ASSISTING IN THE OPERATING ROOM

One of the most common and most effective methods of tooth repair is that of filling teeth. A large percentage of our adult population boasts of one or more dental fillings. Many children have found it necessary to have fillings in their baby or deciduous teeth.

A large amount of the assistant's time will be spent assisting the dentist with tooth preparation. She should be able to talk intelligently with her dentist about teeth and the various types of fillings. Her knowledge of procedures should be thorough enough for her to anticipate the dentist's actions.

In this assignment you will have the opportunity to study the duties required of a dental assistant while assisting with the preparation of teeth.

Assignment:

1. Read the reference listed below.
2. Answer the questions below and turn in this assignment by _____.
3. Prepare a list of instruments and plan the procedure for each of the basic operation set-ups (consult your employer for the list of set-ups).

Reference:

A. Schwarzrock, Effective Dental Assisting, pp. 288-293; 434-453.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The assistant should be sympathetic toward the patient.

T F 2. The assistant should try to carry on a conversation with the patient while the dentist is busy operating.

T F 3. Instruments required for an operation should be placed on the bracket table before the operation starts.

T F 4. The assistant should keep all instruments used during an operation in order.

T F 5. Dentists try to follow the same sequence of steps for each type of operation.

T F 6. The assistant should know the sequence of instrument usage for each type of operation.

T F 7. The assistant should be alert to take from the dentist the instrument he has been using and hand him the next one he will need.

T F 8. The assistant should constantly watch for things causing the patient to be uncomfortable.

T F 9. It is especially important to be completely set up before starting dental preparations for young children.

T F 10. If a child indicates interest in a piece of dental equipment, the assistant should show him the various parts.

T F 11. The assistant should attempt to turn the interest of the child to things outside the dental office in order to de-emphasize the dental equipment.

T F 12. The presence of parents in the operatory tends to help children get along better while in the dental chair.

T F 13. It is a bad practice to leave a child alone in the dental chair.

T F 14. Rubber dams are tucked under the free gum margin into the gingival crevice.

T F 15. Dental chairs can be adjusted to make the patient more comfortable.

T F 16. The assistant should ask the patient to leave packages and purses in the waiting room.

T F 17. If a patient must remove his dental appliance, the assistan should dry it and place it on the bracket table.

T F 18. When returning an appliance to a patient, the assistant should let the patient pick it up.

T F 19. Patients seldom forget appliances that were removed for dental examination or work.

T F 20. When preparing the set-up for basic operative procedures, the assistant should see that air and water syringes are available.

T F 21. The mouth mirror, explorer, and cotton pliers are essential in a basic operative set-up.

T F 22. The saliva ejector is placed on the bracket table before the patient is seated.

T F 23. Dental mirrors are manufactured in assorted sizes.

T F 24. Explorers are manufactured as single-end and double-end instruments.

T F 25. The assistant does not place a bib on patients for non-operative purposes.

T F 26. If, during the pulp testing process, the full degree of current is applied without response in the tooth, the tooth is known to be alive.

T F 27. The pulp tester examines all the teeth in the mouth at one time.

T F 28. During an oral examination of new patients, the dentist records missing teeth and condition of the gums.

T F 29. If, during an oral examination, the assistant fails to get one notation written before the dentist gives another, she should try to remember it and go to the next notation.

T F 30. When a patient is in for a recall prophylaxis and examination, his last x-ray should be placed on the view box.

T F 31. The new patient examination procedure for children is the same as that for adults.

T F 32. Baby teeth should never be filled, since they are only temporary.

Completion

Directions: Fill in the blank(s) with the word(s) required to complete the sentence correctly.

1. If the assistant wishes to give a message to the dentist while he is working in the operating room, she should _____ him a _____.

2. The patient should be referred to and addressed by _____.

3. The assistant stands by the patient's _____ side.

4. During long operations the assistant can give the patient's jaws a rest by placing a _____ _____ between his teeth.

5. The most satisfactory way of keeping the field of operation dry is by the application of a _____ _____.

6. If the dentist indicates he wants to use a rubber dam, the assistant should cut a piece about _____ inches long.

7. The holes punched in a rubber dam are _____ to aid in slipping them over the teeth.

8. The rubber dam is held down to the most distal tooth with a rubber dam _____.

9. Rubber dam clamps are placed into position by a rubber dam _____ _____.

10. The left and right free ends of the rubber dam are held snugly in place by the rubber dam _____.

11. Rubber dams are made more comfortable by placing _____ _____ under the dam.

12. Pulp testing involves the application of a small _____ _____ to the tooth.

13. During the pulp testing process the assistant gradually increases the amount of _____ flowing through the tester.

14. The patient's clothing is protected by a _____.

15. Two types of dental mirror stems are _____ and _____ _____.

16. The two types of dental mirrors available are the _____ and _____.

17. During a recall oral examination, the only thing noted on the patient's record is the areas of new _____.

18. When preparing for a recall prophylaxis, _____ feet of floss tape are needed.

19. Prophylaxis paste is placed for use in a _____ dish.

20. If upon completion of a recall prophylaxis and examination dental work has been found necessary, the assistant should be certain the patient has an _____ for its completion.

21. Full upper and lower denture patients are recalled for examination once each _____.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. The shape a dentist cuts into a tooth into which filling material is placed is called a (A) cavity; (B) preparation; (C) depression; (D) incision.

_____ 2. Pulp testing gives information concerning (A) tooth vitality; (B) gum condition; (C) membrane condition; (D) condition of enamel.

_____ 3. As soon as a patient indicates he has felt a response from the pulp tester, the assistant should (A) turn the current to high; (B) turn the current to zero; (C) allow the current to remain steady; (D) unplug the tester.

_____ 4. A basic set-up for non-operative procedures includes (A) explorers; (B) copper bands; (C) gingival margin trimmers; (D) amalgam fillers.

_____ 5. When the dentist is ready to proceed with the oral examination, the assistant should stand to the (A) rear of the dentist; (B) rear of the patient; (C) to the left of the dentist; (D) left of the patient.

_____ 6. A recall prophylaxis and examination requires the assistant to lay out for use (A) face bows; (B) impression trays; (C) scalers; (D) hydrocolloid syringes.

_____ 7. For a toothbrushing demonstration, the assistant should provide (A) vulcanite burs; (B) a toothbrush; (C) prophylaxis handpiece; (D) bristle polishers.

~~Assignment~~
Sheet No. 13

Covering
Units 95-108

MATERIALS AND PROCEDURES FOR FILLING TEETH

After the dentist completes the tooth preparation some type of filling material must be prepared and inserted in the preparation. This, properly done, completes the restoration process.

The assistant is of much value to the dentist in the filling process because she can prepare the filling material and have everything ready to complete the process rapidly.

In this assignment you will have the opportunity to learn about filling materials, their preparation and use, and tooth filling procedures.

Assignment:

1. Read the reference listed below.
2. Answer the questions below and turn in this assignment by _____.

Reference:

A. Schwarzrock, Effective Dental Assisting, pp. 294-321; 454-465; 477-483.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The powder and liquid combined to make the zinc oxide-eugenol-thymol combination are poured together in a shallow bowl and stirred.

T F 2. More liquid is added to a zinc-phosphate cement to thicken it.

T F 3. Zinc-phosphate cement powder once removed from the original storage bottle should not be put back in the bottle.

T F 4. The liquid used in mixing zinc-phosphate cement absorbs water from the atmosphere if not kept tightly covered.

T F 5. The dentist must work rapidly when using zinc-oxide-eugenol cement because it hardens rapidly.

T F 6. Exposed pulps are capped with zinc-phosphate cement.

T F 7. Glass slabs and instruments used with zinc-oxide-eugenol should be cleaned immediately after they are used.

T F 8. Slabs and spatulas should not be washed with soap and water.

T F 9. Silver tooth fillings contain 65 per cent silver.

T F 10. Dentists customarily mix their own silver amalgam alloys.

T F 11. Wasted amalgam has reclaim value.

T F 12. Amalgam carvers and burnishers are used in the amalgam filling procedure.

T F 13. Synthetic porcelain is mixed by grinding it with a mortar and pestle.

T F 14. When each synthetic porcelain powder particle is wetted, the outside of the particle dissolves and the inside remains intact.

T F 15. The particles of synthetic porcelain powder are accurately graded in size.

T F 16. The glass slab used for mixing synthetic porcelain should be cooled to 32 degrees Fahrenheit.

T F 17. It is essential that the ingredients for mixing synthetic porcelain be carefully weighed before they are combined.

T F 18. Synthetic porcelain should not be mixed until the exact moment the dentist is ready.

T F 19. Synthetic porcelain fillings are finished immediately after being placed in the preparation.

T F 20. When acrylic fillings are placed using the pressure method, the mix is completed on a slab.

T F 21. Moistened felt discs are used for finishing acrylic fillings.

T F 22. A rubber dam is used during the gold foil filling procedure.

T F 23. The dental assistant can be of little assistance during a gold foil filling operation.

T F 24. Non-cohesive gold foil requires annealing before it is placed in the preparation for condensing.

T F 25. Zinc-oxide-eugenol cement is used as a part of an operative procedure.

T F 26. Materials used in dentistry for filling teeth are relatively few.

T F 27. Ward's Wonderpack is a commercial preparation of zinc-oxide-eugenol cement.

T F 28. It is permissible to add water to Ward's Wonderpack to accelerate and assure uniform setting.

T F 29. Zinc-phosphate cement is available commercially in powder form only.

T F 30. The total elapsed mixing time for zinc-phosphate cement is approximately two and one-half minutes.

T F 31. The process called amalgamation is a chemical and physical reaction between any metal and mercury.

T F 32. The crushing strength of an amalgam is referred to as its tensile strength.

T F 33. When mercury is added to a silver alloy, a new alloy is created.

T F 34. The expansion of an amalgam filling can be influenced by the care exercised in preparing the mixture.

T F 35. Overmixing of silver amalgam will retard the setting.

T F 36. High crushing strength of a silver amalgam is vital for the long service life of a filling.

T F 37. Silver amalgams do not require polishing.

T F 38. It is possible to form gold into a sheet thinner than the diameter of a human hair.

T F 39. Gold is sold by the sheet.

T F 40. A sheet of gold foil is called a gold leaf.

T F 41. Gold can be cold welded directly in a tooth which has been prepared to receive the restoration.

T F 42. Annealed gold foil is inherently cohesive.

T F 43. Exposure to air can cause gold foil to be impure.

T F 44. Spirits of ammonia placed in a small open jar near gold will prevent it from becoming impure.

T F 45. Underannealing will destroy the value of a piece of gold for further use.

T F 46. Alcohol is preferred as a fuel for annealing gold foil by the piece method.

T F 47. After a piece of gold foil is annealed by piece method, it should be placed in an air tight box.

T F 48. Electric annealers are commonly used for bulk annealing.

T F 49. Annealed gold foil should be kept warm after it is annealed until the dentist is finished with the restoration.

T F 50. Gold foil which remains after restoration is completed should be left in the annealer for the next restoration.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The glass slab used for the preparation of synthetic porcelain cements should be cooled to between _____ and _____ degrees Fahrenheit.

2. The base used under fillings, for cementing inlays, crowns, bridges and jacket crowns is _____ - _____ cement.

3. The consistency of zinc-phosphate cement used as a base is like _____.

4. The setting time for zinc-phosphate cement can be hastened by _____ _____ of the mix.

5. The liquid used in zinc-oxice-eugenol cement contains 98 per cent _____ and 2 per cent _____.

6. A zinc-oxide-eugenol cement mix requires _____ times as much powder as liquid.

7. The rate of setting of zinc-oxide-eugenol cement can be speeded up by adding _____ _____ crystals.

8. The glass slab used for mixing zinc-oxide-eugenol cement should be cleaned by wiping it with _____ and then washing it with soap and water.

9. Zinc-oxide-eugenol cement is sometimes used as a _____ treatment.

10. Silver amalgam alloy contains a minimum of _____ per cent tin.

11. The metal that is used as a deoxidizing agent and to help overcome melting and alloying problems in the silver amalgam is _____.

12. Silver alloy particles are mixed with _____ to make an amalgam alloy filling.

13. The ingredients of silver amalgam are mixed by an electric machine called an _____.

14. After silver amalgam has been triturated, the excess _____ is removed.

15. When the dentist works the amalgam into the preparation, he is _____ the amalgam.

16. The final polish is put on an amalgam restoration using half and half dry _____ _____ and _____.

17. Amalgam restorations are coarse polished using _____ paste as the abrasive.

18. Most synthetic porcelain mixes should be spatulated for _____ minutes.

19. The liquid and powder of a synthetic porcelain mix is spatulated with a rapid _____ motion.

20. Immediately after using with synthetic porcelain, the glass slab and spatula should be cleaned with _____ _____.

21. The most commonly used gold foil is _____ gold foil.

22. Silver amalgam is used almost exclusively as a filling material for the _____ teeth.

23. Silver amalgam is easy to use and requires _____ _____ of both the dentist and the patient.

24. _____ is an important variable in amalgam fillings which must be controlled.

25. The setting time of an amalgam is determined by the _____ _____, _____ _____, _____ _____ _____, and _____.

26. Crushing strength of an amalgam restoration is affected by _____ _____, amount of _____ _____, and the technique used in _____ and _____.

27. Gold foil restorations are made with the use of gold in its _____ _____.

28. Annealing is a cleansing operation and is necessary in order to make gold _____.

29. _____ gases cannot be driven off by the process of annealing.

30. _____ and _____ are essential factors in the proper annealing of gold.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. The consistency of zinc-phosphate cement used for bases differs from that for cementing crowns in that the base cement must be (A) thinner; (B) heavier; (C) lighter; (D) darker.

_____ 2. Properly mixed zinc-oxide-eugenol cement is the consistency of (A) molasses; (B) cream; (C) varies with use; (D) water.

_____ 3. Tin is added to a silver alloy to (A) increase strength; (B) replace zinc; (C) speed up setting; (D) reduce expansion.

_____ 4. A mortar and pestle is used for (A) triturating alloy and mercury; (B) measuring mercury; (C) measuring alloy; (D) weighing alloy and mercury.

_____ 5. The length of time that must lapse between the installation and the finishing and polishing of an amalgam filling is (A) 30 minutes; (B) six hours; (C) 24 hours; (D) three days.

_____ 6. The first number toward the operative and of dental cutting instruments indicates the (A) width of the blade; (B) length of the blade; (C) angle of the blade; (D) grade of steel.

_____ 7. The purpose for spatulating synthetic porcelain powder and liquid is to (A) grind the powder finer; (B) beat the liquid into the powder; (C) wet the surface of each particle of powder; (D) crush the powder into the liquid.

_____ 8. If a spatulated synthetic porcelain mix has a high glossy sheen, the mix is (A) too dry; (B) just right; (C) under spatulated; (D) too thin.

_____ 9. The entire spatulation process for mixing synthetic porcelain should be completed within (A) 30 seconds; (B) 60 seconds; (C) two minutes; (D) five minutes.

_____ 10. Before a shade guide is used it should be (A) polished; (B) moistened; (C) dried; (D) dulled.

_____ 11. Acrylic filling materials placed using the pressure method are placed into the preparation with a (A) sable brush; (B) Texton trimmer; (C) spatula; (D) Stellite instrument.

Assignment Sheet No. 14

Covering Units 109-118

ASSISTING WITH INLAYS, CROWNS, BRIDGES AND JACKET CROWNS

The preparation of inlays, crowns, bridges, and jacket crowns involves much skill on the part of the dentist. The work of fitting these restorations is a tedious, delicate, and time-consuming job. A well-trained dental assistant can be of invaluable assistance in preparing and placing these devices.

In this assignment you will have the opportunity to study the duties required of a dental assistant when working with inlays, crowns, bridges and jacket crowns.

Assignment:

1. Read the reference listed below.
2. Answer the questions below and turn in this assignment by _____.

Reference:

A. Schwarzrock, Effective Dental Assisting, pp. 466-476; 499-505; 511-513.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. To prepare for children's steel crown procedure, the assistant should prepare the basic set-up for operative procedures.

T F 2. Cases prepared for children's steel crown procedure involving deep decay require that adrenalin be made available.

T F 3. Children's steel crowns are set the next day after the preparation is made.

T F 4. If the children's steel crown procedure involves treatment of the pulp, the dentist needs especially close assisting in the treatment process.

T F 5. As a part of the gold inlay procedure, the assistant should light the gas burner at the bracket table.

T F 6. Cast gold inlays are set during the same appointment at which the wax pattern is made.

T F 7. Full gold crowns require subsequent appointments but three-fourth crowns can be completed in the appointment.

T F 8. Elastic silicone impression material will not shrink if left exposed to air.

T F 9. Full gold crowns are not set during the same appointment that the wax pattern is made.

T F 10. Copper bands used in full gold crown placement are available in annealed and unannealed form.

T F 11. Copper bands are not used in jacket crown placement.

T F 12. Shade guides are used in jacket crown procedure.

T F 13. When making a jacket crown, generally a drawing of the tooth crown with a distribution of the various shades over the various parts of the tooth is made.

T F 14. Bridges may be supported entirely on jacket-crowns.

T F 15. Impression material must be readied by the assistant for bridgework procedures.

T F 16. Upper and lower bridges have the same type of pontics.

T F 17. Lower posterior pontics frequently have a space left between the chewing surface and the ridge below.

T F 18. Hydrocolloid must be prepared before the scheduled appointment at which it is to be used.

T F 19. Both ends of the hydrocolloid tube should be opened before immersing it in water for boiling.

T F 20. The patient should begin the salt water rinse before the dentist prepares the mouth for the impression.

T F 21. The assistant should have the impression tray ready for insertion in the patient's mouth at the time that the dentist completes the application of hydrocolloid.

T F 22. The hydrocolloid must be in thinner form for partial denture than for a multiple inlay or bridge.

T F 23. When taking an impression of teeth prepared for bridge abutments, special appointments are recommended for each impression to be taken.

T F 24. There are more types of impression materials available for use in taking an impression of an individual tooth than for larger restorations.

T F 25. Copper bands are available in several sizes and in thicknesses of metal.

T F 26. The largest size copper band is designated by the number 1.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The tool used for making irregular shapes in metal is called _____ pliers.

2. Posterior temporary fillings used during the casting of a gold inlay are made of hard _____-_____.

3. Temporary fillings in anterior teeth prepared for gold inlay are made of crown-forms or _____-_____ and adhered with _____-_____-_____ paste.

4. When making ready for a bridgework procedure, the assistant should prepare the basic set-up for _____ procedures.

5. A bridge replacing one missing tooth is called a _____-_____ bridge.

6. A bridge replacing one missing tooth consists of two _____ and a _____.

7. Abutments in bridgework are placed upon the _____ teeth.

8. The length of a bridge consists of the number of _____ plus the number of _____.

9. The facing on upper posterior bridges is usually made of _____ or _____.

10. A pontic hung like a hammock between the abutment teeth is referred to as a _____ pontic.

11. One hydrocolloid impression requires _____ tubes of hydrocolloid.

12. The hydrocolloid material is prepared in a _____ _____.

13. Hydrocolloid tubes are prepared by boiling them in water for _____ to _____ minutes.

14. The final tempering of hydrocolloid material takes about _____ to _____ minutes.

15. A _____ or _____ cap or band may be substituted for the large tray when making individual tooth impressions for dies.

16. The lower edge of a copper band is trimmed to get the curvature of the tooth at the _____. when using the modeling compound method of taking tooth impressions.

17. If modeling compound is used to take an impression, it should be _____ after it is forced into the impression.

18. Rubber base impression materials can be removed from tools by wiping them with _____.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. Bridges may be supported entirely on (A) full crowns; (B) inlays; (C) matrix bands; (D) sprue bases.

_____ 2. An abutment in bridgework procedure is a (A) replacement for missing tooth; (B) support; (C) cap on the replacement tooth; (D) band divider.

_____ 3. A pontic in bridgework procedure is a (A) replacement for missing tooth; (B) cap on natural teeth; (C) support; (D) jacket crown.

_____ 4. When setting a gold inlay, the assistant should have ready for use a (A) sable brush; (B) trimmer; (C) leather-faced mallet; (D) gold file.

_____ 5. Impression trays for hydrocolloid impressions are cooled with (A) air; (B) alchohol; (C) water; (D) ether.

_____ 6. Hydrocolloid ready for use to make an impression can be stored in a (A) refrigerator; (B) conditioner; (C) vacuum bottle; (D) mason jar.

_____ 7. Dietrich's Impression Material should be prepared by (A) boiling; (B) freezing; (C) spatulating; (D) kneading.

Assignment
Sheet No. 15

Covering
Units 119-130

SURGERY

Some dentists perform only a minimum of surgical work, but most dentists remove teeth, make incisions, and do whatever surgical work is necessary for the relief of pain.

Similar principles are applied in all surgical operations. Since the mouth does not lend itself to actual sterilization, a most careful aseptic technique must be applied at all times. The dental assistant can be of much assistance in providing the dentist with the necessary sterile instruments, swabs, ligatures, and other materials. Some assistants can do a better job of getting the patient in the right frame of mind for surgery than can the dentist.

In this assignment you will have the opportunity to study the tools and techniques pertaining to dental surgery.

Assignment:

1. Read the reference listed below.
2. Answer the questions below and turn in this assignment by _____.

Reference:

A. Schwarzrock, Effective Dental Assisting, pp. 485-495.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle arond the letter "F."

T F 1. When preparing for periodontic procedures, the assistant should place a prophylactic at right angle with a rubber cup on the bracket table.

T F 2. Mouth mirrors should not be used during periodontic procedures.

T F 3. The purpose of periodontic procedure is to treat the mouth condition called pyorrhea.

T F 4. When a tooth is scaled, it is polished with a paste and rubber cup.

T F 5. If gum tissue must be cut away during treatment for pyorrhea, the dentist engages the assistance of a surgeon.

T F 6. It is important to explore the medical history of the patient prior to surgery.

T F 7. Pre-operative medication is valuable in reducing pain and bleeding during surgery.

T F 8. The proper positioning of the patient's body is important for dental surgery.

T F 9. Prior to dental surgery, the assistant should have the patient loosen tight clothing so the body can ventilate properly.

T F 10. The stomach should be empty if general anesthesia is being used in dental surgery.

T F 11. Accumulation of fluids and secretions in the lungs should be eliminated by medication and aspiration.

T F 12. Hemostats are used for handling suture needles.

T F 13. Before beginning surgery, the dentist and his assistant should scrub thoroughly.

T F 14. A dentist can maintain a truly sterile field in oral surgery.

T F 15. The assistant is of little help when the dentist sutures the wound in the mouth.

T F 16. Endodontic procedure for routine treatment involves apical surgery.

T F 17. The remarks and expression of the assistant during surgery have much to do with the calmness of the patient.

T F 18. After a tooth has been extracted, the drinking of hot liquids helps reduce bleeding.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Deep scaling during treatment for pyorrhea is accomplished with tools called _____ _____.

2. Heavy calculus is removed using _____ scalers.

3. If bite equillibration is to be accomplished, the assistant should have _____ paper and a _____ stone ready.

4. A mere common name for calculus of the teeth is _____.

5. The position advocated for surgery in the dental office is the _____ position.

6. If dental surgery is performed in a hospital, _____ position is used.

7. To insure adequate airway during surgery, the patient's _____ should be supported.

8. The suture used in dental surgery is sterile plain _____.

9. The kidney-shaped dish used during dental surgery is called an _____ _____.

10. During dental surgery, the patient's lips are coated lightly with _____.

11. Post-operative instructions should be given to the patient in _____.

12. The purpose of the endodontic procedure is to _____ a tooth.

13. The operating field for an apico-ectomy is painted with tincture of _____.

14. The principal washing agent when flushing root canals during an apico-ectomy procedure is a five per cent solution of _____ _____.

15. During an apico-ectomy the bacteria in the root canal are destroyed by sealing in _____ _____-_____- _____-_____.

16. An apico-ectomy procedure _____ the tooth as well as removes a portion of the _____ _____.

17. After a tooth extraction, the mouth should not be rinsed for _____ hours.

18. The rinse to use after a tooth extraction consists of ____-_____ teaspoon of _____ in a glass of tepid water.

19. Swelling following surgery can be reduced by applying _____ _____ outside the face.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The dappen dishes which should be on the bracket table when a patient is to be treated for pyorrhea are:

(A)_____ (C)_____

(B)_____

2. Among the materials the assistant gets ready for an endodontic procedure for routine treatment, she should place on a sterile towel the following:

(A) _____ (C) _____

(B) _____ (D) _____

3. The Bard-Parker sterilizer when used in an endodontic procedure for routine treatment should contain:

(A) _____ (C) _____

(B) _____ (D) _____

Assignment
Sheet No. 16

Covering
Units 131-140

DENTURES AND ORTHODONTIC DEVICES

Due to accidents, disease and age, people lose their teeth. The dentist, therefore, finds it necessary to reproduce a tooth, several teeth, or a complete set of teeth. This requires great accuracy and artistry because not only must the denture or partial denture fit perfectly and function properly, but it must not detract from the patient's appearance.

Many people have irregularities of the shape of the jaw and malocclusion of the teeth. These irregularities can be treated and corrected. This type of treatment, orthodontics, has become highly specialized and widely used.

The assistant must be prepared to assist the dentist in every possible way when he is building dentures or fitting orthodontic devices.

In this assignment you will have the opportunity to study the prodedures in denture construction and orthodontic corrections.

Assignment:

1. Read the reference listed below.
2. Answer the questions below and turn in this assignment by _____.

Reference:

A. Schwarzrock, Effective Dental Assisting, 280-288; 496-498; 509-510; 514-520.

Questions:

True-False

Directions: The following statement are either true or false. If the statement is true, draw a circle around the letter "T." If the letter is false, draw a circle around the letter "F."

T F 1. Alginate will set faster if it is mixed with water below 70 degrees.

T F 2. Alginate impressions should be poured as soon as possible.

T F 3. Impression compound is placed on gauze when prepared in the compound heater.

T F 4. After an impression has been taken and set, the cast should be poured immediately.

T F 5. Casts are removed from the impression material by immersing them both in cold water.

T F 6. Impression compound is removed from impression trays by softening it over an open flame.

T F 7. Impression trays are sterilized after they have been used.

T F 8. Some impression trays are made of metal that will melt over an open flame.

T F 9. Face bow transfer is used to discover the proper relationship of the patient's lower jaw to his upper jaw.

T F 10. The success of the articulation process rests upon how accurately the centers of rotation of the mandible are located.

T F 11. At the ends of the "U" on the face bow are located pointers.

T F 12. The centers of rotation of the temporo-mandibular joints can be located by using a hinge axis locator.

T F 13. When using a kinematic face bow, part of the device attaches to the lower arch of the patient.

T F 14. The bite fork of the transfer bow is imbedded in the upper trial denture when full dentures are being constructed.

T F 15. The purpose of the first sitting in the construction of full dentures is to make an alginate impression of the opposing denture.

T F 16. Zinc-oxide paste is used for alginate impressions.

T F 17. Teeth are set up in the trial dentures before the patient appears for his sixth sitting.

T F 18. It is important to have a member of the patient's family verify the appearance of the finished dentures.

T F 19. If operative work is required in the mouth to prepare room for occlusal rests, this work should be performed after the partial denture has been completed.

T F 20. During the fourth sitting, adjustments are made in the partial denture and they are placed in the patient's mouth.

T F 21. Recall control cards for patients with partial dentures are marked for recall once a year.

T F 22. Dentures must occasionally be re-fitted to the patient's mouth after they have been worn over a period of time.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Red boxing wax is used for building up _____ when using the alginate impression technique.

2. Before an impression is taken, the patient is asked to rinse his mouth with _____ _____.

3. If both upper and lower impressions are to be taken, the _____ is taken first.

4. After impressions are taken, they are rinsed in water and placed in the _____ solution.

5. After alginate impressions have been poured, they should be immersed in _____ _____.

6. The patient's name should be written on the cast with a (an) _____ _____.

7. Preparation of the impression compound should begin about _____ minutes before the time for the appointment.

8. The center of rotation of the _____ - _____ joints is the guide for face bow transfer.

9. The tool used to duplicate the movements of the mandible in relation to the maxilla is called the _____.

10. A kinematic face-bow is used to locate the _____ _____ _____ of the temporo-mandibular joints.

11. Zinc-oxide impressions are removed from the cast by immersing in _____ at _____ degrees for _____ minutes.

12. The patient should wear his finished dentures _____ to _____ days before the dentist makes his final check.

13. If one partial denture is to be constructed, the opposing model is poured in _____ _____.

14. In order to design the clasps on a partial denture, the study model is placed on a _____ instrument.

15. The desired shape and color of replacement teeth in a partial denture are selected during the _____ sitting.

16. Calculus that has collected on dentures due to use can be removed by soaking them in a _____ per cent solution of _____ _____.

17. The most important rule for the care of all articulators is to keep them _____.

18. All sliding or hinged parts on an articulator should be lightly _____ to keep them in good operating condition.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. An impression of one arch requires the use of (A) one; (B) two; (C) three; (D) four cakes of impression material.

_____ 2. Impression material is softened for use in a (A) freezer; (B) vacuum; (C) compound heater; (D) sterilizer.

_____ 3. After an impression has been taken, the compound is set by (A) drying it in an oven; (B) chilling it in water; (C) cooling at room temperature; (D) drying it in cloth.

_____ 4. After impression compound is removed from an impression tray, the tray is coated with (A) hydrocolloid; (B) water; (C) carding wax; IDO Vaseline.

_____ 5. Impression trays can be brightened after continual use by (A) sanding; (B) steelwool; (C) Lan-o-Sheen; (D) boiling.

_____ 6. Final impressions of the full denture area are made during the (A) first; (B) second; (C) third; (D) fourth sitting.

_____ 7. The third sitting in constructing full dentures involves (A) articulation; (B) making trial dentures; (C) securing final impressions; (D) inserting dentures in patient's mouth.

Assignment
Sheet No. 17

Covering
Units 141-151

IMPRESSIONS, MODELS, DENTURES AND CASTING

Many dentists make the impressions of the mouth and delegate much of the laboratory work to their assistants or have the modeling, denture construction, and casting work performed by highly skilled laboratory technicians. This is exacting work and requires a high degree of manipulative skill and finger dexterity. A great deal of the success of a prosthetic device depends upon the quality of the laboratory work.

The assistant should be able to perform basic laboratory jobs as well as talk intelligently with the dentist and laboratory technician about them.

In this assignment you will have the opportunity to learn about the materials used and the processes involved in making impressions, models, dentures, and castings.

Assignment:

1. Read the reference listed below.
2. Answer the questions below and turn in this assignment by _____.
3. Make a drawing of the biting surfaces of the upper and lower arches showing in relief the proper contours and occlusal carvings.

Reference:

A. Schwarzrock, Effective Dental Assisting, pp. 321-394.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Gold alloys used for castings are generally composed of gold, silver, copper and platinum.

T F 2. An alloy of gold, silver and copper is stronger than pure silver.

T F 3. Moisture will cause a container of plaster of Paris to harden.

T F 4. When mixing plaster of Paris, pour water into a bowl containing the dry powder.

T F 5. When spatulating plaster of Paris, you need not be concerned about the amount of time required.

T F 6. Quick-setting plaster of Paris is available in plain or flavored types.

T F 7. Casts made of artificial stone are softer and not as strong as plaster of Paris casts.

T F 8. Artificial stone is available in colors.

T F 9. The amount of water added to a dental stone will affect the strength of the final product.

T F 10. Artificial stone does not require vibrating.

T F 11. Boxing wax is joined by heating the meeting ends.

T F 12. Impressions taken in modeling compound do not distort during the boxing process.

T F 13. Boxing material on an upper impression is luted to the tray.

T F 14. A lower impression is easier to box than an upper impression.

T F 15. A boxed impression is placed on the vibrator when it is poured.

T F 16. Artificial stone, when poured into a vibrating boxed impression, will flow from the low areas to the higher areas of the impression.

T F 17. If it is not possible to box an impression, the impression must be destroyed and a new one made.

T F 18. Alginate impressions stick very tightly to their casts.

T F 19. If an impression for a full denture is made from zinc-oxide paste, no coating material is required over the paste to aid in separating it from the cast.

T F 20. Casts for partial dentures must be separated very carefully from the impression material in order to keep from fracturing the patient's tooth.

T F 21. The wax pattern of an inlay is the exact duplicate of the gold casting to be made.

T F 22. The material used to make a positive of an impression is the same as the amalgam filling used in restorations.

T F 23. Dies can be made of a special artificial stone.

T F 24. Inlay waxes are compounded to burn out of the mold leaving no residue harmful to the gold casting.

T F 25. An oil base lubricant applied to the die will facilitate the removal of the wax pattern and protect its surface.

T F 26. The investment ring should be lined with asbestos paper to cushion the unequal expansion of investment and ring.

T F 27. Before the investment ring is filled with investment material, the wax pattern is lubricated with water.

T F 28. The investment should be allowed to set for at least one-half hour before the ring is removed.

T F 29. Class "C" golds castings should be quenched in water immediately after casting.

T F 30. Class "B" golds are harder than Class "C" golds.

T F 31. In order to conserve time in pickling, it is common practice to plunge a hot casting into cold acid.

T F 32. After the casting is removed from the pickle, it should be rinsed in cold water to neutralize the acid.

T F 33. The main purpose of polishing a gold inlay is to produce a high glossy attractive outer surface.

T F 34. Gold expands when heated and shrinks when cooled.

T F 35. Successful inlay casting is dependent upon careful control of the expansion and contraction of the various materials.

T F 36. A thicker mix of investment and water should be used for vacuum investing than for investing without vacuum.

T F 37. The use of an asbestos liner can be eliminated successfully when investing with vacuum.

T F 38. The Barr investment unit mixes the investment material under vacuum.

T F 39. The sprueing of wax patterns for vacuum casting is the same for non-vacuum casting.

T F 40. Plaster of Paris and artificial stone are two materials commonly used for making dies.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. An impression of a patient's dental arch is the _____, in shape, of the patient's mouth.

2. When an impression is filled with a material, a model or _____ is formed.

3. Study models are made of _____ _____ _____.

4. The addition of salt to plaster of Paris will _____ its setting.

5. A plaster of Paris mix for a single arch impression requires about _____ cc of water.

6. As plaster of Paris is spatulated, care should be taken to work in as little _____ as possible.

7. Air bubbles are removed from plaster of Paris mix by _____ it on a machine called a _____.

8. The two types of plaster of Paris are _____ setting and _____ setting.

9. Artificial stone mix for the average single arch impression required _____ cc of water.

10. When mixing artificial stone the _____ is added to the _____.

11. Enclosing the impression and its tray with sides of wax strips is called _____ the impression.

12. Cast material is _____ into the impression to prevent the entrapment of air.

13. If a cast poured in an impression made of impression compound is left in the compound heater too long, the cast will _____ to the impression.

14. The machine used to trim casts is called a _____ _____.

15. The two types of denture models are _____ and _____ denture models.

16. Partial denture impressions are referred to as _____.

17. Working models of dentures are poured in _____ _____.

18. The limits of a full denture cast are dictated by _____ _____.

19. Wax bite rim material is supplied in _____ inch bars that are _____ inch square in cross section.

20. Wax bite rim material softens at about _____ degrees.

21. Flaming and wiping a wax surface makes it _____ and _____.

22. The two methods of preparing patterns for gold castings are the _____ and the _____ methods.

23. A positive of the inlay impression is called a _____.

24. As an inlay impression is filled with amalgam, the excess _____ should be removed as the condensing into the impression proceeds.

25. A material similar to synthetic porcelain used for inlay dies is _____.

26. Before a die is used to construct the wax pattern, it is given a coating of _____ by the _____ - _____ process.

27. Kerr's microfilm is used as a _____ _____ for removal of the wax pattern from the die.

28. The pattern should be carefully painted with the _____ _____ before it is placed in the ring.

29. The wax pattern is removed from the investment by _____ it out.

30. When melting a nugget of gold, it should be placed on the _____ of the _____ in order to insure complete melting.

31. The process of boiling the casting to remove surface oxides is called _____.

32. The fact that metals occupy _____ space in their solid state creates a problem in correctly sprueing a pattern.

33. Correct positioning and sprueing for centrifugal castings requires that the pattern be placed _____ inch from the bottom of the ring.

34. The word _____ is used to describe the cooling of metal in a mold.

35. Two dangers to guard against in mixing investment materials is excess _____ and entrapped _____.

36. The over-all procedure for making a gold casting of an inlay or crown by the indirect method includes taking an individual tooth _____, constructing an amalgam _____, shaping the _____ pattern, mounting it on a _____ _____, _____ the pattern, _____ _____ the mold, and pouring the molten _____ _____ in the mold.

37. Much hard work in finishing and polishing the wax pattern can be eliminated by paying particular attention to the _____ _____.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. The material used to make wax patterns for gold castings is (A) beeswax; (B) carnauba wax; (C) paraffin wax; (D) inlay wax.

_____ 2. Mixing bowls used for preparing plaster of Paris are made of rubber because (A) it is easier to spatulate; (B) dry materials are easier to remove; (C) less water is absorbed; (D) it is possible to knead mix.

_____ 3. Quick setting plaster of Paris sets up in (A) one to three; (B) three to five; (C) five to ten; (D) ten to fifteen minutes.

_____ 4. Artificial stone should be mixed to a consistency of (A) paste; (B) water; (C) cream; (D) molasses.

_____ 5. Impressions taken in impression plaster must be coated with (A) Vaseline; (B) hydrocolloid; (C) zinc-oxy-phosphate; (D) tincture of green soap.

_____ 6. After they are poured, impressions taken in alginate or hydrocolloid materials is generally (A) dried in an oven; (B) covered with cloth; (C) submersed in water; (D) air dried.

_____ 7. Casts poured in an impression of modeling compound are separated by (A) immersing in water; (B) prying apart; (C) placing in a compound heater; (D) placing in an oven.

_____ 8. Edentulous ridges are ridges (A) without teeth; (B) with partial teeth; (C) with a full set of teeth; (D) caused by pyorrhea.

_____ 9. Before a wax pattern is invested, it should be thoroughly cleaned with a mixture of (A) green soap and hydrogen peroxide; (B) alcohol; (C) naphtha; (D) ether.

_____ 10. Wax patterns are burned out of the investment at (A) 100 degrees for 30 minutes; (B) 500 degrees for one hour; (C) 1350 degrees for one-half hour; (D) 2000 degrees for two hours.

_____ 11. After a gold casting has been removed from the investment, it is pickled in (A) water; (B) hydrogen peroxide; (C) ammonia; (D) sulphuric acid.

Matching

Directions: Read statements listed alphabetically in the right hand column and rearrange in correct sequence by placing the letters from the right hand listing in the space provided adjacent to the numbers in the left hand column.

1. The procedure for waxing up a pattern as described in the reference can be reduced to the following operations:

1. _____	A. Build up to approximate shape
2. _____	B. Seat the die
3. _____	C. Establish contacts and occlusion
4. _____	D. Check margins and replace missing portions
5. _____	
6. _____	E. Remove surplus wax
7. _____	F. Melt inlay wax
8. _____	G. Replace in die
9. _____	H. Establish the occlusion
10. _____	I. Build up contacts
11. _____	J. Smooth and polish
12. _____	K. Complete carving
13. _____	L. Run into preparation
14. _____	M. Lubricate contact areas
15. _____	N. Lift die from articulated model
16. _____	O. Press against walls of die
17. _____	P. Soften wax pattern
18. _____	Q. Seat die in model
19. _____	R. Remove from die and check inner surface
	S. Create proper contours and occlusal carvings

Assignment
Sheet No. 18

Covering
Units 153-164

RADIOGRAPHY

Radiographic, or x-ray, equipment has become an essential part of practically all dental offices. Through the use of this equipment, a shadow picture can be produced of any area and its adjacent or associated parts. The dentist can then use these findings in diagnosing dental conditions not exposed to normal vision.

Most dentists expect their new assistants to assist them in dental radiology to a limited extent. In fact, in many dental offices, after a period of training, the assistant assumes complete responsibility with the exception of the exposure procedure and the final interpretations of the films.

In this assignment you will have the opportunity to study the methods, uses, and cautions to be observed in dental radiology.

Assignment:

1. Read the reference listed below.
2. Prepare a sketch of your employer's x-ray processing room, along with a list of the available equipment. Next, prepare a revised sketch of the room showing improvements in placing equipment along with a list of equipment you would add to improve the developing process.
3. Answer the questions below and turn in this assignment by _____.

Reference:

A. Schwarzrock, Effective Dental Assisting, pp. 395-433.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. X-rays are potentially dangerous to the dentist, his assistant, and the patient.

T F 2. Persons regularly exposed to x-ray radiation should be selected to hold the film in the patient's mouth when it is necessary.

T F 3. The intensity of x-ray radiation varies inversely as the square of the distance from the tube target.

T F 4. X-ray radiation output varies with changes in kilovoltage.

T F 5. Radiation produced by low kilovoltage x-rays is not capable of burning a patient.

T F 6. The effect of x-ray waves on living tissue is cumulative.

T F 7. If a patient has a record of easily sunburning, normal x-ray dosages should be considered very carefully before they are used.

T F 8. If the peak x-ray kilovoltage is decreased, then the exposure time must also be decreased.

T F 9. The central rays of the x-ray machine should be directed perpendicular to the surface of the x-ray film.

T F 10. The occlusal x-ray technic is used to expose diseases of the mouth to x-ray radiation.

T F 11. Before taking x-rays of a patient, the assistant should inquire as to when he was last exposed to x-ray or gamma ray radiation.

T F 12. When preparing a patient for x-rays, the assistant should position his head so that the plane of occlusion of the teeth to be visualized is perpendicular to the floor.

T F 13. The center of the x-ray film must be placed so that it is over the center of the region to be exposed.

T F 14. The occlusal edge of the x-ray packet should be parallel with the occlusal edge of the teeth.

T F 15. X-ray film may be bent in the mouth provided the bend occurs in the center of the region of interest.

T F 16. X-ray film must be bent to get a satisfactory exposure in the molar region.

T F 17. The tongue and muscles of the floor of the mouth should be relaxed in order to properly place x-ray films for the lower jaw.

T F 18. Changes in the apical structure are shown on an x-ray taken with the bitewing technic.

T F 19. X-ray film designed especially for use with the bitewing technic can be purchased.

T F 20. Bitewings in the anterior region are of little value.

T F 21. The extraoral technic requires film wrapped in lightproof paper.

T F 22. X-rays may be used as evidence and therefore must be accurately labeled so they can be readily identified.

T F 23. One method used to store the patient's x-rays is to file them in file drawers.

T F 24. X-rays that are no longer current are discarded.

T F 25. The x-ray developing tank originally holding the fixer solution should not be used for developer solution even if the tank has been scrubbed clean.

T F 26. X-ray fixer solution has a shorter life than the developer solution.

T F 27. The sequence in which films are placed in the mouth for bitewing x-rays varies with the areas to be exposed.

T F 28. X-ray packets are available that make it possible to take two identical x-rays with the one packet.

T F 29. X-ray film while wrapped in the packet should not be exposed to any kind of light.

T F 30. If the temperature of developing solutions rises above the safe limit, it should be cooled by placing ice in the solution.

T F 31. Fresh developing solutions increase the developing time required.

T F 32. Place film to be developed on the lowest clips of the film holder.

T F 33. The process of fixing an x-ray film must be timed to the exact second.

T F 34. When x-rays are mounted, they are placed in a logical sequence of occurrence.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The unit of measure for x-rays is called the _____.

2. One one-thousandth of a roentgen is called a _____.

3. The hazard of exposure to the operator of the x-ray unit can be eliminated by having the operator stay _____ the _____ of the x-ray.

4. The hazard from secondary radiation can be reduced to a permissible dose by standing at least _____ feet away from the patient's head.

5. If a patient receives an overdoes of x-ray, his skin becomes _____ and he will lose the _____ on the exposed part.

6. The x-ray dosage rate is expressed in _____ _____.

7. Soft radiation, produced by low kilovoltage x-rays, can be removed by using an _____ x-ray _____.

8. If a patient has been exposed to 1,200 milliampere seconds of x-ray radiation, no further roentgenographic examinations should be given for _____ weeks.

9. When the x-ray film is placed within the patient's mouth, it is called the _____ technic.

10. The technic for producing an x-ray which will visualize the crowns of the teeth only is called the _____ technic.

11. Occlusal films measure _____ inches by _____ inches.

12. When using the long target-film technic, the distance between the target and the film is increased to at least _____ inches.

13. Contrast and penetration for the long target-film technic is controlled by increasing or decreasing the _____ setting on the x-ray machine.

14. When using the long target-film technic, _____ speed film should be used.

15. The extraoral technic requires the use of an aluminum _____ instead of a film holder.

16. The standard periapical film size is _____ inches by _____ inches.

17. An x-ray packet contains an outer wrapper, black _____, _____ _____, _____, and another piece of black _____.

18. X-ray film is stored in a box lined with _____.

19. The developer and fixer compartments, when emptied, should be scrubbed with a brus' and a solution of _____.

20. When preparing for bitewing x-rays for patients over twelve years of age, the assistant should place _____ films on the bracket table.

21. When two films are used for small children, the first exposure is of the _____ side.

22. A full mouth x-ray requires _____ films.

23. Illumination in the dark room is provided by a _____light.

24. Film is held for developing in a device called a _____ _____.

25. The temperature of the developer solution is ascertained by keeping in the solution a floating _____.

26. The warmer the developing solution, the _____ the film is developed.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. The unit of measure for x-rays is designated by the symbol (A) x; (B) r; (C) xr; (D) nr.

_____ 2. The symbol mr represents (A) milioroentgens; (B) thousand-roentgens; (C) voltage; (D) amperes.

_____ 3. The maximum total roentgen dosage to which any part of the body shall be permitted to be exposed continuously in one week is (A) .003r; (B) .03r; (C) 0.3r; (D) 3.0r.

_____ 4. A safe x-ray dose for a patient in one sitting is (A) 200; (B) 1000; (C) 1200; (D) 12,000 milliampere seconds.

_____ 5. In dental x-ray work a bite block is used to (A) deflect radiation; (B) locate teeth to be pictured; (C) elongate the tooth shadow; (D) hold the x-ray film.

_____ 6. The x-ray technic designed for visualizing the coronal portion of the tooth is the (A) bitewing; (B) periapical; (C) occlusal; (D) extraoral technic.

_____ 7. When periapical x-ray films do not permit complete visualization of the region to be inspected roentgenographically, the dentist will use (A) long target; (B) bitewing; (C) anterior; (D) occlusal film.

_____ 8. X-ray developing tanks are made from (A) cast iron; (B) copper; (C) rubber; (D) aluminum.

_____ 9. The length of time the film should remain in the developing solution should be ascertained by (A) asking the dentist; (B) reading the label on the developer bottle; (C) looking in a textbook; (D) watching the films until they are developed.

_____ 10. Developing solutions should never exceed the temperature of (A) 32; (B) 59; (C) 78; (D) 212 degrees.

_____ 11. After the film has been in the developer the required length of time, it is (A) dipped in water; (B) dipped in ether; (C) dried; (D) exposed to ultra-violet light.

Information
Sheet No. 1

CARE AND MAINTENANCE OF THE VACUDENT UNIT

1. Shut off motor at every opportunity when not in use. As in all equipment containing motors, this mechanism is expendable, and the length of life can be extended when it is given a chance to rest and cool off.

2. Spray Vacudent germicidal solution into mouthpiece, with motor running, at the end of each day. By spraying sufficient quantities to moisten inside of hose, it will tend to eliminate bacterial growth in the filter bag and tank.

3. Flush with water through mouthpiece after every bloody operation.

4. Change filter bags once or twice a week. Do not operate the equipment without a filter bag in place, even though the gold and amalgam cuttings are not to be saved. The filter bag serves a dual purpose of separating the water from the air, as well as catching debris. Used filter bags can be stored in a quart fruit jar and sterilized to prevent breeding of bacteria. When a sufficient number of bags have been saved, they can be turned in to a gold refining company for reclaim.

5. Remove and clean filter tank once a week, using special wrench provided with the unit. When setting the filter tank back in the box, use a little Vaseline on the tube fittings. This makes them work easily and prevents leaking and wearing.

6. Check power unit container once a week for condensation of moisture. If moisture is present, wipe unit dry. Change paper filters every thirty days, or oftener if wet. No water should collect in the bottom of the power unit. This should be checked periodically by pulling out the motor.

7. After an unusually long operation, check the glass container at the bottom of the cabinet for moisture. Water in this container will cause the motor to stop operating. Remove and dry the container. Be sure to tighten container firmly when replacing it.

Check Points on Vacudent Unit

1. What to do if the switch refuses to stay on.

   This indicates water in the line and the need to empty the glass container at the bottom of the cabinet. Clean and dry out the container.

2. What to do if the suction seems weak and ineffective.

(A) Check cloth filter bag in filter tank at cabinet, as it may be full of debris and in need of changing.

(B) An obstruction in the hose itself or in the "L" at the top of the filter tank.

(C) A stuck valve will prevent suction at the mouthpiece as there will be a leakage coming in from the drain line.

(1) To remedy this; run through volumes of water, flushing the system out completely and thoroughly.

(D) A leaky air line.

(1) Check all air line connections

(E) Air leaking through at filter tank.

(1) Use Vaseline at all connecting points and fittings of filter tank. Intake hoses should be left open to help cool the motor.

This information was taken from publications of Densco Incorporated, Denver, Colorado.

TRAINING PLAN AND PROGRESS RECORD
for
DENTAL ASSISTANT

JOB TRAINING: What the worker should be able to do	Proficiency Shown	RELATED INFORMATION: What the worker should know
Reception Responsibilities		
Speak, walk, stand and dress properly, use telephone, greet patients, dismiss patients, present cases to patients Time in hours _____	☒	Acceptable greeting procedures, telephone courtesy, psychology of dealing with children, presenting cases
Care and Maintenance of Office and Equipment		
Clean and tidy office, clean and maintain dental equipment Time in hours _____	☒	Methods for cleaning various pieces of office and dental equipment
Clerical Duties		
Make appointments, handle mail, maintain records, send statements Time in hours _____	☒	Procedures for keeping appointment book, problems in mail handling, methods for keeping records, problems in collecting accounts
Basic Duties		
Ready patients' records, seat patient, arrange instruments, assist with prophylaxis, brush teeth Time in hours _____	☒	Procedure for chair adjustment method of sterilization of equipment, prophylaxis procedures
Caries and Anatomy		
Instruct patients in tooth care, identify anatomical terms Time in hours _____	☒	Causes of tooth decay, meaning of anatomical terms
Assist with Tooth Preparation and Restorations		
Assist in emergencies, assist with each step of preparation, prepare cements, prepare amalgam, porcelain, and acrylic restorations, assist with gold foil fillings Time in hours _____	☒	First aid procedures, acceptable conduct in the operating room, sequence of tool operations, procedure for inserting restorations

Inlays, Crowns, Bridges and Jacket Crowns

Assist with steel crowns, gold inlays, gold crowns, jacket crowns and bridgework, prepare hydro-colloid materials, make dies

Time in hours _____

Procedure for fitting and ~~setting~~ steel crowns, gold inlays, gold crown, jacket crowns and bridgework, set-up for hydrocolloid impressions, method for making dies

Surgery

Prepare patient, assist with suturing, devitalization apico-ectomy, tooth removal and treatment of oral disease

Time in hours _____

Use of anesthesia, procedure for surgery, devitalization, endodontic procedures, apico-ectomy and tooth removal

Dentures and Orthodontic Devices

Mix alginate, assist with taking impressions and articulation process, assist with denture construction and orthodontic appliance installation and adjustments

Time in hours _____

Procedure for taking impressions, care and use of articulators, process for denture construction and orthodontic procedures

Impressions, Models, Dentures and Castings

Mix plaster of Paris, artificial stone, pour models and casts, separate and trim models, make dies, pattern and cast gold inlays

Time in hours _____

Method of preparing plaster of Paris, artificial stone, procedure for pouring models, steps in making wax patterns

Radiography

Prepare patient, assist with taking radiograms, develop, fix, dry film

Time in hours _____

Procedure for adjusting x-ray machine, safe dosage rates, position of x-ray head, procedure for developing x-ray

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Code for employer's use in marking student's progress:

Performed some operations in area

Performed some operations with reasonable proficiency

Performed most operations in area

Performed most operations satisfactorily

TRAINING PLAN AND PROGRESS RECORD
for
DENTAL ASSISTANT

Employer's Copy

JOB TRAINING: What the worker should be able to do	Proficiency Shown	RELATED INFORMATION: What the worker should know
Reception Responsibilities		
Speak, walk, stand and dress properly, use telephone, greet patients, dismiss patients, present cases to patients Time in hours _____	☒	Acceptable greeting procedures, telephone courtesy, psychology of dealing with children, presenting cases
Care and Maintenance of Office and Equipment		
Clean and tidy office, clean and maintain dental equipment Time in hours _____	☒	Methods for cleaning various pieces of office and dental equipment
Clerical Duties		
Make appointments, handle mail, maintain records, send statements Time in hours _____	☒	Procedures for keeping appointment book, problems in mail handling, methods for keeping records, problems in collecting accounts
Basic Duties		
Ready patients' records, seat patient, arrange instruments, assist with prophylaxis, brush teeth Time in hours _____	☒	Procedure for chair adjustment method of sterilization of equipment, prophylaxis procedures
Caries and Anatomy		
Instruct patients in tooth care, identify anatomical terms Time in hours _____	☒	Causes of tooth decay, meaning of anatomical terms
Assist with Tooth Preparation and Restorations		
Assist in emergencies, assist with each step of preparation, prepare cements, prepare amalgam, porcelain, and acrylic restorations, assist with gold foil fillings Time in hours _____	☒	First aid procedures, acceptable conduct in the operating room, sequence of tool operations, procedure for inserting restorations

Inlays, Crowns, Bridges and Jacket Crowns

Assist with steel crowns, gold inlays, gold crowns, jacket crowns and bridgework, prepare hydro-colloid materials, make dies

Time in hours _____

Procedure for fitting and ~~setting~~ steel crowns, gold inlays, gold crown, jacket crowns and bridgework, set-up for hydrocolloid impressions, method for making dies

Surgery

Prepare patient, assist with suturing, devitalization apico-ectomy, tooth removal and treatment of oral disease

Time in hours _____

Use of anesthesia, procedure for surgery, devitalization, endodontic procedures, apico-ectomy and tooth removal

Dentures and Orthodontic Devices

Mix alginate, assist with taking impressions and articulation process, assist with denture construction and orthodontic appliance installation and adjustments

Time in hours _____

Procedure for taking impressions, care and use of articulators, process for denture construction and orthodontic procedures

Impressions, Models, Dentures and Castings

Mix plaster of Paris, artificial stone, pour models and casts, separate and trim models, make dies, pattern and cast gold inlays

Time in hours _____

Method of preparing plaster of Paris, artificial stone, procedure for pouring models, steps in making wax patterns

Radiography

Prepare patient, assist with taking radiograms, develop, fix, dry film

Time in hours _____

Procedure for adjusting x-ray machine, safe dosage rates, position of x-ray head, procedure for developing x-ray

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Code for employer's use in marking student's progress:

Performed some operations in area

Performed some operations with reasonable proficiency

Performed most operations in area

Performed most operations satisfactorily

TRAINING PLAN AND PROGRESS RECORD
for
DENTAL ASSISTANT

Student's Copy

JOB TRAINING: What the worker should be able to do	Proficiency Shown	RELATED INFORMATION: What the worker should know
Reception Responsibilities		
Speak, walk, stand and dress properly, use telephone, greet patients, dismiss patients, present cases to patients Time in hours _____	☒	Acceptable greeting procedures, telephone courtesy, psychology of dealing with children, presenting cases
Care and Maintenance of Office and Equipment		
Clean and tidy office, clean and maintain dental equipment Time in hours _____	☒	Methods for cleaning various pieces of office and dental equipment
Clerical Duties		
Make appointments, handle mail, maintain records, send statements Time in hours _____	☒	Procedures for keeping appointment book, problems in mail handling, methods for keeping records, problems in collecting accounts
Basic Duties		
Ready patients' records, seat patient, arrange instruments, assist with prophylaxis, brush teeth Time in hours _____	☒	Procedure for chair adjustment method of sterilization of equipment, prophylaxis procedures
Caries and Anatomy		
Instruct patients in tooth care, identify anatomical terms Time in hours _____	☒	Causes of tooth decay, meaning of anatomical terms
Assist with Tooth Preparation and Restorations		
Assist in emergencies, assist with each step of preparation, prepare cements, prepare amalgam, porcelain, and acrylic restorations, assist with gold foil fillings Time in hours _____	☒	First aid procedures, acceptable conduct in the operating room, sequence of tool operations, procedure for inserting restorations

Inlays, Crowns, Bridges and Jacket Crowns

Assist with steel crowns, gold inlays, gold crowns, jacket crowns and bridgework, prepare hydro-colloid materials, make dies

Time in hours _____

Procedure for fitting and ~~setting~~ steel crowns, gold inlays, gold crown, jacket crowns and bridgework, set-up for hydrocolloid impressions, method for making dies

Surgery

Prepare patient, assist with suturing, devitalization apico-ectomy, tooth removal and treatment of oral disease

Time in hours _____

Use of anesthesia, procedure for surgery, devitalization, endodontic procedures, apico-ectomy and tooth removal

Dentures and Orthodontic Devices

Mix alginate, assist with taking impressions and articulation process, assist with denture construction and orthodontic appliance installation and adjustments

Time in hours _____

Procedure for taking impressions, care and use of articulators, process for denture construction and orthodontic procedures

Impressions, Models, Dentures and Castings

Mix plaster of Paris, artificial stone, pour models and casts, separate and trim models, make dies, pattern and cast gold inlays

Time in hours _____

Method of preparing plaster of Paris, artificial stone, procedure for pouring models, steps in making wax patterns

Radiography

Prepare patient, assist with taking radiograms, develop, fix, dry film

Time in hours _____

Procedure for adjusting x-ray machine, safe dosage rates, position of x-ray head, procedure for developing x-ray

---

Code for employer's use in marking student's progress:

Performed some operations in area

Performed some operations with reasonable proficiency

Performed most operations in area

Performed most operations satisfactorily

State of New Jersey
Department of Education
Vocational Division

ED013439

MATHEMATICS 1 - NEEDLE TRADES

Prepared by
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Middlesex County Vocational and Technical High Schools
New Brunswick, New Jersey

Vocational Division - Curriculum Laboratory
New Brunswick, New Jersey

VT 02921

MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) Benjamin Shapiro (Agency) VocationalDiv.-Curriculum Laboratory

(Address) School of Education-Rutgers; 10 Seminary Pl, New Brunswick, N J

DATE: June 7, 1967

RE: (Author, Title, Publisher, Date) Antoinette J. Colicchio; MATHEMATICS 1 - NEEDLE TRADES; Vocational Division-Curriculum Laboratory; July 1960

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State of New Jersey
Department of Education
Vocational Division

NEEDLE TRADES MATHEMATICS - I

Prepared by
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JULY, 1960

INTRODUCTION

Skill in mathematics is as valuable to the needle trades worker as skill in handling the operations of the trade. The student who masters both enters the field with a double asset.

It is the purpose of this book to furnish the student with a basic knowledge of mathematics and to develop her skill in solving mathematical problems pertinent to the needle trades. Wherever it was possible, problem situations and terms common to the trade were used to familiarize the student with everyday practices in the field.

Fashion, after all, is a most important industry in America. The job opportunities are unlimited. Some of the highest paid feminine jobs are in Fashion, Merchandising, Promotion, and Advertising. Did you know that a buyer of piece goods can earn more than $15,000 a year? A competent student with a needle trades background and a workable knowledge of mathematics could climb into one of these desirable careers.

The major part of the industry, generally known as the needle trades, consists of three types of establishments: (1) the regular factories or manufacturers; (2) the apparel jobbers; (3) the contract factories or contractors. As it would be impossible to present to the student problems dealing with all the different types of concerns in the trade, most of the problems have been worked out from a manufacturer's viewpoint. The functions of the manufacturing company cover the widest scope, from the buying of raw materials, through designing and preparing samples and arranging for the manufacture of garments from their materials, to the selling of the finished apparel.

The atmosphere of the book is informal and informing, stressing always the application of practical mathematics rather than the formal and theoretical.

This book includes many types of lessons. Some are designed for class discussion and serve to provide a background in the special application to the needle trades field; others supply specific practice in the kind of written or mental computations needed; still others are specially designed to teach pupils how to select pertinent facts, how to judge whether a result is reasonable, or how to estimate. It would be well to encourage the student to preserve the complete set of solutions to the problems in a suitable notebook for future reference, as there is every probability that she will use some of them later on when she goes to work.

If the student makes a sincere effort to master the pretest and review lessons, she will find she can more easily grasp the new material. The mastery of this course will provide not only a practical background for her vocation, but for life preparation as well.

NEEDLE TRADES MATHEMATICS - I

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UNIT I - WHOLE NUMBERS

Pre-Test No. 1

OBJECTIVE: To recall the knowledge of whole numbers and to review working with whole numbers.

RELATED INFORMATION:

In this lesson you will have an opportunity to review the fundamental processes of working with whole numbers. After you have successfully completed this lesson, you will be ready to proceed with the mathematics planned especially for needle trades workers.

PROCEDURE:

1. Do all the work on paper furnished by the instructor. Do not write on this sheet.

2. Read the problem through very carefully.

3. See what facts are given.

4. See what the problem asks you to find.

5. Do not leave a problem until you are sure the answer is right. This is not a speed test.

6. Papers will be checked for legibility and neatness as well as accuracy.

I. Review of signs and terms. Indicate which of the following are true and which are false.

1. The sign ÷ is the sign of addition. _____

2. To add means to take away. _____

3. The sign $\overline{}$ is a sign of division. _____

4. The sign + means equals. _____

5. The sign X is the sign of addition. _____

6. The sign ÷ is the sign of division. _____

7. Zero means not any, or nothing. _____

8. Plus means that numbers are to be added. _____

9. 12 is 5 less 7. _____

10. The sign = between two things means that they are the same value. _____

11. The sum is the name of the answer in multiplication. _____

12. - is the sign for minus. _____

13. The difference is the name of the answer in subtraction. _____

14. 13 is 4 more than 9. _____

15. What is left when you divide is called the remainder. _____

II. Addition

Add the following mentally. Put only the answers on your paper.

1. 5 + 8 + 4 + 3 + 2
2. 9 + 7 + 5 + 1 + 6
3. 10 + 14 + 15 + 11 + 17
4. 12 + 3 + 6 + 15 + 7
5. 8 + 13 + 6 + 5 + 17

III. Copy the following on your paper and add.

1.
```
 695
 499
 357
 382
```

2.
```
 465
 256
 300
 537
 364
```

3.
```
72877
25734
86754
42576
65232
```

4.
```
1245
1770
1335
1245
2715
```

5.
```
475891
698507
579243
126759
```

IV. Subtract the following mentally and put only the answers on your paper. Do not copy the problem.

1. 17 - 5
2. 12 - 7
3. 88 - 11
4. 19 - 6
5. 13 - 5

V. Copy the following on your paper and subtract.

1. 182	2. 1635	3. 2715	4. 276	5. 10905
- 130	- 1336	- 1164	- 208	- 9814

VI. Multiplication

Multiply the following mentally and put only the answers on your paper.

1. 8 x 6
2. 9 x 7
3. 12 x 10
4. 3 x 7
5. 5 x 11

VII. Copy the following on your paper and multiply.

1. 144	2. 1075	3. 3750	4. 6294	5. 7483
x 307	x 33	x 234	x 176	x 4613

VIII. Division

Divide the following and put only the answers on your paper.

1. 12 ÷ 3
2. 16 ÷ 4
3. 32 ÷ 8
4. 144 ÷ 6
5. 36 ÷ 6

IX. Copy the following on your paper and divide.

1. $36/\overline{180}$
2. $12/\overline{288}$
3. $8/\overline{128}$
4. $16/\overline{1920}$
5. $86/\overline{63640}$
6. $92/\overline{349671}$
7. $675/\overline{39825}$
8. $32/\overline{15200}$
9. $70/\overline{61225}$
10. $65/\overline{10595}$

Reading and Writing Whole Numbers — Lesson No. 1

OBJECTIVE: To understand the importance of being able to read and write numbers correctly.

RELATED INFORMATION:

It is important to know how to read and write numbers correctly in order to avoid errors in the trade work. It is a very common error to reverse the correct sequence of a group of numbers. In recording an order for 176 yards of fabric, a person might incorrectly write 167. Also, in writing a check, a common error is to write $2030.00 instead of $2000.30.

PROCEDURE:

a. In receiving an order by phone or delivered personally, always re-check all figures with the person placing the order after writing the number or amount.

b. In giving an order by phone always ask the person receiving the order to read back numbers or amounts as a re-check.

ASSIGNMENT:

1. Rewrite the following sentences using numerals where amounts are stated:

   a. Ten million, forty-three thousand, seven hundred sixty-eight pounds of woolens were received in the U.S. since January first.

   b. The Claudia Company had a net profit of forty-two thousand, seven hundred and fifty-three dollars for a three-month period.

   c. Eleven thousand shares in the Claudia Company were issued in nineteen hundred fifty-seven.

   d. At the end of thirteen weeks, net profits in the Clark Company had declined fifty and one-half percent. Net profit for that period was one hundred forty-four thousand, eight hundred and fifty-eight dollars and twenty-eight cents as compared with two hundred ninety-two thousand, six hundred forty-three dollars.

2. Read the following sentences:

   a. There are 675 dresses cut in style #101.

   b. The sales reported in 1957 by Smith and Co. totaled $22,083,628 as compared with $23,763,218 in 1958.

   c. The price for raw silk in 1958 was listed as 174,900 yen per bale.

   d. Easter business declined 23% this year with total sales at $80,892,808.

   e. An agreement which involved 93,000 workers and 2675 employers was negotiated in the dress industry.

3. Find in today's Women's Wear Daily five sentences in which numbers containing five or more figures appear. Copy the sentences that contain the largest numbers. Be prepared to read these sentences in class.

OBJECTIVE: To learn how to compute materials cost of garments. To recognize the importance of knowing the cost of items used in the manufacture of garments.

RELATED INFORMATION:

Do you think you would have a true picture of the cost of a dress if you just figured the cost of the fabric? It is important to list also and total all trimmings and notions as well as the time spent in making a dress. The cost of all fabric, trimmings, and notions used in a garment is known as the materials cost. The time element is known as the labor cost.

A manufacturer must figure all items included in making each of the different style garments he will be producing. The total cost of fabric, notions, trimmings, labor, and overhead expense determines the selling price of his dresses.

Prices are subject to change; therefore the manufacturer must keep a close check on all items purchased for each garment. This lesson deals only with materials cost.

PROCEDURE:

In figuring the materials cost of a garment, a wholesale manufacturer usually finds it best to thoroughly check with the sample garment so that all materials used will be included in the computation.

Since the fabric is usually the most expensive portion, he checks the price of the fabric used in the garment and the yardage used in the garment. In a wholesale manufacturing firm, this item is usually checked with the piece goods buyer.

He then checks the prices of all trimmings used on the garment. In a wholesale manufacturing firm, there is usually a trimmings buyer who handles all trimmings and notions and novelties other than piece goods.

ASSIGNMENT:

For this lesson you will refer to the following price list:

Spun linen		68¢ per yard
Cotton Broadcloth		56¢ per yard
Dotted Swiss		45¢ per yard
Zippers	14" O. T. (open top)	14¢ each
	12" Pl. (placket)	11¢ each
	7" Sk. Pl. (skirt placket)	10¢ each
Buttons	Pearl S. S. /36 (self-shank, line 36)	6¢ each
	Pearl S. S. /30 (self-shank, line 30)	5¢ each
Pads	Snap-in	28¢ a pair
Monograms		$1.25 each
Belts	$\frac{3}{4}$" Washable	35¢ each
	1" Washable	40¢ each
Piqué Cording		4¢ per yard
Tucking		$1.10 per yard

1. Compute the materials cost of one dress cut in each of the following styles:

   a. Style #803 (sunback)
      3 yards of spun linen
      1 14" O. T. zipper
      1 $\frac{3}{4}$" belt
      1 pair of snap-in pads
      3 yards of piqué cord

   b. Style #804 (sunback)
      3 yards of cotton broadcloth
      1 14" O. T. zipper
      1 $\frac{3}{4}$" belt
      5 buttons S. S. /30
      1 pair of snap-in pads

   c. Style #805 (shirtwaist)
      4 yards of spun linen
      1 12" Pl. zipper
      6 buttons S. S. /36
      1 1" belt
      1 monogram

d. Style #806 (sunback)
   4 yards of cotton broadcloth
   1 14" O. T. zipper
   1 yard of tucking
   1 $\frac{3}{4}$" belt
   1 pair of snap-in pads

e. Style #807 (two-piece dress)
   4 yards of dotted swiss
   1 7" Sk. Pl. zipper
   4 buttons S. S. /30
   1 $\frac{3}{4}$" belt
   $\frac{1}{2}$ yard of tucking

f. Style #808 (sunback)
   3 yards of dotted swiss
   1 14" O. T. zipper
   1 1" belt
   1 pair of snap-in pads
   2 buttons S. S. /36

2. A manufacturer made 132 dresses in style #806. How much was the total cost of materials used?

3. If 14" O. T. zippers cost 14¢ each, what would be the cost of 132 zippers used in style #806?

4. A manufacturer received two bolts of dotted swiss, each measuring 66 yards, to be used for style #807. How many dresses were cut in this style?

5. A bill for belts amounting to $96.60 was received. The delivery included styles #803 and #804. The records showed that 146 dresses were made in style #803. How many dresses were made in style #804?

6. A total of 167 monograms was received for style #805. What was the total cost of monograms at $1.25 each?

7. If snap-in pads cost 28¢ a pair, what would be the cost of the 189 pairs used in style #808?

OBJECTIVE: To learn the method of entering and totaling customers' orders.

RELATED INFORMATION:

Before a manufacturer decides on the quantity of dresses, suits, or coats to be made, he must know the number of garments ordered. To do this he must keep a clear, simple record of all garments ordered by customers. Every garment ordered must be recorded in some way.

Let us say that you are a manufacturer who cut 100 dresses of style #803. In checking, you find that only 30 of the 100 dresses were actually sold to customers. This is definitely not a "running number". You can see the loss you would suffer if each of the 70 unsold dresses cost you $10.00 each to manufacture.

Since these records will be handled daily throughout a complete manufacturing season, it is most important that they be entered on sturdy paper. One of the most common forms for entering customers' orders is made of oak tag. It is commonly known as the style card. The following information should be recorded on these style cards:

a. The style number. Each style card records a single style.

b. Short description of each style to easily identify it.

c. Date of customer's order.

d. Name of customer.

e. Date order is due to be shipped.

f. Sizes and colors ordered.

The following example of an order placed by a customer has been entered on a typical style card reprinted in this lesson.

Jones & Co. of Norfolk, Virginia placed the following order on June 4th, 1958, to be shipped within two weeks:

Style #808

Blue: 1 size 12, 3 size 16 (written as 1/12, 3/16)
Red: 2 size 14, 5 size 18 (written as 2/14, 5/18)
Pink: 6 size 10, 2 size 20 (written as 6/10, 2/20)

Dotted Swiss

DESCRIPTION Sunback **STYLE NO.** 808

Date 1958	NAME	Date Due		COLOR Blue 10	12	14	16	18	20	COLOR Red 10	12	14	16	18	20	COLOR Pink 10	12	14	16	18	20	COLOR 10	12	14	16	18	20	COLOR 10	12	14	16	18	20
June 4	Jones & Co.	6/18			1		3					2		5		6					2												

PROCEDURE:

Upon receipt of customers' orders, enter the necessary information on style cards. Remember that there is a style card for each style number.

ASSIGNMENT:

Enter on the proper style cards the following orders received during the month of June. All orders were placed with the understanding that shipment would be made within three weeks.

1. The following orders were received on June 2, 1958:

Becks Shop of Charleston, S. C. ordered

Style #803	Blue	2/12	2/16	1/20
	Pink	2/10	3/12	3/14
	Aqua	2/10	2/12	2/16

Snead & Co. of Salem, Mass. ordered

Style #804	Navy	1/10	2/12	3/14	3/16	1/18
	Brown	2/14	2/16	1/18		
Style #803	Blue	1/10	2/12	2/14	1/16	

2. The following on June 4th:

Margarets of Miami, Fla.

Style #803	White	3/10	2/12	2/14	2/16		
	Maize	2/10	2/12	2/14	2/16		
Style #804	Beige	1/10	2/12	2/14	1/16		
	Black	1/10	2/12	3/14	3/16	2/18	1/20

Mrs. Satterwath of Richmond, Ind.

Style #804	Brown	1/10	2/12	4/14	5/16	3/18	1/20
	Navy	2/12	3/14	3/16	2/18	1/20	
	Black	1/10	2/12	2/14	2/16	1/18	
Style #806	Navy	1/10	2/12	2/14	2/16	1/18	
	Brown	1/12	2/14	3/16	1/18		
	Beige	1/10	3/12	3/14	2/16		

Cunninghams of Palm Springs, Calif.

Style #803	Blue	2/10	2/12	4/14	4/16	4/18	1/20
	White	3/10	4/12	6/14	6/16	1/18	
	Aqua	2/10	2/12	4/14	4/16		
Style #805	Maize	1/10	2/14	1/18			
	Aqua	1/12	1/14	1/16	1/18		

Gay-Nell of Wilmington, Delaware

Style #803	Pink	3/10	5/12	6/14	6/16	1/18	
	Aqua	1/10	1/12	3/14	3/16	2/18	
	Blue	3/12	2/14	2/16	2/18		

3. The following on June 9th:

Monroe Shop of Richmond, Virginia

Style #806	Navy	1/10	2/12	1/14	3/16	1/18	
	Brown	1/10	3/12	2/14	3/16		
	Beige	2/10	2/12	3/14	4/16		
	Black	1/10	2/12	4/14	5/16	2/18	1/20
Style #804	Beige	1/10	1/12	2/14			
	Black	2/12	3/14	2/16	1/18	1/20	

The French Shop of Clearwater, Fla.

Style #805	Blue	1/10	2/12	3/14	3/16	1/18	
	Pink	2/12	2/14	1/16	1/18		
	Maize	1/10	1/12	1/14	1/16	1/18	
	Aqua	2/12	2/14	1/16	1/18		
Style #806	Navy	1/12	3/14				
	Brown	1/12	2/14	1/18			
	Black	1/12	2/14	3/16	1/18	1/20	

Helen's Town & Country of Chicago, Ill.

Style #803	Maize	1/10	2/12	3/14	2/16
	White	2/12	4/14	2/16	1/18
Style #805	Maize	2/12	1/14	2/16	
	Aqua	1/10	2/14	1/16	1/18

Jeannettes of Woodbridge, N. J.

Style #807	Blue/white dot	2/10	2/12	3/14	3/16	1/18	
	Navy/red dot	1/10	1/12	1/14	1/16	1/18	
Style #803	Maize	1/12	1/18				
	White	2/14					
	Aqua	3/14	3/16	2/18	1/20		

4. On June 11th, the following:

Mary Rose Fashions of Montclair, N. J.

Style #807	Pink/wht	1/10	2/12	3/14	2/16	1/18	
	Blue/wht	1/10	1/12	1/14	1/16	1/18	
	Wht/blue dot	2/10	2/12	2/14	2/16		
Style #804	Navy	3/14	4/16	3/18	2/20		
	Brown	2/14	3/16	2/18	1/20		

Maison Lilliane, Kingston, N. Y.

Style #807	Wht/blue dot	1/10	1/12	2/14	2/16	1/18
	Pink/wht dot	2/10	2/12	2/14	2/16	
	Navy/red dot	1/10	1/12	1/14	1/16	1/18
Style #804	Navy	3/12	4/14	4/16	3/18	2/20
	Brown	1/12	3/14	4/16	3/18	1/20
	Beige	1/10	1/12	1/14	1/16	1/18
	Black	1/12	2/14	2/16	1/18	

The Ideal Dress Shop of Greenville, S. C.

Style #803	Blue	2/12	2/14	3/16	3/18	1/20
	Maize	2/10	4/12	3/14	1/16	1/18
	Pink	2/12	3/14	1/18		
	White	2/12	2/16			
Style #805	Blue	1/12	1/16	1/18		
	Pink	1/14	1/16	1/18		
	Maize	1/12	2/14	1/16		

5. On June 13th:

Claudia Dress Shop of Elizabeth, N. J.

Style #804	Navy	1/10	2/12	3/14	3/16	2/18	1/20
	Brown	1/12	3/14	3/16	2/18	1/20	
	Black	1/12	1/14	1/16			
Style #807	Wht/blue dot	2/14	2/16	1/18			
	Pink/wht dot	2/12	1/16				

Crossroad Shop of Freehold, N. J.

Style #805	Blue	1/10	1/14	1/18		
	Pink	1/12	1/14	1/16		
	Maize	1/10	1/12	2/14	1/16	1/18
	Aqua	1/10	1/12	2/14	1/16	
Style #807	Blue/Wht	1/10	1/12	1/14	1/16	1/18
	Navy/red	2/12	2/16			
	Pink/wht	1/10	1/12	2/14	2/16	

Toni's Town & Country of Ft. Lauderdale, Fla.

Style #803	Pink	3/12	3/14			
	Maize	1/10	3/12	4/14	2/16	1/18
	White	1/12	1/14			
Style #805	Blue	1/12	2/14	2/16		
	Pink	1/10	1/12	2/14	1/18	

6. On June 17th:

Franklins of Madison, Wisconsin

Style #804	Navy	1/12	4/14	4/16	2/18	1/20
	Brown	1/12	3/14	3/16	1/18	1/20
	Beige	1/12	1/14	1/16		
	Black	1/14	2/16	1/18		

Lillian's of Baltimore, Maryland

Style #803	Pink	1/12	1/14			

The Dress Fair of Toms River, New Jersey

Style #804	Navy	1/12	2/14	2/16	1/18	2/20
	Black	1/16	1/20			
	Brown	1/12	2/14	4/16	1/18	

The Emporium of Pittsburgh, Pa.

Style #804	Navy	2/16	2/18	1/20		
	Brown	2/14	2/16	1/18	1/20	
	Beige	1/12				
Style #806	Brown	1/10	2/12	2/14	1/16	
	Beige	1/10	1/12	2/14	2/16	1/18
	Black	1/12	1/14	2/16	1/18	

Hollywood Dress Shop of Washington, D. C.

Style #804	Brown	2/16	1/18	1/20		
	Beige	1/12	1/14			
Style #805	Pink	1/12	2/14	1/16		
	Maize	1/12	2/14	1/16		
	Aqua	1/12	2/14	1/16	1/18	

The Little Shop, Bayshore, Long Island, N. Y.

Style #806	Navy	1/10	1/12	1/14	1/16	1/20
	Brown	1/12	1/14			
	Beige	1/14	1/16	1/18		
	Black	1/12	1/14	2/16		
Style #807	Blue/wht	1/10	2/12	1/14	1/16	1/18
	Navy/red	1/12	2/14	2/16	1/18	
	Wht/blue	2/14	2/16	1/18		

Young Modern Dress Shop, Trenton, N. J.

Style #805	Blue	1/10	1/12	1/14	1/16	1/18
	Pink	1/12	2/16			
	Maize	1/10	2/14	1/18		
	Aqua	2/12	1/16			
Style #807	Blue/wht	1/12	2/14	2/16	2/18	
	Navy/red	1/10	1/12	3/14	3/16	2/18
	Wht/blue	1/10	1/12	1/18		
	Pink/wht	1/12	2/16			

Estimating Quantities of Materials Needed — Lesson No. 4

OBJECTIVE: To learn how to estimate yardage and trimmings needed. To practice cross or horizontal addition.

RELATED INFORMATION:

After the record is made on style cards of all garments ordered by customers, it is important to estimate the fabric yardage and total trimmings needed to manufacture these garments.

Working with the style cards, as used in Lesson 3, the total quantity ordered is transferred to a "cutting ticket". The cutting ticket is usually a small paper form totaling the number of garments to be cut in each size and color of each style. The following information must appear on the cutting ticket:

a. Date total is taken after all orders are entered on style card.
b. Style number.
c. Colors ordered.
d. Sizes ordered.
e. Total quantity of each color.

The horizontal total of each color is then multiplied by the average yardage per dress to obtain the fabric yardage estimate. All other items needed to complete the garments are estimated in the same way. Workers in needle trades must be able to add horizontally as quickly as vertically.

On page 16 is a sample of a cutting ticket used in the trade.

PROCEDURE:

a. Total the number of garments ordered in sizes and colors on style cards.
b. Transfer style numbers, colors, and sizes ordered to a cutting ticket.
c. On the cutting ticket total horizontally the number of garments in each color.
d. Total number of garments in each size. The totals of (c) and (d) must be the same.
e. Estimate fabric needed in each color, using yardages listed in Lesson No. 2.
f. Estimate trimmings needed for each style as listed in Lesson No. 2.

CUTTING TICKET

Date cut June 25, 19—

Style 714

Date June 20, 19—

Cutter

	COLOR	10	12	14	16	18	20	34	36	38	40	42	44	46	TOTAL
	White	2	7	15	21	19	12								76
	Blue	3	8	21	25	21	14								92
	Pink	2	7	14	19	17	6								65
	Maize	1	5	6	12	10	4								38
															271 dresses
		8	27	56	77	67	36								

ASSIGNMENT:

1. Add without writing in a column:

   a. 100 + 75 + 28 + 32 + 67 + 59

   b. 18 + 628 + 187 + 14 + 195 + 65

   c. 107 + 223 + 16 + 104 + 87 + 365

   d. 100 + 200 + 400

   e. 27 + 99 + 36 + 14

2. Add both ways and check:

   a. 5 + 14 + 8 + 20

   b. 3 + 4 + 7 + 8

   c. 10 + 15 + 16 + 14

   d. 9 + 8 + 20 + 14

   e. 11 + 31 + 70 + 18 +64

   f. 94 + 19 + 17 + 18 + 25

   g. 24 + 32 + 83 + 8 + 13

   h. 7 + 16 + 64 + 9 + 12

   i. 5 + 6 + 7 + 20 + 22

3. Total quantity of garments ordered in each style as shown on style cards used in Lesson No. 3.

4. Transfer the quantity of garments ordered to cutting tickets.

5. Total horizontally the number of garments in each color.

6. Total the number of garments in each style.

7. Check cross addition.

8. Which style would you consider the best "running number"?

9. Estimate yardage needed for each style using figures in problem 1 of Lesson No. 2.

10. Estimate total trimmings needed for all styles, using the figures in problem 1 of Lesson No. 2.

11. How many buttons must be ordered for 435 garments, if each garment requires 12 buttons for the front and 2 for the pockets?

12. A dress requires 13 buttonholes. How many buttonholes will be made on 379 dresses?

Daily Package-Receipt Records Lesson No. 5

OBJECTIVE: To learn how to keep daily package-receipt records.

RELATED INFORMATION:

In order to keep an accurate record of all merchandise received, one of the first steps necessary is to receipt all bills that accompany packages. It is important that you pay only for what you receive. Packages can be misplaced and you may still be charged for them. Everything that is delivered to a manufacturing firm must be recorded in some way.

A common practice among businesses, whether they manufacture ready-to-wear or sell ready-to-wear, is to keep a daily package-receipt book. This receipt book can be divided into any number of columns. We will use a seven-column receipt book as shown on the following page. The following information should be recorded:

a. The date the package is received.
b. A consecutive receipt number.
c. The supplier's name.
d. The supplier's bill number, which is on the bill received with the package.
e. The number of packages received.
f. The items received.
g. The amount of the bill.

PROCEDURE:

Upon receipt of a package, no matter what size, record it in the package-receipt book.

Check the quantity received with the quantity charged for on the bill.

As a further check, the receipt number that identifies the package is then written on the face of the bill. For example, the first entry on the package receipt book page is a record of a package received on June 2nd from Belbro Brothers. The package-receipt book number is #101. This number is written on the supplier's bill which is #1644.

Claudia Designs, Inc.

PACKAGE RECEIPT BOOK

DATE	PACKAGE RECEIPT NO.	SUPPLIER'S NAME	BILL NO.	NO. OF PACKAGES	ITEM	AMOUNT OF BILL	
June 2	101	Belbro Bros.	1644	1	Zippers	1	07
2	102	Amari Textiles	14007	1	Spun	735	70
3	103	Perfect Pad Co.	50404	1	Pads	3	36
5	104	Belbro Bros.	1660	2	Zippers	1	51
6	105	Fashion Belt	5608	1	belts	22	42
6	106	Goth Corrugated	03231	4	boxes	7	70
9	107	Fashion Belt	5623	1	belts	11	88
9	108	Ellen's Novelty Co.	4326	1	Cardage	13	08
9	109	Belbro Bros.	1683	1	Zippers	10	67
10	110	Belbro Bros.	1685	1	Zippers	32	88
10	111	Prince Novelty Co	5710	1	buttons	6	75
10	112	Perfect Pad Co.	57541	1	Pads	33	00
10	113	Belbro Bros.	1694	1	thread	12	20
11	114	Fashion Belt Co.	5659	1	Belts	18	00
11	115	Aimay Plating Co.	7026	1	Trucking	12	00
11	116	Long Paper Co.	17370	1	twine	16	80
11	117	Amari Textiles Co.	14008	2	Spun	508	82
12	118	Goth Corrugated	03401	3	boxes	5	60
12	119	Long Paper Co.	17300	2	boards	28	00
12	120	Max Nelson	1041	1	belts	9	54
13	121	Art Monogram Co.	4692	1	Monograms	25	00
16	122	Perfect Pad Co.	57654	1	Pads	15	96
16	123	Amari Textile	14047	2	prints	57	00
16	124	Perfect Pad Co.	57691	1	Pads	14	32

ASSIGNMENT:

1. Why is it necessary to keep a record of every package received?

2. If, in checking receipt #114, you find you were charged with 100 belts but you received 102 belts, what would you do?

3. What is the supplier's bill number for receipt #103?

4. What type of fabric was received from Amari Textile on receipt #123?

5. Using lined paper and referring to the sample, make up a page for the package-receipt book of Claudia Designs, Inc., and make these additional entries:

   a. On June 16th one bolt of piqué was received from Amari Textile Company. The bill number was 14061; the total cost was $28.56.

   b. On June 17th, Belbro Brothers delivered 1 box of zippers. The bill number was 1755; the cost was $7.19.

   c. On June 17th a package of belts amounting to $19.98 was received from Max Felsom Company. The bill number was 5699.

   d. Belbro Brothers delivered one package of zippers on June 18th. The bill number was 1763; the total cost was $9.97.

   e. Amari Textile Company was called to rush the delivery of spun rayon, which was needed for some special dresses. On the 18th, they shipped at once two cartons amounting to $480.72; the bill number was 14096.

   f. A great amount of boxes is needed in order to ship dresses in quantity. Goth Corrugated Container Co. delivered 5 bundles of boxes on June 21st. The bill number was 03536; the total cost was $9.20.

   g. Elmer Button Company delivered one package of buttons amounting to $9.38, bill #6255, on June 21st.

   h. Bill #4655 amounting to $7.62 was received from Ellen's Novelty Company with a package of number twelve cordage, on the 22nd of June.

i. Tucking, which was needed to complete one of the most popular styles, was received on June 23rd from Aimax Pleating Company, bill #7044, amounting to $20.00.

j. There was a shortage of boxes and Goth Container Company was called to make a special delivery of three bundles of boxes. The bill was #03596 amounted to $13.00. It was received on June 25th.

k. Some customers requested personal monograms. Art Monogram Company made a delivery of one package of monograms on June 28th. Bill #4701 amounted to $22.50.

l. One package of belts was received from Fashion Belt Co. on June 28th. Bill #5911 amounted to $27.00.

m. One package of pads was delivered by Perfect Pad Company on June 29th. Bill #57703 amounted to $9.00.

n. Hirsch Company made a delivery of one package of zippers on June 29th. The bill amounted to $7.65; bill #13125.

o. An additional package of belts was received from Fashion Belt Company amounting to $6.48; bill #6083.

p. Every manufacturing firm uses printed invoices or bills. A shipment of invoice envelopes was received on June 30th from Long Paper Company amounting to $3.00; bill #17673.

6. Referring to problem 5:

   a. What entry do you have recorded for receipt #133?

   b. How many entries have you made where the item entered was zippers? List the firms who delivered zippers.

   c. List the companies from which fabric was received.

   d. What items would you consider as trimmings used on dresses listed in the entries you have made?

   e. W hat receipt number have you given to the delivery made by Fashion Belt Company on June 28th?

7. What would you do if you received a package without a bill?

Checking Daily Bills **Lesson No. 6**

OBJECTIVE: To understand the importance of checking daily bills and monthly statements.

RELATED INFORMATION:

What would you think of a dressmaker who kept a package-receipt book, but neglected to check the quantities charged on the bill with what she actually received? What would you think of a person who neglected to check the amount received with the amount she had ordered? You would probably agree that this is a poor way to conduct a business.

What would you do if you had ordered only 45 belts and received 60 belts? Remember you would be charged for these additional 15 belts on the bill. You must remember that in the needle trades there are changes every season. A dressmaker making one dress or a manufacturer making hundreds of dresses cannot afford to keep anything extra in stock unless it is a staple item.

At the end of each month, each supplier sends out a statement for the money due him. You, of course, must be able to check the amount of each bill you have received with the amount recorded on the statement of each supplier. A sample of a statement received from Belbro Brothers is shown below.

STATEMENT.

FOLIO_____

June 30 1960

M Belbro Bros.

338 W. 37 St.

To Claudia Dress Co.

TERMS: 2 70 152 W 36th St. N.Y.C.

June	2	Bill# 1644	1	07		
	5	# 1660	1	51		
	9	# 1683	10	67		
	10	# 1685	32	88		
	10	# 1694	12	20		
	17	# 1755	7	19		
	18	# 1763	9	97		
		Total			75	49

PROCEDURE:

Only one person in the firm receipts the bills.

After a bill is receipted, the package and bill are sent to the department which ordered the particular item. The following procedure is followed in each separate department.

a. Check the quantity.

b. Check the price on the bill with the price agreed at the time the order was placed.

c. Check the total amount of the bill for accuracy.

d. At the end of the month check the supplier's statements with the bills received.

ASSIGNMENT:

Note: Refer to the package-receipt entries in Lesson 5 to solve the following problems.

1. Why should the price of each item be checked before extending the total of the bill?

2. Perfect Pad Company delivered 24 pairs of pads at 18¢ a pair, bill #50404. Check the amount of the bill.

3. Ellen's Novelty Company delivered 436 yards of #12 cordage at 3¢ a yard. Check bill #4326.

4. A total of 582 belts were received from Fashion Belt Company. At 18¢ a belt, what is the total of the payment due?

5. Amari Textile Company delivered 60 yards of Birdseye piqué at 95¢ a yard. What is the total of the bill?

6. Total the bills received from Art Monogram Company as listed in the package-receipt book during the month of June. If the price of a single monogram is $1.25, how many monograms were received?

7. Referring to the sample shown in this lesson, make up statements of bills for each supplier as they would be presented at the end of the month. Total each statement.

8. Total all the bills received during the month of June.

9. Are the totalsof 7 and 8 the same amount? They should be.

10. If the #12 cordage received from Ellen's Novelty Company is 3¢ a yard, how many yards were received with bill #4655?

11. If Perfect Pad Company delivered 76 pairs of pads at 12¢ a pair, what is the price per pair of the remaining 38 pairs of pads received with bill #57654?

12. Bill #5608, received from Fashion Belt, was for 119 belts at 18¢ each. What is the total of the bill?

Computing Parcel Post Charges — Lesson No. 7

OBJECTIVE: To understand the method of computing parcel post charges for shipping merchandise.

RELATED INFORMATION:

Goods may be shipped by parcel post, railway express, airmail, air express, air freight, and truck. In the garment industry, many goods are shipped by parcel post.

Why do you suppose many kinds of goods are shipped by mail and not by freight? Shipping by mail affords a quick, convenient method of sending small packages and mail reaches more places than any other means of transportation. The special advantages of mail are the low transportation charges and the rapid delivery of goods.

Parcel post is considered fourth-class mail. The cost of sending a package by parcel post depends on the weight of the package and the distance it is to be sent. Packages to be sent by parcel post must weigh not less than 1 pound and not over 70 pounds. In determining weight for finding shipping charges, a fraction of a pound is counted as a full pound. Thus 18 ounces is counted as 2 pounds and $3\frac{1}{2}$ pounds as 4 pounds.

For determining distances in calculating postage, the country is divided into eight circular zones, with the post office from which the parcel is sent as the center of the circles. In order to find what zone a city is located in, we need to know only how far away it is. Any city within 50 miles of your post office is in Zone 1. A city between 50 and 150 miles from your post office is in Zone 2, and so on. Parcel post zone guides, published by the U. S. Post Office Department, are available for each post office unit.

On the next page you will find a copy of the Fourth Class Rates (Parcel Post Zone Rates) as of 1960.

If a package of merchandise weighs less than 16 ounces, it goes by third class mail, for which the rate is uniform regardless of the distance. The rate (1960) is 3¢ for the first two ounces and $1\frac{1}{2}$¢ for each additional ounce or fraction of an ounce.

Fourth-Class (Parcel Post) Zone Rates

Weight, 1 pound and not exceeding—	Zones							
	Local	1 and 2 Up to 150 miles	3 150 to 300 miles	4 300 to 600 miles	5 600 to 1000 miles	6 1000 to 1400 miles	7 1400 to 1800 miles	8 Over 1800 miles
2 pounds	$0.24	$0.33	$0.35	$0.39	$0.45	$0.51	$0.58	$0.64
3 pounds	.26	.38	.41	.47	.55	.64	.74	.83
4 pounds	.28	.43	.47	.55	.65	.77	.90	1.02
5 pounds	.30	.48	.53	.63	.75	.90	1.06	1.21
6 pounds	.32	.53	.59	.70	.85	1.03	1.22	1.40
7 pounds	.34	.58	.65	.77	.95	1.16	1.38	1.59
8 pounds	.36	.63	.71	.84	1.05	1.29	1.54	1.78
9 pounds	.38	.68	.77	.91	1.15	1.42	1.70	1.97
10 pounds	.40	.73	.83	.98	1.25	1.55	1.86	2.16
11 pounds	.42	.77	.89	1.05	1.35	1.67	2.02	2.34
12 pounds	.44	.81	.95	1.12	1.45	1.79	2.18	2.52
13 pounds	.46	.85	1.01	1.19	1.55	1.91	2.34	2.70
14 pounds	.48	.89	1.07	1.26	1.65	2.03	2.50	2.88
15 pounds	.50	.93	1.13	1.33	1.75	2.15	2.66	3.06
16 pounds	.52	.97	1.18	1.40	1.85	2.27	2.81	3.24
17 pounds	.54	1.01	1.23	1.47	1.95	2.39	2.96	3.42
18 pounds	.56	1.05	1.28	1.54	2.05	2.51	3.11	3.60
19 pounds	.58	1.09	1.33	1.61	2.15	2.63	3.26	3.78
20 pounds	.60	1.13	1.38	1.68	2.25	2.75	3.41	3.96
21 pounds	.62	1.17	1.43	1.75	2.34	2.87	3.56	4.14
22 pounds	.64	1.21	1.48	1.82	2.43	2.99	3.71	4.32
23 pounds	.66	1.25	1.53	1.89	2.52	3.11	3.86	4.50
24 pounds	.68	1.29	1.58	1.96	2.61	3.23	4.01	4.68
25 pounds	.70	1.33	1.63	2.03	2.70	3.35	4.16	4.86
26 pounds	.72	1.37	1.68	2.10	2.79	3.47	4.31	5.04
27 pounds	.74	1.41	1.73	2.17	2.88	3.59	4.46	5.22
28 pounds	.76	1.45	1.78	2.24	2.97	3.71	4.61	5.40
29 pounds	.78	1.49	1.83	2.31	3.06	3.83	4.76	5.58
30 pounds	.80	1.53	1.88	2.38	3.15	3.95	4.91	5.76
31 pounds	.82	1.57	1.93	2.45	3.24	4.06	5.05	5.93
32 pounds	.84	1.61	1.98	2.52	3.33	4.17	5.19	6.10
33 pounds	.86	1.65	2.03	2.59	3.42	4.28	5.33	6.27
34 pounds	.88	1.69	2.08	2.66	3.51	4.39	5.47	6.44
35 pounds	.90	1.73	2.13	2.73	3.60	4.50	5.61	6.61
36 pounds	.92	1.77	2.18	2.80	3.69	4.61	5.75	6.78
37 pounds	.94	1.81	2.23	2.87	3.78	4.72	5.89	6.95
38 pounds	.96	1.85	2.28	2.94	3.87	4.83	6.03	7.12
39 pounds	.98	1.89	2.33	3.01	3.96	4.94	6.17	7.29
40 pounds	1.00	1.93	2.38	3.08	4.05	5.05	6.31	7.46
41 pounds	1.02	1.97	2.43	3.15	4.14	5.16	6.45	7.62
42 pounds	1.04	2.01	2.48	3.22	4.23	5.27	6.59	7.78
43 pounds	1.06	2.05	2.53	3.29	4.32	5.38	6.73	7.94
44 pounds	1.08	2.09	2.58	3.36	4.41	5.49	6.87	8.10
45 pounds	1.10	2.13	2.63	3.43	4.50	5.60	7.01	8.26
46 pounds	1.12	2.17	2.68	3.50	4.59	5.71	7.15	8.42
47 pounds	1.14	2.21	2.73	3.57	4.68	5.82	7.29	8.58
48 pounds	1.16	2.25	2.78	3.64	4.77	5.93	7.43	8.74
49 pounds	1.18	2.29	2.83	3.71	4.86	6.04	7.57	8.90
50 pounds	1.20	2.33	2.88	3.78	4.95	6.15	7.71	9.06
51 pounds	1.22	2.37	2.93	3.84	5.03	6.26	7.84	9.22

Most packages sent by the garment industry are insured. In order to obtain payment for loss of, rifling of, or damage to a package mailed, it must be insured. The insurance fees follow:

Liability	Fee
$ 0.01 to $10.	$0.10
10.01 to 50.	0.20
50.01 to 100.	0.30
100.01 to 200.	0.40

Liability for insured mail is limited to $200.

There are times when a manufacturer wishes to send packages by parcel post and have the merchandise paid for at the time of delivery. The cost of the article and the cost of the postage are collected from the addressee when the article is delivered. This is collected-on-delivery service, which is usually called C.O.D. service. The amount collected is returned to the manufacturer by a postal money order. The C.O.D. fees follow:

FEES (IN ADDITION TO POSTAGE)

Liability (and COD collection to $200)	COD Fees	
	Registered (See 163.6)	Unregistered
$0.01 to $5	$0.80	$0.30
$5.01 to $10	.80	.40
$10.01 to $25	1.10	.60
$25.01 to $50	1.10	.70
$50.01 to $100	1.20	.80
$100.01 to $150	1.40	.90
$150.01 to $200	1.40	1.00
$200.01 to $300	1.50	Liability for unregistered COD mail is limited to $200; for registered COD $1,000, same as for other registered mail. Collection for COD mail, unregistered or registered, is limited to $200.
$300.01 to $400	1.60	
$400.01 to $500	1.70	
$500.01 to $600	1.80	
$600.01 to $700	1.90	
$700.01 to $800	2.00	
$800.01 to $1,000	2.10	

PROCEDURE:

A. Determine to what zone the package is being sent.

B. Weigh the package; count any fraction of a pound as a full pound.

C. Refer to rate chart in this lesson to figure parcel post charges.

D. Figure additional charges, such as C. C. D., insurance, etc.

Example: Jones & Co., of Woodbridge, N. J. is sending a package which contains 2 dresses, weighing $3\frac{1}{2}$ pounds, to A. Smith, Newark, N. J. The package is valued at $31.50. Find the cost of sending this package by insured parcel post.

Since Newark is within the first zone, you would check under zone I, and in line with the four pound weight you would find a 43¢ charge for parcel post. The insurance fee is 20¢. Therefore, the total postal charges for this package amount to 63¢.

ASSIGNMENT:

1. Find the cost of sending each of these packages into the zone indicated:

	Weight	Zone		Weight	Zone
a.	6 lbs.	3	e.	11 lbs.	8
b.	15 lbs.	6	f.	25 lbs.	7
c.	9 lbs.	5	g.	$3\frac{1}{2}$ lbs.	1
d.	5 lbs. 9 oz.	Local	h.	13 lbs. 2 oz.	4

2. If a person is sending packages from New York City, in what zone is each of these cities? (The mileage in parentheses is the distance from New York.)

a.	Atlanta, Ga.	(876 miles)	i.	Columbus, Ohio	(544 miles)
b.	Denver, Colo.	(1768 miles)	j.	Washington, D. C.	(224 miles)
c.	Seattle, Wash.	(2932 miles)	k.	Wichita, Kansas	(1428 miles)
d.	Santa Fe. N. Mex.	(1980 miles)	l.	Boston, Mass.	(217 miles)
e.	Baltimore, Md.	(186 miles)	m.	Cincinnati, Ohio	(639 miles)
f.	Richmond, Va.	(330 miles)	n.	Philadelphia, Pa.	(88 miles)
g.	Chicago, Ill.	(814 miles)	o.	Raleigh, N. C.	(497 miles)
h.	Miami, Fla.	(1336 miles)	p.	Akron, Ohio	(474 miles)

3. Find the cost of sending each of these insured packages from Woodbridge, N. J. to the cities listed. The figures in parentheses are the zone numbers.

	Weight	City	Liability
a.	15 lbs.	Denver, Colo. (7)	$24.50
b.	19 lbs.	San Francisco, Cal. (8)	9.75
c.	35 lbs.	New Orleans, La. (6)	55.50
d.	$27\frac{1}{2}$ lbs.	Havre, Mont. (8)	36.50
e.	$12\frac{1}{2}$ lbs.	Detroit, Mich. (4)	105.50
f.	9 ounces	El Paso, Texas (8)	97.50
g.	2 lbs. 3 ozs.	Duluth, Minn. (5)	76.50 C. O. D.
h.	11 ounces	New York, N. Y. (1)	49.50
i.	5 lbs.	Richmond, Va. (3)	14.75 C. O. D.
j.	12 lbs.	Madison, Wis. (5)	50.00
k.	15 lbs.	Cleveland, Ohio (4)	50.50
l.	$13\frac{1}{2}$ lbs.	Baltimore, Md. (2)	75.00
m.	25 lbs.	Hartford, Conn. (2)	49.75

4. The shipping department of Woodbridge Garment Company records the daily shipments made by parcel post on a "manifest." Using a manifest similar to the one on the next page, enter the shipments appearing in problem 3 and figure the total postage.

NAME OF SENDER

ADDRESS

Indicate type of mail

☐ INSURED ☐ C. O. D.

☐ CERTIFIED

POSTMARK AND DATE OF RECEIPT

	NUMBER OF ARTICLE	NAME OF ADDRESSEE, STREET, AND POST-OFFICE ADDRESS	Postage	Fee	Due Sender if C. O. D.	†Endorsement	R. R. Fee	S. D. Fee	*S. H. Fee	Restricted Delivery Fee / Remarks
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										

TOTAL NUMBER OF PIECES LISTED BY SENDER *(Write number here in words)*

TOTAL NUMBER OF PIECES RECEIVED AT POST OFFICE

POSTMASTER, PER *(Name of receiving employee)*

†Mark "F" if "Fragile," "P" if "Perishable," "E" if "Eggs," "EH" if "Eggs for Hatching," "B" if "Butter," "FL" if "Fragile—Liquid," and "FLU" if "Fragile—Liquid—This Side Up."

*Special-handling charges apply only to fourth-class parcels. Special-delivery service also includes special-handling service.

POD Form 3877-A
Oct. 1956

GPO: C8—16—72948-1

Short Cuts in Arithmetic — Lesson No. 8

OBJECTIVE: To gain speed in figuring and checking problems.
To develop the skill of calculating problems mentally.

RELATED INFORMATION:

It is important to be quick in figuring problems in the trade, and the ability to use short cuts is an asset.

PROCEDURE:

A. To multiply by:

1. 10 Add a zero to the multiplicand, as: 788 x 10 = 7880

2. 5 Add a zero and then divide by 2:

$$788 \times 5 = 2\overline{)7880}\ \ 3940$$

3. 25 Add 2 zeros to the multiplicand and divide by 4:

$$788 \times 25 = 4\overline{)78800}\ \ 19700$$

4. 11 Add a zero to the multiplicand and add the original number:

$$788 \times 11 = \begin{array}{r} 7880 \\ 788 \\ \hline 8668 \end{array}$$

5. 9 Add a zero to the multiplicand and subtract the original number:

$$788 \times 9 = \begin{array}{r} 7880 \\ -\ 788 \\ \hline 7092 \end{array}$$

B. Checking addition problems

Perhaps the only way that most of you know how to check an addition problem is by re-adding the problem in the opposite direction. You are now going to learn a new way of checking an addition problem. It is called the "casting-out of nines."

Example:

4897		4	8	~~9~~	7	=	19	=	10	=	1		
2348		~~2~~	~~3~~	~~4~~	8	=	8				8		
9572		~~9~~	5	~~7~~	~~2~~	=					5		
3644		~~3~~	~~6~~	4	4	=					8		
7856		7	8	5	6	=	26			=	8		
28317	2	~~8~~	3	~~1~~	7	=	12	=	3		30	=	3

Before explaining this method, is there anyone in the class who can see and explain how the above problem was checked?

The casting-out of nines can save a great deal of time in checking an addition problem, but <u>first you must have an answer</u> to check.

In the casting-out of nines, instead of re-adding in the opposite direction, you add the digits across (horizontally), casting out nines and zeros until you end with a single digit.

Example:

$4 + 8 + \cancel{9} + 7 = 19 = 1 + 9 = 10 = 1$

$(2 + \overset{\cancel{9}}{3} + 4) + 8 = 8$

$\cancel{9} + 5 + (7 \overset{\cancel{9}}{+} 2) = 5$

Can you work out the remaining rows?

These single digits are then added vertically and the answer is broken down to a single digit. If your original addition was correct, the single digit in your answer will be the same as that in the last step of your check. In the problem above, 3 = 3.

ASSIGNMENT:

Exercise I. Multiply the following using short cuts:

1. 343 x 11
2. 1788 x 5
3. 770 x 5
4. 732 x 9
5. 102 x 11
6. 298 x 5
7. 722 x 11
8. 307 x 9
9. 84 x 5
10. 308 x 9
11. 6775 x 5
12. 208 x 10
13. 44 x 9
14. 676 x 11
15. 5567 x 10

Exercise II. Which of the following problems have the correct answers? Do not work the problem over. Check them by casting-out nines method.

1.
```
 43763
 98143
 76214
 13420
 ------
231540
```

2.
```
 1430
 9572
 6341
  256
 -----
17599
```

3.
```
 47
 23
 95
 41
 62
 58
 ---
306
```

4.
```
 46
 95
 32
 14
 87
 73
 ---
348
```

5.
```
 143
 256
 904
  82
 176
 ----
1571
```

6.
```
 76
 93
 46
 81
 43
 19
 ---
358
```

UNIT II - FRACTIONS

Pre-Test No. 2

In this test there are some important facts you should know by this time. See if you can go through this test without an error.

EXERCISE I. Add the following:

1. $9\frac{1}{8}$ + $7\frac{3}{4}$ + $3\frac{1}{2}$

2. $1\frac{3}{4}$ + $2\frac{1}{2}$ + $6\frac{3}{4}$

3. $4\frac{3}{8}$ + $3\frac{7}{8}$ + $13\frac{3}{8}$

4. $17\frac{5}{8}$ + $8\frac{1}{2}$ + $3\frac{1}{2}$

5. $3\frac{1}{4}$ + $1\frac{1}{2}$ + $47\frac{7}{12}$

6. $4\frac{3}{8}$ + $3\frac{1}{4}$ + $3\frac{1}{2}$

7. $12\frac{1}{2}$ + $15\frac{1}{4}$ + $8\frac{5}{8}$

8. $6\frac{5}{8}$ + $6\frac{1}{4}$ + $6\frac{7}{8}$

EXERCISE II. Subtract the following:

1. $2\frac{1}{2} - 1\frac{1}{4}$

2. $7\frac{3}{4} - 3\frac{7}{8}$

3. $6\frac{3}{4} - 1\frac{1}{2}$

4. $12\frac{7}{8} - 3\frac{1}{2}$

5. $8\frac{1}{2} - 1\frac{3}{4}$

6. $4\frac{5}{8} - 2\frac{3}{4}$

7. $3\frac{1}{4} - 1\frac{5}{8}$

EXERCISE III: Multiply the following:

1. $15 \times 1\frac{1}{3}$

2. $14 \times 2\frac{1}{8}$

3. $72 \times \frac{1}{4}$

4. $16 \times 3\frac{1}{2}$

5. $50 \times 7\frac{1}{6}$

EXERCISE IV: <u>Divide</u> the following:

1. $1\frac{1}{2} \div \frac{1}{8}$

2. $3\frac{1}{4} \div \frac{1}{4}$

3. $3\frac{1}{2} \div \frac{1}{16}$

4. $22\frac{3}{4} \div 13$

5. $17\frac{1}{2} \div 7$

6. $\$18.25 \div 36\frac{1}{2}$

7. $2\frac{1}{2} \div \frac{3}{4}$

8. $74\frac{1}{4} \div \frac{3}{8}$

9. $288 \div \frac{1}{12}$

10. $40 \div \frac{1}{6}$

Review of Terms Lesson No. 1

OBJECTIVE: To review terms used in the study of fractions.

RELATED INFORMATION:

Often we talk about something that is part of something else, as a part of a yard, part of a gross, part of a dozen, part of an inch, or part of a pound. Fractions, which we will cover in this lesson, are parts of a whole thing which has been divided or broken into equal parts. Fractions are constantly being used by the needle trades worker in the problems he meets daily.

You have learned that if you divide anything into two equal parts, one of the parts is called one-half ($\frac{1}{2}$). And you remember that if you divide anything into four equal parts, one of the parts is called one-fourth ($\frac{1}{4}$). Parts like $\frac{1}{2}$ or $\frac{1}{4}$ are called fractions or fractional parts.

In this lesson the terms most commonly used will be reviewed.

PROCEDURE:

The following facts are important in the understanding of fractional terms. A fraction, as stated above, is part of a whole thing which has been divided or broken into equal parts.

The fraction is composed of two parts:

a. The number below the line in a fraction shows how many parts in the whole unit. It is called the denominator.

b. The number above the line in a fraction shows how many parts have been taken or used. It is called the numerator.

You can see that in reading fractions, you must read the numerator first and then the denominator. In the fraction $\frac{3}{8}$ - a whole unit or "1" has been divided into eight parts and three parts have been taken.

$\frac{3}{8}$ 3 is the numerator
8 is the denominator

ASSIGNMENT:

1. What do the following mean:

   a. $\frac{3}{4}$ b. $\frac{3}{16}$ c. $\frac{7}{8}$ d. $\frac{3}{10}$ e. $\frac{5}{6}$

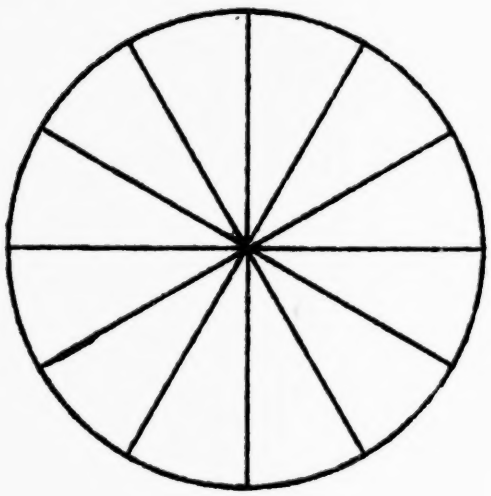
2. Write the following fractions:

   a. four-fifths b. twenty thirty-sixths c. three-sixteenths
   d. twelve thirty-sixths e. seven-fourteenths f. fourteen-thirtieths

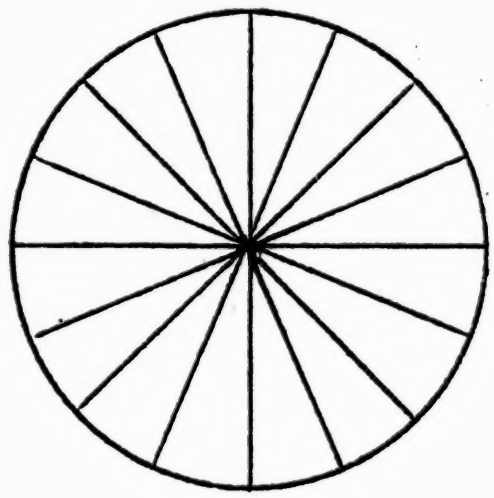
3. What does numerator mean and where is it found in the fraction?

4. What does the number below the line mean?

5. Into how many equal parts is circle A divided? Circle B?
   What is each one of these parts called?



A



B

6. a. There are _____ cents in a quarter.
   b. What part of a quarter is ten cents?
   c. Write this number as a fraction.

7. The following materials were used to make six different garments.
   Write as a fraction, the amount of material used in making one garment:

	6 garments	1 garment	Fraction
a.	24 yards of chambray	3 yards	
b.	36 buttons	4 buttons	
c.	6 zippers	1 zipper	
d.	3 spools of thread	$\frac{1}{2}$ spool	

8. a. How many months are there in one year?
   b. What part of a year is 4 months?
   c. What part of a year is 2 months?
   d. What part of a year is 1 month?

9. Which is more, $\frac{1}{4}$ or $\frac{1}{2}$?

10. a. How many fifths are there in twenty-five? b. in a quarter?
    c. What part is five of twenty-five? d. of a quarter?

11. Write the fractions of a dollar for the following amounts:

    a. 25¢ b. 30¢ c. 15¢ d. 70¢ e. 60¢

12. Give the value in cents of the following fractions of a dollar:

    a. $\frac{1}{10}$ b. $\frac{1}{2}$ c. $\frac{6}{8}$ d. $\frac{7}{10}$ e. $\frac{1}{5}$

Review of Types of Fractions — Lesson No. 2

OBJECTIVE: To recall the different types of fractions.

RELATED INFORMATION:

a. A proper fraction is a fraction whose numerator is smaller than its denominator and whose value is less than a unit. Thus $\frac{7}{12}$ and $\frac{2}{3}$ are proper fractions.

b. An improper fraction is one whose numerator is equal to or greater than its denominator, and whose value is therefore one complete unit or more than one unit. Thus $\frac{8}{8}$ or $\frac{16}{4}$ are improper fractions.

c. A mixed number is a number expressed by a whole number and a fraction combined. $1\frac{1}{4}$ is a mixed number.

We may change any improper fraction to a mixed number and any mixed number to an improper fraction.

PROCEDURE:

To change improper fractions to mixed numbers or whole units:

Example: $\frac{16}{4}$ - an improper fraction

To change an improper fraction to a mixed number or whole unit, divide the numerator (16) by the denominator (4), which will give you an answer of 4 complete units.

To change mixed numbers to improper fractions:

Multiply the whole number by the denominator and to the result add the numerator. Write the sum over the denominator of the original fraction.

Example: Suppose you have the mixed number $3\frac{1}{2}$. To change it to an improper fraction, multiply the whole number (3) by the denominator and to the result (6) add the numerator (1) which equals 7 . Write the sum (7) over the denominator of the original fraction (2). The improper fraction would be $\frac{7}{2}$.

ASSIGNMENT:

1. Classify the following according to the three types of fractions:

a.	$\frac{13}{12}$	e.	$\frac{35}{50}$	i.	$\frac{13}{8}$
b.	$8\frac{1}{4}$	f.	$74\frac{1}{4}$	j.	$4\frac{1}{7}$
c.	$\frac{15}{16}$	g.	$\frac{7}{12}$	k.	$\frac{16}{5}$
d.	$53\frac{5}{8}$	h.	$\frac{3}{10}$	l.	$3\frac{1}{2}$

2. Change the mixed numbers in problem 1 to improper fractions.

3. Change the improper fractions in problem 1 to mixed numbers.

4. The following figures indicate materials in inventory at the end of the month. (1) Give the type of fraction for each one. (2) Change the mixed numbers to improper fractions.

			Type	Change
a.	Spun Linen	$45\frac{7}{8}$ yds.		
b.	Broadcloth	$25\frac{3}{8}$ yds.		
c.	Dotted Swiss	$34\frac{3}{4}$ yds.		
d.	14" O. T. Zippers	$1\frac{1}{12}$ gr.		
e.	12" Pl. Zippers	$\frac{5}{12}$ gr.		
f.	7" Pl. Zippers	$\frac{1}{6}$ gr.		
g.	S. S./30 Pearl Buttons	$6\frac{5}{6}$ gr.		
h.	S. S. /36 Pearl Buttons	$1\frac{3}{4}$ gr.		
i.	Pins	$2\frac{1}{2}$ lbs.		
j.	Thread	$\frac{3}{12}$ doz.		

5. Change the following improper fractions to whole numbers or to mixed numbers:

a.	$\frac{13}{3}$	d.	$\frac{33}{8}$	g.	$\frac{32}{8}$	j.	$\frac{12}{12}$
b.	$\frac{28}{5}$	e.	$\frac{14}{4}$	h.	$\frac{13}{5}$	k.	$\frac{72}{7}$
c.	$\frac{21}{9}$	f.	$\frac{36}{6}$	i.	$\frac{17}{2}$	l.	$\frac{65}{11}$

6. Change to improper fractions:

a.	$5\frac{1}{8}$	c.	$12\frac{3}{8}$	e.	$3\frac{2}{5}$	g.	$6\frac{1}{3}$
b.	$5\frac{1}{6}$	d.	$9\frac{3}{9}$	f	$11\frac{5}{36}$	h.	$17\frac{5}{18}$

Reduction of Fractions Lesson No. 3

OBJECTIVE: To develop skill and accuracy in the reduction of fractions.

RELATED INFORMATION:

Changing the form of a fraction without changing its value is called reducing the fraction. Thus, when we change $\frac{2}{4}$ to $\frac{1}{2}$ we are reducing the fraction without changing its value. It is important that you be able to reduce and handle fractions, since this work is basic to a great part of the needle trades.

Proper fractions like $\frac{1}{16}$, $\frac{3}{16}$, $\frac{5}{16}$, and $\frac{7}{8}$ are said to be in their lowest terms. That is, both the numerator and the denominator cannot be further reduced by dividing each of them by the same number. When in this condition they are also referred to as being in their simplest form.

Such fractions as $\frac{2}{4}$, $\frac{12}{16}$, $\frac{18}{64}$ are not in their lowest terms nor in their simplest form because each may be further reduced by dividing both terms (numerator and denominator) by a number which will be exactly contained in them. This exact divisor is called a factor, and because it is common to both terms it is known as a common factor of these terms.

Both the numerator and the denominator of $\frac{2}{4}$ may be divided by 2. This number 2, therefore, is a common factor of these terms. The division reduces both terms of the fraction by changing the numerator to 1 and the denominator to 2, making the fraction read $\frac{1}{2}$ instead of $\frac{2}{4}$. This process is known as factoring.

Although the form of this fraction has been changed by this reduction, its value has not changed. To illustrate this further: $\frac{2}{4}$ of an inch equals $\frac{1}{2}$ of an inch; $\frac{2}{4}$ of 1 yard equals $\frac{1}{2}$ of a yard. In like manner $\frac{12}{16}$, and $\frac{18}{64}$ when reduced to lowest terms become $\frac{3}{4}$ and $\frac{9}{32}$ respectively. Here again the form of the fraction has been changed but the value has not changed. A fraction should always be expressed in its simplest form. That is, the the numerator and the denominator should be reduced as much as possible by dividing both terms by common factors as explained above.

PROCEDURE:

A. To reduce a proper fraction, the numerator and the denominator are divided by a number which will go into each evenly.
Example:

$$\frac{4}{8} \div \frac{4}{4} = \frac{1}{2}$$

B. To reduce an improper fraction to a whole number or to a mixed number divide the numerator by the denominator.
Example:

$$\frac{3}{2} \qquad 2\overline{)3}\ 1\tfrac{1}{2}$$

C. To change a mixed number to an improper fraction, multiply the whole number by the denominator of the fraction, and then add to this amount the numerator of the fractional part of the mixed number. Write the resulting number over the same denominator.
Example:

$$5\tfrac{3}{8} \qquad 5 \times 8 = 40 + 3 = \frac{43}{8}$$

ASSIGNMENT:

1. Reduce each of the following fractions to its lowest terms:

a. $\frac{12}{15}$	e. $\frac{24}{36}$	i. $\frac{6}{36}$	m. $\frac{35}{50}$
b. $\frac{15}{21}$	f. $\frac{27}{45}$	j. $\frac{12}{36}$	n. $\frac{12}{144}$
c. $\frac{14}{28}$	g. $\frac{9}{36}$	k. $\frac{25}{35}$	o. $\frac{67}{72}$
d. $\frac{18}{24}$	h. $\frac{60}{144}$	l. $\frac{10}{16}$	p. $\frac{16}{32}$

2. Change to improper fractions:

a. $6\frac{1}{2}$ b. $9\frac{1}{3}$ c. $3\frac{11}{12}$ d. $12\frac{3}{4}$ e. $3\frac{7}{16}$

3. Write as a whole number or a mixed number:

a. $\frac{9}{8}$ b. $\frac{24}{4}$ c. $\frac{36}{8}$ d. $\frac{13}{13}$ e. $\frac{31}{12}$

4. Change each fraction to the denominator named:

a. $\frac{3}{8}$ to $\overline{16}$	e. $\frac{7}{12}$ to $\overline{144}$	i. $\frac{12}{72}$ to $\overline{144}$
b. $\frac{11}{16}$ to $\overline{32}$	f. $\frac{12}{16}$ to $\overline{8}$	j. $\frac{1}{4}$ to $\overline{12}$
c. $\frac{2}{3}$ to $\overline{12}$	g. $\frac{8}{32}$ to $\overline{4}$	k. $\frac{5}{8}$ to $\overline{32}$
d. $\frac{3}{4}$ to $\overline{16}$	h. $\frac{1}{8}$ to $\overline{72}$	l. $\frac{3}{9}$ to $\overline{36}$

5. a. $\frac{2}{8}$ of a yard equals _____ of a yard

b. $\frac{32}{4}$ quarts of oil equals _____ qts. of oil

c. $\frac{12}{144}$ gross buttons equals _____ gr. buttons

d. $\frac{6}{16}$ lbs. of pins equals _____ lbs. of pins

e. $\frac{20}{16}$ of an inch equals _____ inches

f. $\frac{6}{8}$ of an inch equals _____ of an inch

g. $\frac{13}{8}$ of an inch equals _____ inches

h. $\frac{31}{8}$ yards equals _____ yards

OBJECTIVE: To review work in addition and subtraction of fractions.
To learn how these processes are used in the trade.

RELATED INFORMATION:

Fractions cannot be added or subtracted unless they have the same denominator. When a group of fractions have the same denominator, they are said to have a common denominator. When we have a group of fractions that do not have a common denominator, we must obtain one before we can add or subtract them.

One of the basic rules of mathematics is "only like things or parts of like things may be added or subtracted." Thus, $\frac{1}{2}$ yard cannot be added to $\frac{1}{3}$ pound. In adding or subtracting parts of like things, as $\frac{1}{8}$ of a yard, $\frac{1}{6}$ of a yard, and $\frac{1}{4}$ of a yard, not only must the things (yards in this case) be alike, but the parts of the thing must be expressed in fractions having the same denominator.

Here we find that 24 can be used as a common denominator.

Example: $\frac{1}{8}$ yard $= \frac{3}{24}$

$\frac{1}{6}$ yard $= \frac{4}{24}$

$\frac{1}{4}$ yard $= \frac{6}{24}$

PROCEDURE:

If you can't readily find the least (smallest) common denominator by examination, the following method can be used.

To find the least common denominator in the following problem:

$$\frac{3}{8} + \frac{5}{6} + \frac{3}{4} + \frac{7}{10}$$

2/8	6	4	10
2/4	3	2	5
2/2	3	1	5
1	3	1	5

a. Set the denominators down in a horizontal row as shown.

b. Divide by the smallest factor common to two or more of them. This process is continued until no two of the remaining numbers can be divided by a common factor. Since 3 and 5 have no common factor, they remain the same.

c. After all possible divisions have been completed, multiply all the numbers along the outside of the box.
Ex: 2 x 2 = 4 x 2 = 8 x 1 = 8 x 3 = 24 x 1 = 24 x 5 = 120.
120 is the least common denominator.

$$\frac{3}{8} = \frac{45}{120}$$

$$\frac{5}{6} = \frac{100}{120}$$

$$\frac{3}{4} = \frac{90}{120}$$

$$\frac{7}{10} = \frac{84}{120}$$

$$\frac{319}{120} \quad 120\overline{)319} \quad 2\frac{79}{120}$$

d. The next step in adding these fractions is to change them to equivalent fractions having 120 as their new denominator.
The numerator 45 is obtained by dividing 8 into 120 (= 15); 15 x 3 = 45. Proceeding in the same manner, we obtain 100 as numerator for the 2nd number, 90 for the 3rd, and 84 for the 4th. We now have the simple problem of adding all the new numerators and placing this sum (319) over 120 to obtain $\frac{319}{120}$. Since this is an improper fraction, we must divide 319 by 120 to get a mixed number. $(2\frac{79}{120})$

To add mixed numbers, we must find the least common denominator of the fractional portions of the mixed numbers. Thus, to add $12\frac{5}{6}$, $16\frac{7}{12}$, and $6\frac{2}{3}$, we must first find the least common denominator of $\frac{5}{6}$, $\frac{7}{12}$ and $\frac{2}{3}$.

A close examination shows that this is 12, so these fractions are changed to fractions having 12 as a denominator.

$$\frac{5}{6} = \frac{10}{12} \qquad 12\frac{10}{12}$$

$$\frac{7}{12} = \frac{7}{12} \qquad 16\frac{7}{12}$$

$$\frac{2}{3} = \frac{8}{12} \qquad \begin{array}{r} 6\frac{8}{12} \\ \hline 34\frac{25}{12} \end{array} \qquad \begin{array}{r} 2\frac{1}{12} \\ \hline 12\overline{)25} \end{array}$$

$$\begin{array}{r} 34 \\ 2\frac{1}{12} \\ \hline 36\frac{1}{12} \end{array}$$

Adding the fractions first, the total is $\frac{25}{12}$, which is an improper fraction. Simplify this to $2\frac{1}{12}$. This is then added to 34, making a total of $36\frac{1}{12}$.

Subtraction of fractions, like addition, also requires a least common denominator.

Example: Subtract $\frac{3}{8}$ from $\frac{7}{8}$.

$$\begin{array}{r} \frac{7}{8} \\ -\ \frac{3}{8} \\ \hline \frac{4}{8} = \frac{1}{2} \end{array}$$

Example: Subtract $1\frac{3}{4}$ from $2\frac{7}{8}$

$$\begin{array}{rcr} 2\frac{7}{8} & = & 2\frac{7}{8} \\ -\ 1\frac{3}{4} & = & 1\frac{6}{8} \\ \hline & & 1\frac{1}{8} \end{array}$$

ASSIGNMENT:

1. Find the least common denominator for the following fractions and add:

   a. $\frac{1}{2} + \frac{3}{4} + \frac{5}{8}$

   b. $\frac{9}{16} + \frac{3}{8} + \frac{5}{12}$

   c. $\frac{7}{12} + \frac{1}{4} + \frac{3}{8}$

   d. $\frac{3}{5} + \frac{9}{12} + \frac{17}{30}$

2. Sample pieces of fabric measuring $3\frac{5}{8}$, $4\frac{3}{4}$ and $5\frac{1}{2}$ yards were used to make dresses requiring $3\frac{1}{2}$, $4\frac{3}{4}$, and $4\frac{1}{4}$ yards. How much fabric was left?

3. Add the following:

a. $\frac{3}{8}$	b. $\frac{7}{36}$	c. $\frac{3}{4}$	d. $\frac{2}{3}$	e. $\frac{2}{5}$
$\frac{5}{8}$	$\frac{9}{36}$	$\frac{1}{2}$	$\frac{5}{6}$	$\frac{1}{2}$
$\frac{1}{8}$	$\frac{11}{36}$	$\frac{3}{8}$	$\frac{11}{12}$	$\frac{7}{10}$

4. The following quantities of materials and notions were used in making garments ordered by customers. Find the total of each:

a. Linen: $65\frac{7}{8}$, $57\frac{3}{8}$, $35\frac{1}{4}$, $30\frac{1}{2}$ yds.

b. Buttons: $7\frac{5}{6}$, $10\frac{3}{12}$, $5\frac{1}{6}$, $11\frac{2}{3}$ gross

c. Pins: $3\frac{1}{8}$, $2\frac{1}{2}$, $\frac{3}{4}$, $4\frac{3}{16}$ pounds

5. There were $15\frac{3}{12}$ gross of buttons in inventory at the beginning of the month. During the month, $6\frac{1}{6}$ gross were used. What was left?

6. In joining two pieces of material together, a $\frac{7}{8}$ inch seam was taken. In pinking the seam, $\frac{1}{4}$ inch was trimmed. How much seam remained?

7. The fabric inventory showed that there were $155\frac{3}{8}$ yards of linen on hand. The inventory at the end of the following month showed a balance on hand of $69\frac{3}{4}$ yards. How much linen had been used?

8. The following bolts of broadcloth were used up in making a quantity of blouses: $40\frac{3}{4}$, $35\frac{7}{8}$, $31\frac{1}{2}$, $19\frac{2}{3}$, and $30\frac{1}{6}$ yards. What was the total fabric used?

9. A dressmaker needs 5 pieces of cloth measuring $4\frac{2}{3}$, $7\frac{1}{2}$, $2\frac{5}{8}$, $4\frac{3}{4}$, and $3\frac{7}{8}$ yards. How many yards of cloth should she buy?

10. From a bolt containing $30\frac{5}{8}$ yards, a clerk sold $3\frac{3}{4}$ yards. How many yards were left on the bolt?

OBJECTIVES: To learn how the multiplication of fractions is used in the trade.
To develop skill in multiplication of fractions.

RELATED INFORMATION:

You will find many problems in needle trades that require a quick and accurate knowledge of multiplying fractions. The multiplication of fractions may be somewhat shortened by the process of cancellation. This is accomplished by striking out, or canceling, factors that are common to both numerator and denominator. How this is done is illustrated in the following problem:

Multiply: $\frac{3}{4} \times \frac{7}{12} \times \frac{8}{21}$

Working out the cancellation, the solution becomes:

$$\frac{\overset{1}{\cancel{3}}}{\underset{1}{\cancel{4}}} \times \frac{\overset{1}{\cancel{7}}}{\underset{6}{\cancel{12}}} \times \frac{\overset{1}{\cancel{8}}}{\underset{\underset{1}{\cancel{3}}}{\cancel{21}}} = \frac{1}{6}$$

Cancellation is really a reduction to lowest terms before multiplying takes place. This reduction is accomplished by dividing both terms of the fraction by factors that are common to each. The method of cancellation as used in the above problem is explained as follows:

Seven is a factor of 7 in the numerator and 21 in the denominator. These are "cancelled" by drawing a line through each number and placing above the numerator and below the denominator the figures which represent the number of times this factor 7 is contained in 21. Cancel the rest of the numbers in the same way.

To obtain the result of this cancellation, all uncanceled terms remaining in the numerator are multiplied together for a new numerator, and all uncanceled terms remaining in the denominator are multiplied together for a new denominator.

There are four types of operations involved in multiplying fractions. They are:

a. Multiplying a fraction by a fraction.
b. Multiplying a fraction by a whole number.
c. Multiplying a mixed number by a whole number.
d. Multiplying a mixed number by a mixed number.

PROCEDURE:

Type A: Multiplying a fraction by a fraction:

Example: $\frac{3}{4} \times \frac{1}{2} \times \frac{5}{8} \times \frac{8}{9}$

1. Cancel or reduce any numerator or denominator that can be divided by the same number.

2. Multiply the uncanceled terms remaining in the numerator for a new numerator.

3. Multiply the uncanceled terms remaining in the denominator for a new denominator.

Type B: Multiplying a fraction by a whole number.

Example: $8 \times \frac{3}{4}$

1. Change the whole number to an improper fraction.

$$\frac{8}{1} \times \frac{3}{4}$$

2. Cancel terms wherever possible.

3. Multiply numerators.

4. Multiply denominators.

5. Change answer to whole number, mixed number, or proper fraction in its lowest terms.

Type C: Multiplying a mixed number by a whole number.

Example: $4 \times 3\frac{1}{2}$

1. Change the whole number and the mixed number to improper fractions.

$$\frac{4}{1} \times \frac{7}{2}$$

2. If possible, cancel terms.

3. Multiply numerators.

4. Multiply denominators.

5. Change to whole number, proper fraction, or mixed number.

OR

$$\begin{array}{r} 4 \\ \times\ 3\tfrac{1}{2} \\ \hline 2 \\ 12 \\ \hline 14 \end{array} \qquad \begin{array}{l} \tfrac{1}{2} \text{ of } 4 = 2 \\ 3 \times 4 = 12 \\ \hline 14 \end{array}$$

Type D: Multiplying a mixed number by a mixed number.

Example: $4\frac{1}{2} \times 8\frac{1}{4}$

1. Change the mixed numbers to improper fractions. $\frac{9}{2} \times \frac{33}{4}$
2. Cancel where possible (none in this case).
3. Multiply numerators. $9 \times 33 = 297$
4. Multiply denominators. $2 \times 4 = 8$
5. Change to whole number, mixed number, or proper fraction.

$$\frac{8/297}{37\frac{1}{8}}$$

ASSIGNMENT:

1. Work the following problems. Be on the alert for cancellations. Reduce answers to lowest terms.

a. $\frac{1}{2} \times \frac{3}{8}$

b. $\frac{3}{16} \times \frac{1}{2} \times \frac{1}{4}$

c. $\frac{5}{16} \times \frac{2}{5}$

d. $\frac{5}{6} \times \frac{7}{12} \times \frac{9}{36}$

e. $\frac{2}{3} \times \frac{7}{12}$

f. $5 \times \frac{3}{12}$

g. $10 \times \frac{5}{6}$

h. $9 \times \frac{1}{8}$

i. $2\frac{5}{8} \times 7$

j. $5\frac{1}{2} \times 8$

k. $14 \times \frac{2}{3}$

l. $7 \times \frac{5}{8}$

m. $12\frac{1}{2} \times 8\frac{1}{4}$

n. $5\frac{1}{2} \times 6\frac{3}{4}$

o. $2\frac{1}{12} \times 1\frac{7}{8}$

p. $\frac{5}{32} \times 3$

q. $16 \times \frac{5}{12}$

r. $9 \times 3\frac{1}{8}$

2. A dressmaker has an order to make 4 dresses; $3\frac{1}{2}$ yards are needed to make one dress. How many yards will she need?

3. If it takes $1\frac{1}{4}$ hours to make a blouse, how long will it take to make 14 blouses?

4. Each scallop on the neckline of a blouse measures $1\frac{1}{8}$ inches. If there are 14 scallops, what is the measurement of the neckline?

5. One skirt requires $2\frac{3}{8}$ yards. How much yardage will a dozen skirts need?

6. Compute the following:

a.	$\frac{1}{2}$ yd. x 3	_____ yds. of fabric
b.	$\frac{1}{4}$ yard x 8	_____ yds. of bias tape
c.	16 tucks x $\frac{1}{2}$ inch	_____ inches
d.	$4\frac{1}{2}$ hours x 50 employees	_____ working hours
e.	72 x $\frac{1}{4}$ oz. balls of cording	_____ ozs.
f.	$4\frac{5}{12}$ x 8	_____ gross
g.	9 x $6\frac{1}{2}$ yards	_____ yards

7. Figure the fabric yardage needed, using the following quantities and yardage per garment:

	Style #	Yds. Per Garment	Quantity to be Made
a.	101	$2\frac{1}{16}$	79
b.	105	$3\frac{1}{2}$	132
c.	107	$4\frac{1}{3}$	111
d.	110	$3\frac{5}{8}$	51
e.	111	$1\frac{3}{8}$	60

Division of Fractions **Lesson No. 6**

OBJECTIVE: To review methods for the division of fractions as used in the trade.

RELATED INFORMATION:

During the day the needle trades worker often finds it necessary to divide fractional measurements of materials, divisions of time, numbers of articles, or amounts of money.

PROCEDURE:

There are as many types of operations in division as in multiplication of fractions. In division, one basic rule applies: invert the divisor and proceed as in multiplication.

Example: $\frac{1}{2} \div 3 = \frac{1}{2} \div \frac{3}{1} = \frac{1}{2} \times \frac{1}{3} = \frac{1}{6}$

Invert the terms of the divisor (turn the fraction upside down) and then proceed as in multiplying fractions. In this method, cancellation may be used.

To divide a mixed number by a whole number or vice versa, change both numbers to improper fractions before proceeding to invert the divisor and multiply.

ASSIGNMENT:

1. Work out the following problems:

a. $\frac{1}{8} \div 2$

b. $\frac{3}{10} \div 5$

c. $3 \div \frac{1}{2}$

d. $12 \div \frac{1}{3}$

e. $\frac{9}{16} \div 3$

f. $3\frac{3}{4} \div 5$

g. $276\frac{5}{6} \div 8$

h. $2\frac{1}{3} \div 6$

i. $328\frac{3}{8} \div 9$

j. $328\frac{3}{4} \div 5$

2. Three-quarters of a yard divided by two equals _____

3. How many $\frac{3}{4}$ units can be obtained from a $2\frac{1}{4}$ unit?

4. Nine buttons are placed in a 12-inch space. The first and last buttons are at the ends of the cloth. Give the distance apart.

5. Give the size scallop that will result if $17\frac{1}{2}$ inches is divided into 7 scallops.

6. Thirteen hems were made in $22\frac{3}{4}$ hours. Give the average time for making one hem.

7. Work out the following problems:

a. 12 yds. $\div \frac{1}{2}$	f. $\frac{1}{2}$ yd. $\div$ 4
b. 16 in. $\div \frac{1}{2}$	g. $\frac{3}{4}$ yd. $\div$ 2
c. 8 in. $\div \frac{1}{4}$	h. 20 in. $\div \frac{1}{5}$
d. $\frac{1}{4}$ doz. $\div$ 3	i. 9 yds. $\div \frac{1}{3}$
e. $\frac{1}{2}$ doz. $\div$ 6	j. 12 yds. $\div \frac{1}{3}$

8. The finished length of a coat dress is $43\frac{3}{4}$ inches from the neck to hem. Plan the spacing for 14 buttons. (The first button is at the neckline and the last space is equal to the others.)

9. In trimming a gathered skirt with rickrack, a dressmaker decided to use 8 rows of evenly spaced rickrack, leaving a space above and below the rickrack. The finished length was 27 inches. What would the spacing be between the rows of rickrack?

10. How many quarter-yard pieces of ribbon can be cut from:

a. $5\frac{3}{4}$ yd.? b. $7\frac{1}{4}$ yd.? c. $10\frac{1}{4}$ yd.?

11. How many $\frac{1}{2}$ yard banners can be made from:

a. $6\frac{1}{2}$ yds.? b. 15 yds.? c. $11\frac{1}{2}$ yds.?

12. One-third of a dozen is how many? Are you multiplying or dividing? By what?

Pre-Test No. 3

1. Change $103\frac{1}{2}$", 81", 88", $22\frac{1}{2}$", and 12" to yards. Add the total yardage.

2. How many yards are needed for 6 dresses, each requiring 3 yards and 14"?

3. 18" is what part of a yard?

4. List the following fractions of an inch--largest first.

$$\frac{7}{8}, \quad \frac{3}{16}, \quad \frac{3}{4}, \quad \frac{2}{8}, \quad \frac{1}{2}, \quad \frac{15}{16}$$

5. If a dozen buttons cost 42¢, what is the cost of one button?

6. A piece of lace insertion at 3¢ a yard costs $12.60. How many yards were in the piece?

7. What is the cost of 6 dozen pearl buttons @ $2.70 a gross?

8. At 52¢ a dozen spools, what is the cost of $2\frac{1}{2}$ gross spools of thread?

9. Find the cost of $10\frac{1}{2}$ pounds of dressmaker pins @ 30¢ a quarter pound.

10. How many pairs of pads in a shipment of 376 pads?

11. How many quarts of oil are there in $3\frac{1}{2}$ gallons?

12. If 24" of material costs 36¢, what would $1\frac{1}{2}$ yards cost?

13. True and False:

a.	6 yards	=	206 inches
b.	$4\frac{1}{2}$ inches	=	$\frac{1}{8}$ yard
c.	$\frac{17}{8}$ yards	=	$2\frac{1}{8}$ yards
d.	4 gills	=	1 gallon
e.	8 pints	=	4 quarts
f.	40 ounces	=	$2\frac{1}{2}$ lbs.
g.	$\frac{1}{4}$ hour	=	20 minutes
h.	¢	means	dollars
i.	53 quarters	=	$13.00
j.	$\frac{5}{8} - \frac{2}{4}$	=	$\frac{3}{4}$

UNIT III - MEASUREMENTS

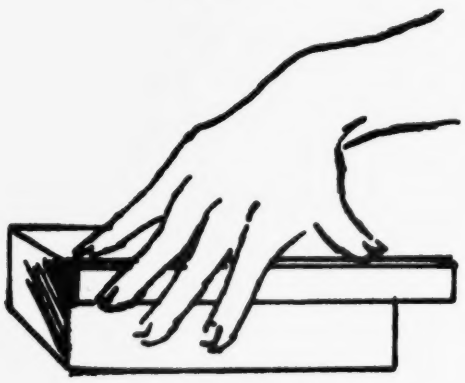
Review **Lesson No. 1**

OBJECTIVE: To recall the terms necessary to the study of measurement as applied to the work in needle trades.

RELATED INFORMATION:

To measure any object means to apply some unit of measure to it. Without a system of measurement it would be impossible to carry on any kind of a business. In the garment industry, fabric, ribbons, and some notions are purchased by the yard; buttons by the gross; pins by the pound; and cleaning fluid by the gallon. It is important, therefore, to know the measures common to the needle trades and to understand how to apply them.

FOOT



SPAN

The idea of numbers originally started with counting on the fingers. So measurement was first connected with parts of the body. Thus we had the foot, the span, the finger, and the joints on the finger all used as units of measure. The yard was taken as the distance from the tip of the nose to the outstretched fingers.
Because each town had its own standards of measure, it made a great deal of difference whether one bought a yard of cloth in Venice, in Genoa, or in London. It didn't take long to find out that one man's rule of measuring "a yard" from the tip of his nose to outstretched fingers was not the same as another's. Because of this, steps were taken to adopt standards of measure.

Any length could be used as a unit in measuring lengths. But lengths cannot be compared unless the units in measuring them are the same. Today nearly every nation has fixed standard units which everyone must use. At the Bureau of Standards in Washington, D. C., you can see the bar on which one yard is marked. The distance between two marks on the bar (at a certain temperature) is defined to be one yard.

Being able to measure length, time, weight, and other quantities helps us to make ourselves understood clearly by other people. It also cuts down on waste of time and materials.

PROCEDURE:

In using measuring tools, there are a few simple rules to be mastered.

1. To measure directly with a ruler, place the end of the ruler flush with one end of the object to be measured. Glance along the ruler to the other end of the object. Read the marking on the ruler at this point as the measurement.

2. If the end of the ruler is badly worn, it would be better to place the one-inch mark of the ruler flush with the end of the object to be measured. But then you must remember to subtract that inch from your final marking.

The following tools will be needed in this lesson:

6-inch or 12-inch ruler, yardstick, tape measure.

ASSIGNMENT:

1. Measure the width of the schoolroom using your foot as a unit of measure. Then measure it with a yardstick and compare the two measurements.

2. The first joint of the thumb is sometimes taken as one inch. Measure and see if this is so in your case. If it isn't, see if you have a joint on one of your fingers which is one inch. Use this joint to measure the length of a page in this book. Then measure the page with a ruler.

3. Measure the length of lines a, b, c.

   a. _____

   b. _____

   c. _____

4. Another interesting unit of measure based on a part of the body was the digit. The digit was the size across the middle finger at the center. The digit was about $\frac{3}{4}$ inch. The width of four fingers from the waistline has been used many times for the placement of a pocket. Measure the width of your four fingers and compare this with the measurement of the distance between the waistline and the pocket in any skirt pattern or ready-made skirt available.

5. What measurements are necessary to consider if you wish to make a dress?

Use of a Gauge | Lesson No. 2

OBJECTIVES: To learn how to make and use a gauge.

To learn the importance of accuracy when working with parts of an inch.

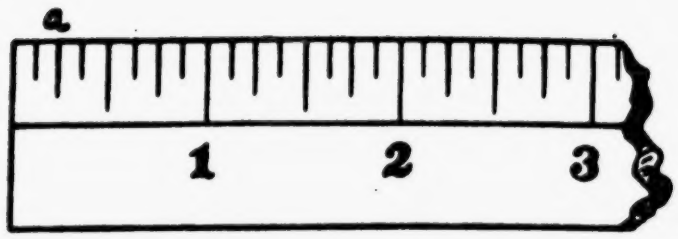
RELATED INFORMATION:

How often have you needed a small measuring tool to help you turn up a hem of a dress accurately when altering it? You probably found that a piece of cardboard cut to the measurement of the width of the hem being altered proved to be a simple and accurate tool. There are many instances when you will find a small, accurate measuring tool an aid in your shop work. The simplest and most dependable device is a gauge, which you can make for any special measurement you need. In addition to being used for measuring hems, gauges are used for measuring spaces between tucks, buttons, snaps, and pleats, and for any other operation that requires a small measuring tool. Today you will find a variety of plastic gauges on the market for these purposes.

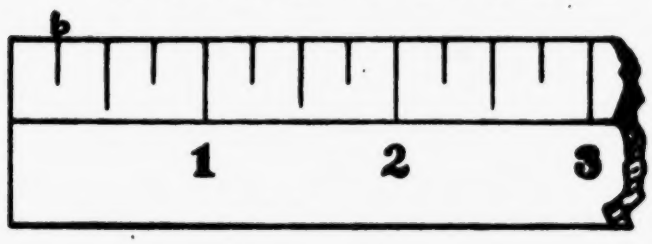
In making your own gauge, it is important to understand the parts of an inch. The inch is mankinds' oldest unit of length.

As you have learned in Unit II, we use the term fraction to mean a part of something or one or more of the equal parts of a whole thing. To do well in any job in the needle trades, you must know how to compute with fractions, especially in measurements.

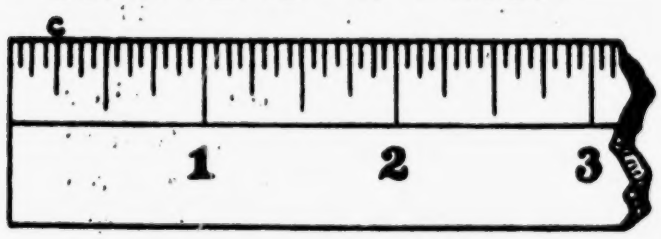
In the following drawings you can see equal parts of an inch. Note that although the three rulers are divided differently, they are all three inches long.



EIGHTHS - 1/8 INCH



QUARTERS - 1/4 INCH



SIXTEENTHS - 1/16 INCH

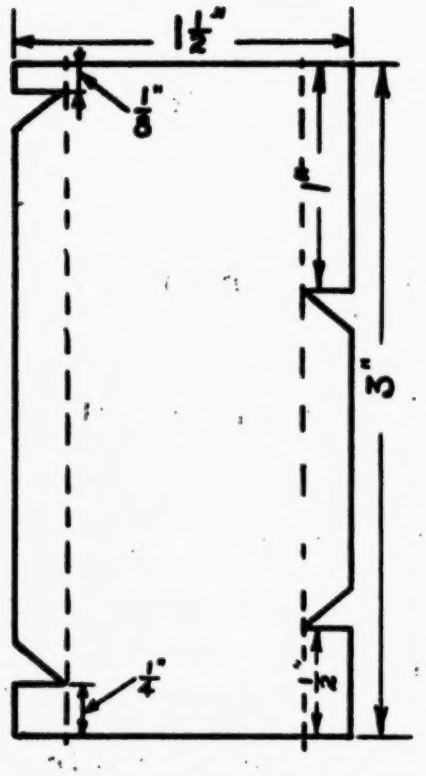
1. Into how many parts is the inch in the top drawing divided? Each part is what part of an inch? Write this fraction.

2. Into how many parts is the inch in the center drawing divided? Each part is what part of an inch? Write this fraction.

3. Into how many parts is the inch in the bottom drawing divided? Each part is what part of an inch? Write this fraction.

In checking the drawings, you can see that a, b, c, are all the same measurement even though they are $\frac{2}{8}''$, $\frac{1}{4}''$, and $\frac{4}{16}''$.

In needle trades, the ruler or tape measure ordinarily used to measure lengths is divided into inches, and each inch is divided into either 2, 4, 8, 16, or 32 equal parts, depending upon the nature of the work that is to be measured. In making a gauge, we will work with $\frac{1}{2}$, $\frac{1}{4}$, and $\frac{1}{8}$, since the work you will be doing seldom calls for measurement more accurate than $\frac{1}{16}$ of an inch.



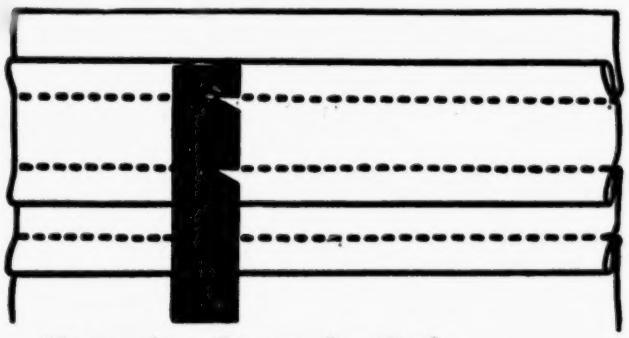
PROCEDURE:

Cut a piece of cardboard to measure 3" by 1½". Measure in ¼" from each of the long sides and draw a line parallel to each edge. Mark your measurement along this line, using the measurements from the sample gauge shown here.

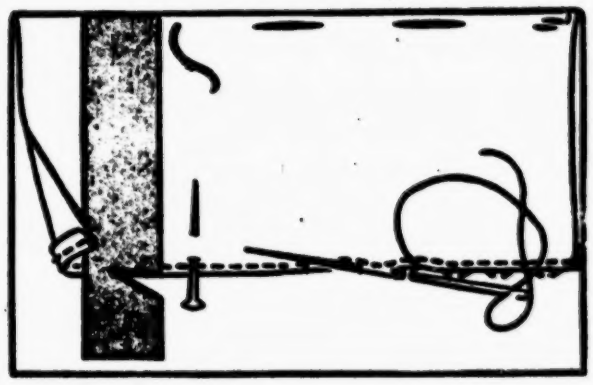
Cut in on a straight line to each mark, then clip on a slant line to notch. The distance from the corner to the straight line of the notch is the measure used.

The gauge must be very accurate, or the gauge is of no value to you.

Two Common Uses of the Gauge in Needle Trades



Measuring Gauge for Tacks



Slip-Stitched Hem

ASSIGNMENT:

1. Following the directions on the previous page, make a cardboard gauge as shown with the following measurements indicated on the gauge:
   $\frac{1}{4}''$, $\frac{5}{8}''$, $\frac{3}{4}''$, $1''$, and $2''$.

2. Make a gauge which you would use in making a hem, marking $2''$ and $3''$.

3. A dressmaker said, "Place a pin at the $\frac{3}{4}$ mark of a length of cloth."

   a. Into how many parts was the dressmaker thinking the length was divided?

   b. How many of these parts was she thinking about?

4. Would you expect the sum of $\frac{3}{4}''$ and $\frac{1}{2}''$ to be more or less than $1''$? Explain.

5. Joan added $\frac{3}{4}$ and $\frac{1}{2}$ and got $\frac{4}{6}$ or $\frac{2}{3}$. Explain why $\frac{2}{3}$ is the wrong answer. What mistake did Joan make?

6. Would you expect the sum of $\frac{5}{8}$ and $\frac{1}{4}$ to be closest to $\frac{1}{2}$, 1, or $1\frac{1}{2}$? Explain.

7. Suppose you were asked to make a hem on a garment $\frac{1}{2}''$ less than the pattern was marked. The pattern marking was $\frac{15}{16}''$. Would you expect the finished hem to be closest to $\frac{1}{4}''$, $\frac{1}{2}''$, $\frac{3}{4}''$, or $1''$? Explain.

8. If you were asked to trim $\frac{1}{16}''$ away from a seam that was $\frac{3}{8}''$, would you expect the remaining seam to be more than $\frac{1}{4}''$ but less than $\frac{3}{8}''$? Explain.

9. Bring illustrations of specific uses of gauges in the trade.

Linear Measure Equivalents — Lesson No. 3

OBJECTIVE: To learn the linear measure as applied to needle trades.

RELATED INFORMATION;

Linear or "long" measure is used daily in the needle trades field. Fabrics, ribbons, braids, cable cord, and many other notions cannot be handled unless you have a working knowledge of the linear table which follows:

12 inches (in. or ")	equals	1 foot (ft. or ')
3 feet	equals	1 yard (yd.)
36 inches	equals	1 yard

PROCEDURE:

List the tools that are used for measuring lengths in the needle trades room.

Measure the lengths of ribbon, fabric, zippers, rickrack, and cable cord given to you by the instructor.

Most figuring in the needle trades can be done mentally once you have a clearer understanding of the relationship of the units to each other. Since one foot is one-third of a yard, 12 inches, which equal 1 foot, is also one-third of a yard. You can also see that 36 inches, which is 3 feet, is also one yard.

ASSIGNMENT:

1. What part of a foot is one inch?
2. What is meant by a foot in terms of inches?
3. What part of a yard is one foot?
4. What is meant by a yard in terms of inches?
5. What is a yardstick?
6. What is a tape measure? How long is your tape measure?
7. The number of yards in 72" equals _____?
8. The number of inches in 3 yards equals _____.
9. The number of yards in 180 inches equals _____.
10. The number of inches in 7 yards equals _____.

Use of a Yardstick **Lesson No. 4**

OBJECTIVE: To learn the fractional parts of the yardstick as used in the needle trades.

RELATED INFORMATION:

The most common tool used in the measuring of fabric and notions is the yardstick. It is divided into halves, quarters, and eighths. A garment worker seldom uses the unit foot in working with fabrics or yard goods. Perhaps the only time the term is used is in measuring work area in a factory. All fabrics received from "piece goods houses" (manufacturers or distributors of fabrics) are usually marked in eighths. Almost all measurements are spoken of in inches and yards.

Linear measure equivalents are used constantly in the trade, and all needle trades workers should know the fractional equivalents of yards in inches. The student should memorize the following parts of the yard:

36" equals 1 yard	$4\frac{1}{2}$" equals $\frac{1}{8}$ yard
9" equals $\frac{1}{4}$ yard	$13\frac{1}{2}$" equals $\frac{3}{8}$ yard
18" equals $\frac{1}{2}$ yard	$22\frac{1}{2}$" equals $\frac{5}{8}$ yard
27" equals $\frac{3}{4}$ yard	$31\frac{1}{2}$" equals $\frac{7}{8}$ yard

PROCEDURE:

Examine carefully a yardstick from the needle trades shop. You will notice that one side is marked in fractions of a yard and the other side is marked in inches divided into eighths. Using cord or ribbon, measure the following lengths:

$\frac{7}{8}$ yd., $\frac{1}{2}$ yd., $1\frac{3}{8}$ yd., $\frac{1}{8}$ yd.

Practice Mental Drill

1. In order to save time in the adding or subtracting of fractions of a yard, the equivalent fractional form should be arrived at mentally. Practice orally the following:

a.	$\frac{1}{2}$ yd.	=	$\frac{\quad}{4}$ yd.	g.	$\frac{1}{2}$ in.	=	$\frac{\quad}{16}$ in.
b.	$\frac{1}{4}$ yd.	=	$\frac{\quad}{8}$ yd.	h.	$\frac{3}{4}$ in.	=	$\frac{\quad}{16}$ in.
c.	$\frac{1}{2}$ yd.	=	$\frac{\quad}{8}$ yd.	i.	$\frac{1}{8}$ in.	=	$\frac{\quad}{16}$ in.
d.	$\frac{3}{4}$ yd.	=	$\frac{\quad}{8}$ yd.	j.	$\frac{3}{8}$ in.	=	$\frac{\quad}{16}$ in.
e.	$\frac{6}{8}$ in.	=	$\frac{\quad}{4}$ in.	k.	$\frac{5}{8}$ in.	=	$\frac{\quad}{16}$ in.
f.	$\frac{4}{8}$ in.	=	$\frac{\quad}{2}$ in.	l.	$\frac{7}{8}$ in.	=	$\frac{\quad}{16}$ in.

2. Give the number of inches in each of the following:

a.	$1\frac{1}{4}$ yds.	e.	$\frac{3}{4}$ yard
b.	$\frac{1}{2}$ yard	f.	$3\frac{1}{2}$ yards
c.	$\frac{7}{8}$ yard	g.	$1\frac{3}{8}$ yards
d.	$\frac{1}{8}$ yard	h.	$2\frac{2}{4}$ yards

ASSIGNMENT:

1. If you purchase the following lengths of fabric, you should know the parts of a yard that they represent:

a.	$22\frac{1}{2}$"	_____	g.	9"	_____
b.	18"	_____	h.	$13\frac{1}{2}$"	_____
c.	27"	_____	i.	45"	_____
d.	$31\frac{1}{2}$"	_____	j.	$40\frac{1}{2}$"	_____
e.	36"	_____	k.	54"	_____
f.	$4\frac{1}{2}$"	_____	l.	63"	_____

2. What is the number of yards and inches in 110 inches of grosgrain ribbon?

3. Each student needs one strip of twill tape 4 inches long. How much tape will be needed for 20 students?

4. Using the rule for changing mixed numbers into improper fractions, change the following mixed numbers:

a.	$1\frac{1}{4}$ yds.	to $\frac{}{8}$ yd.	f.	$5\frac{5}{8}''$	to $\frac{}{8}$ inches
b.	$3\frac{1}{2}$ yds.	to $\frac{}{8}$ yd.	g.	$3\frac{3}{8}''$	to $\frac{}{16}$ inches
c.	$2\frac{3}{4}$ yds.	to $\frac{}{8}$ yd.	h.	$1\frac{3}{4}''$	to $\frac{}{16}$ inches
d.	$4\frac{7}{8}$ yds.	to $\frac{}{8}$ yd.	i.	$7\frac{7}{8}$ yd.	to $\frac{}{8}$ yd.
e.	$2\frac{1}{8}$ in.	to $\frac{}{16}$ in.	j.	$8\frac{3}{4}$ yd.	to $\frac{}{4}$ yd.

5. From a $1\frac{1}{2}$ yard "cut" of dotted swiss, how many $\frac{1}{8}$ yd. strips for ruffling can be cut on the crosswise grain?

6. The yardage needed for an apron is $1\frac{1}{8}$ yds. How much material is needed for 24 aprons?

7. At the beginning of the term, the needle trades class had an order to make 32 pinafore aprons. The material needed for one pinafore was $2\frac{7}{8}$ yds. There were on hand 3 bolts of material measuring $35\frac{5}{8}$ yds., $30\frac{2}{8}$, and $30\frac{3}{8}$ yds. What were the lengths of the remnants left?

8. If 45 yards of material were used for a class of 30 students, what was the average amount used by each student?

9. If 16 inches was cut from a $1\frac{5}{8}$ yard remnant, how much remained?

10. If you bought $5\frac{3}{4}$ yards of silk shantung for a dress, and $\frac{3}{8}$ of a yard remained, how much was used?

11. In distributing bias tape, $\frac{7}{8}$ of a yard was cut from a $40\frac{1}{2}''$ piece. What part of a yard remained?

12. From a piece of cloth measuring $30\frac{3}{8}$ yards, $2\frac{1}{4}$ yards were cut at one time and $5\frac{3}{8}$ yards at another. How much was left?

13. How many children's dresses can be made from a 42-yard bolt of fabric when it takes $3\frac{1}{2}$ yards for each dress?

14. Mary Jane bought what she thought was enough fabric to make a dress. In cutting the fabric, she found she needed another half yard. The store had sold all the fabric and Mary Jane could not make the dress. What should she have done before buying the fabric?

15. How many pieces of ribbon 8" long can be cut from a bolt whose length is:

    a. 10 yards b. 12 yards c. 15 yards d. 9 yards?

16. Towels require 42 inches of material. How many towels can be cut from a bolt that contains:

    a. 20 yards b. 14 yards c. 15 yards d. 21 yards
    e. 25 yards?

17. Dresses that require $4\frac{1}{2}$ yards are to be cut from a bolt of spun linen. How many can be cut if the bolt measures:

    a. 65 yds. b. 30 yds. c. $58\frac{1}{2}$ yds. d. 81 yds.?

UNIT III - MEASUREMENT

Use of the Tape Measure **Lesson No. 5**

OBJECTIVE: To learn how to use the tape measure and to understand the importance of accurate measurement in achieving quality workmanship.

RELATED INFORMATION:

Accurate measurement is absolutely necessary for good trade workmanship. You wouldn't consider using a yardstick to measure your waist, but perhaps you have used a piece of cord. A much better tool for measuring the waistline is the tape measure. Measurements are reliable guides and accurate measurements are indispensable.

The tape measure is used constantly to measure irregular, curved, and straight surfaces in trade work. Tape measures come in various lengths. The one most commonly used by the needle trades is made of cloth and is 60 inches long. In your selection of a tape measure be sure it has metal ends and is marked on both sides.

Due to the structural lines of the body, it is necessary to use a tool for measuring which will curve with these lines. Therefore, a cloth tape measure is the only measuring device that can answer the purpose. Accuracy in measuring, results in a saving of time and energy for all needle trades workers involved in the manufacturing of garments.

PROCEDURE:

Working with a tape measure, count the divisions in an inch. Name the smallest divisions of an inch on the tape measure. Compare the divisions on the tape measure with the divisions on a ruler. If you have not mastered the division of a yard, you can work out the parts of a yard using a tape measure. Since the tape measure is made of cloth, you can fold it very easily. Placing a pin at 36", which is one yard, fold the edge of the tape measure to meet the 36" mark; this will show you that 18" equals one-half yard. Dividing the tape measure in half again will show you that 9" equals one-quarter of a yard.

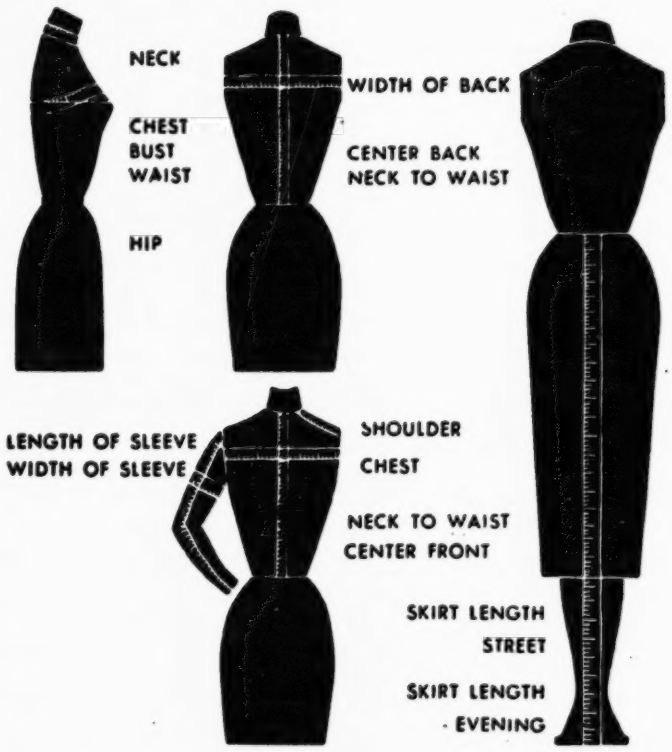
Having located the lines on the actual figure or dress form to be measured, the next step is to take measurements. A dressmaker taking measurements of customers must be sure the person being measured is standing erect, yet in an easy position, with the weight evenly distributed on both feet. The person taking the measurements must be accurate in placing the tape measure on the lines. She must be accurate in reading and recording the measurements. A chart for body measurements is suggested for this record.

Chest—in. taken around the body above the bust up under the arms.

Bust—in. taken around the body over the fullest part of the bust.

Waist—in. taken around the natural waistline.

Hip—in. taken around the fullest part. about 7 inches below natural waistline. or lower if necessary.



Measurement Chart	My Measurements
BUST (around fullest part)	
WAIST (snug)	
HIP (about 7 inches below waist or fullest part.)	
NECK (around base of neck)	
WRIST (not too tight)	
BACK LENGTH TO WAIST (base of neck to waistline)	
FRONT LENGTH TO WAIST (base of neck to waistline)	
SHOULDER (neck to armhole)	
WIDTH OF BACK (armhole to armhole, 4 inches down from shoulder seam)	
WIDTH OF CHEST (armhole to armhole above bust)	
LENGTH OF SLEEVE (top of arm to wrist, arm bent)	
WIDTH OF SLEEVE (around fullest part above elbow)	
BACK SKIRT LENGTH (waist to hem)	
FRONT SKIRT LENGTH (waist to hem)	

ASSIGNMENT:

1. Using a tape measure, take the measurements of a fellow student as described in the measurement chart included in this lesson.

2. Record the measurements of all dress forms used in the needle trades classes.

Unit Measure Lesson No. 6

OBJECTIVE: To gain skill in converting various units of measure.

RELATED INFORMATION:

In the needle trades industry, the trimming buyer, operator, cutter, finisher, draper, and sample hand at one time or another meet the problem of counting units or working with units.

The trimming buyer orders all findings, notions, etc. needed to complete garments. Most of these items are sold by the unit; therefore the unit measure, which is one of the simplest to learn, is used by her daily.

Many factories manufacturing small items or inexpensive garments pay their workers by the dozen or gross. An operator or finisher can easily check her pay at the end of the week if she understands the unit measure.

Example: An operator made 110 items and the price quoted for labor was 15¢ a dozen. She received $1.20 for this work. In checking, she found she should have received $1.37.

In the designing of a garment, you will notice many items that have two similar pieces. These two pieces constitute a pair. Sleeves, cuffs, two-gore skirt fronts, two-gore skirt backs. Therefore, 12 units of the same item would be six pairs. If we had sleeves for 12 blouses this would be 12 pairs or one dozen pairs of sleeves.

PROCEDURE:

Learn the following unit measure:

2 units	=	1 pair
12 units	=	1 dozen (doz.)
12 dozen	=	1 gross (gr.)
144 units	=	1 gross (gr.)
12 gross	=	1 great gross (gt. gr.)

ASSIGNMENT:

1. How many pairs of pads are there in 3 dozen? 5 dozen? 7 dozen?

2. How many dozen pockets are there in a bundle of 180? 132? 60? 108? 90? 80?

3. Express $2\frac{1}{2}$ gross in terms of dozens.

4. If the U. S. manufactured 35,553,731 gross of buttons in a certain year, how many buttons were manufactured?

5. There are 6 buttons sewed on a card. Figure the number of dozens of buttons on 36 cards, on 60 cards, on 80 cards.

6. How many dozen blouses are there in a bundle of 186? 148? 120?

7. How many gross yards of red bias tape are contained in 576 yards? 720 yards? 432 yards?

8. The following orders for pads were placed by the trimming buyer: 124 pairs for style #601, 162 pairs for style #603, 86 pairs for style #607. How many pairs of shoulder pads are needed for the three styles combined? How many dozen pairs of shoulder pads?

9. How many gross of buttons are needed for the following order:

	Style #	Amount of Dresses	# of Buttons on a Dress
a.	602	284	7
b.	601	176	5
c.	604	98	4
d.	603	144	6
e.	605	242	3
f.	607	379	14
g.	609	165	10
h.	611	137	11

10. Figure the price per unit if the following items are sold by the dozen:

    a. Handbags @ $21.36 per dozen
    b. Blouses @ $19.80 a dozen
    c. Belgian beaded handbags @ $186. a dozen
    d. Stockings @ $9.00 a dozen
    e. Stretch stockings @ $10.50 per dozen
    f. Tailor's chalk @ 15¢ a dozen
    g. $4\frac{1}{2}$" embroidery scissors @ $19.50 a dozen

11. Figure the price per unit if the following items are sold by the gross:

a. S. S. /36 fresh water pearl buttons @ $4. 50 a gross

b. Full ball /16 chalk buttons @ $2. 16 a gross

c. S. S. /16 rhinestone buttons @ $3. 24 a gross

d. S. S. /36 ocean pearl buttons @ $14. 00 a gross

e. Flat center /30 self-buttons @ $1. 30 a gross

Liquid Measure | Lesson No. 7

OBJECTIVE: To learn liquid measure as applied to the needle trades in the purchase of oils, cleaning fluid, etc.

RELATED INFORMATION:

You will find in working with machines that the proper oiling and care of a sewing machine are essential in order to get the best results and longest service with the least trouble and expense. You will also find that in purchasing oils for your machine the following table of measure must be understood:

Liquid Measure

4 gills	=	1 pint (pt.)
2 pints	=	1 quart (qt.)
4 quarts	=	1 gallon (gal.)

PROCEDURE:

Memorize the liquid measure table listed above. Following is an example of one of the many problems you will meet:

If two gallons of machine oil were to be put into one-pint oil cans, how many one-pint oil cans would be needed?

Answer:

1 gallon = 4 quarts
1 quart = 2 pints
8 pints in one gallon
x 2 gallons
16 pint oil cans would be needed.

ASSIGNMENT:

1. How many quarts of cleaning fluid are there in $20\frac{3}{4}$ gallons?

2. How many gill containers will be needed to divide 4 gallons of machine oil?

3. At the beginning of the school year, one gallon of machine oil was received. During the term, one-half gallon was used. How many gills were left?

4. Cleaning fluid is sold in one-quart bottles. If the fluid is transferred to gill-size bottles for easier use, how many bottles can be filled from 3 quarts of cleaning fluid?

5. Four gills were taken from a quart can. How much liquid was left?

6. Complete the following:

a. 10 pts. of oil = _____ qts.

b. 20 gals. of water = _____ pts.

c. 120 pts. of cleaning fluid = _____ gills

d. 50 quarts of cleaning fluid = _____ gals.

e. 60 gills of carbon tetrachloride = _____ qts.

7. If one quart of cleaning fluid costs $1.35, what would one gallon cost?

The Avoirdupois Weight Measure — Lesson No. 8

OBJECTIVE: To learn the units of weight measure used in the needle trades.

RELATED INFORMATION:

In the needle trades the following materials are sold by weight: pins, paper, thread, cotton padding, etc.

A needle trades worker must know the following table of weights:

16 ounces (oz.) = 1 pound
100 pounds = 1 hundred weight (cwt.)

PROCEDURE:

Since this is a simple table to learn, you will practice the following orally:

1. How many pounds of pins are there in 32 ounces?

2. Eight-ounce boxes of pins are used in class. How many boxes are in a five-pound carton?

3. How many pounds of pattern paper are in a roll weighing one cwt.? 2 cwt.?

4. If the electric iron used in class weighs $2\frac{7}{8}$ pounds, how many ounces does it weigh?

ASSIGNMENT:

1. If at the beginning of the year two 5-pound cartons of 8-ounce boxes of pins were received, and at the end of the year there were $2\frac{1}{2}$ pounds of pins left, how many 8-ounce boxes were used?

2. How many pounds are in 42 packages each weighing 8 ounces?

3. Two rolls of pattern paper, each weighing one cwt., were ordered. Each roll was twelve pounds short. How many pounds of paper were received?

4. If our cotton mills use 3,743,089 bales of cotton in one year, weighing 1,873,074,716 pounds, what is the average weight per bale? Answer to the whole pound only.

5. Taking inventory, you find you have:

198 lbs. of heavy pattern paper
135 lbs. of marking paper
140 lbs. of separating tissue
97 lbs. of multi-clear marking paper

What is the total weight of paper on hand?

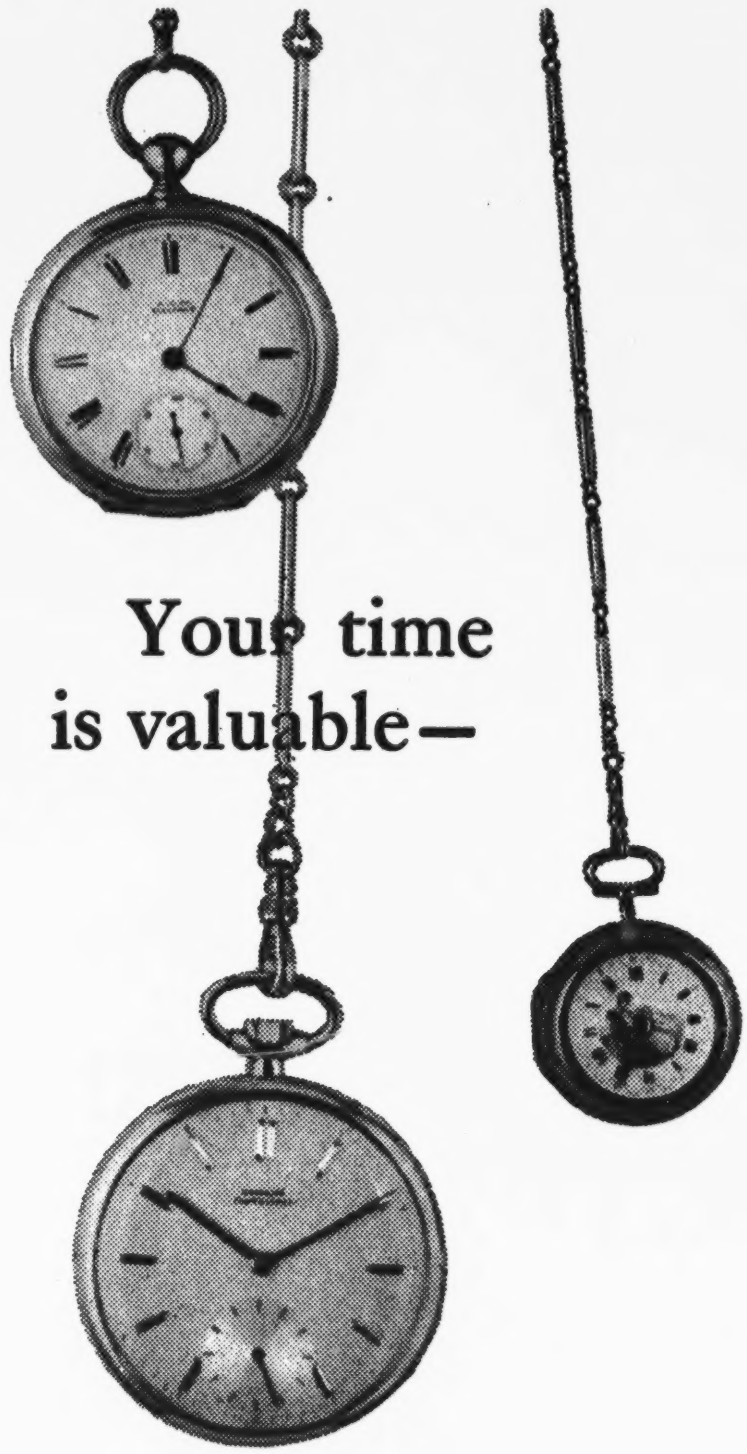
Measure of Time | Lesson No. 9

OBJECTIVE: To learn to handle problems involving time.

RELATED INFORMATION:

Everyone working in the garment trade has chosen his particular job not only because he is interested in this field, but mainly to earn a living. If you are earning money now by baby sitting, doing housework, or in any other way, you know the importance of figuring how much money you should receive for your work. People do make mistakes and since "time is money," you will be the loser if you cannot figure out your own earnings.

Earnings are figured by the hour or the week (time work), or by the piece or unit (piecework).



PROCEDURE:

It is important to learn the following table of the measure of time:

60 seconds (sec.)	=	1 minute	(min.)
60 minutes (min.)	=	1 hour	(hr.)
24 hours	=	1 day	(da.)
7 days	=	1 week	(wk.)
52 weeks	=	1 year	(yr.)
365 days	=	1 year	
100 years	=	1 century	

In many factories, the time is mechanically recorded and shows fractions of hours. In order to check the time, one should be able to calculate fractions. The following fractional equivalents of the hour should be memorized:

$\frac{1}{4}$ hr.	=	15 min.
$\frac{1}{2}$ hr.	=	30 min.
$\frac{3}{4}$ hr.	=	45 min.

ASSIGNMENT:

1. The girls in the trade class recorded their time in the classroom during the past week. Compute the actual time spent per week for each student listed.

Student	Mon.	Tues.	Wed.	Thurs.	Fri.
	9:15	9:30	9:05	9:45	9:10
A.	11:10	11:50	11:10	11:55	11:45
	9:00	9:05	9:00	9:05	9:05
B.	11:45	11:40	11:50	11:35	11:40
	9:15	9:20	9:25	9:05	9:10
C.	11:40	11:50	11:40	11:05	11:15
	9:00	9:00	9:00	9:05	9:00
D.	11:45	11:30	11:15	11:50	11:55

2. During the time assigned to trade work on Thursday, Jane was excused 45 minutes from class for a special Glee Club rehearsal; spent 15 minutes for a group meeting; and, due to bad weather, the class was dismissed 20 minutes early. How much time did Jane lose from her trade work that day?

3. A class was given 90 freshman pinafores to be made. It took 3 weeks of trade time (3 hrs. a day) to complete the work. There were 20 girls in the class. What was the average time for a girl to stitch one pinafore?

4. Joan took 2 trade sessions to stitch a smock. How many hours would it take for her to stitch $1\frac{1}{2}$ dozen smocks?

5. On Monday Alice began work on a child's dress at 9:15. At 10 o'clock she was called into the office and was there 45 minutes. She returned to shop and was dismissed for lunch at 11:50. How much time did Alice spend on the dress that day?

6. In most dress factories today, the work day is 7 hours long. If you started to work at 8:45 and left at 4:15, how much time was allowed for lunch?

7. An operator works 7 hours a day and each day makes an average of 8 dresses @ $\$2.08\frac{1}{4}$ a dress. She left two hours early on Monday and one hour early on Friday. What is her wage loss at the end of the week?

8. A lesson in the making of a two-piece placket took 20 minutes; the rest of shop time (3 hrs. a day) was spent in practicing that lesson. How long was the practice work at the machine that day?

Measure of Money | Lesson No. 10

OBJECTIVE: To learn the importance of counting change correctly to avoid mistakes.
To learn the proper way to indicate amounts of money in writing.

RELATED INFORMATION:

Calculations involving the use of money enter into the daily lives of practically everyone of us whether we are students, workers, householders, or businessmen. Because of this it is very important that you have a working knowledge of elementary calculations used in buying, selling, business transactions, and places of employment.

The unit of the money system in the United States is the dollar. This is divided into small units each represented by its own coin.

The one-cent piece or penny	=	$\frac{1}{100}$ of a dollar
The five-cent piece or nickel	=	$\frac{5}{100}$ of a dollar or $\frac{1}{20}$
The ten-cent piece or dime	=	$\frac{10}{100}$ of a dollar or $\frac{1}{10}$
The twenty-five cent piece or quarter	=	$\frac{25}{100}$ of a dollar or $\frac{1}{4}$
The fifty-cent piece or half-dollar	=	$\frac{50}{100}$ of a dollar or $\frac{1}{2}$

There are also larger multiples of the dollar, as two dollars, five dollars and so on. These are usually issued in bill form and make it convenient to handle large sums of money.

PROCEDURE:

A. Whether you are buying lunch in school, shopping in retail stores, or receiving your weekly wages, you must be familiar with a simplified method of counting change. It is important to re-check your change when it is given to you.

Example: Count the change received from a clerk if 53¢ is spent out of one dollar. (Note: you are not to say $1.00 - 53¢ = ___?)

Answer: 53 + 2 = 55 + 2 dimes = 75 + one quarter = $1.00

Learning the following table will help to simplify counting change:

5 pennies	=	1 nickel
2 nickels	=	1 dime
10 dimes	=	1 dollar
5 nickels	=	1 quarter
2 quarters	=	$\frac{1}{2}$ dollar
4 quarters	=	1 dollar
2 half-dollars	=	1 dollar
10 dollars	=	1 eagle

B. The symbol used in writing amounts of money is $, known as the dollar sign. It is placed in front of the figure or figures representing the number of dollars. The writing of amounts of money resembles the writing of decimals. The decimal point is used to separate dollars from cents and is placed directly after the number representing dollars, as $10.75.

If the amount is less than a dollar, the decimal point is placed in front of the "cents" only, and a 0 is used to express the dollar; for example, $0.45.

The sign ¢ indicates cents, and is quite often used in amounts less than one dollar. When the cent sign is used, neither the dollar sign nor the decimal point should be used. Example: 45¢.

ASSIGNMENT:

1. Examine the following amounts and write correctly those that are not properly expressed:

   a. $.72 b. $0.19¢ c. $4.50 d. $.39¢
   e. 36¢

2. $10 = how many dimes? = how many quarters?

3. $5 = how many cents? = how many nickels?

4. $3.50 = how many quarters? = how many nickels?

5. a. 10 nickels = _____ cents
   b. 31 halves = _____ cents
   c. 55 dimes = _____ cents
   d. 88 quarters = _____ cents
   e. 100 nickels = _____ cents

6. How much change should a boy get in presenting a $5 bill in payment for a pair of jeans @ $1.55 and a shirt @ $1.25? List the units of money he will receive.

7. In giving cash for a check amounting to $48.75, list the units of money you would use.

8. What is the total of the following:

3	twenty-dollar bills
6	ten-dollar bills
5	five-dollar bills
3	one-dollar bills
7	fifty-cent pieces
11	quarters
56	dimes
25	nickels
40	pennies

9. List the change received if $13.46 was spent out of $20.

10. What was the change from $10 for the following items: 2 yards of crepe @ 98¢ a yard, 1 zipper @ 40¢, 1 spool of thread @ 39¢, 1 package of seam binding @ 15¢, and 3 yards of dacron @ 69¢?

UNIT IV - RATIO AND PROPORTION

Pre-Test No. 4

1. Mary said she could do twice as much work as Joan. How many pinafores did Joan make if Mary made 26?

2. The sophomore class made 39 blouses; the freshmen made 27 blouses. What is the ratio of the work done by the former class to that of the latter?

3. Four blouses can be made in a 7-hour day. How many working days will it take to complete 24 blouses?

4. If 5 yards of velvet cost $25.25, find the cost of 3 yards.

5. A homemade dress costs $4.60; a ready-made dress costs $11.50. What is the ratio between them?

6. If the trimming for 16 dresses costs $21.12, then $26.40 will purchase trimming for how many dresses?

7. Find the ratio of the following quantities:

a.	$1.25 to $.25	f.	4" to 2"
b.	3 yards to 2 yards	g.	6 spools to 9 spools
c.	16 gr. to 32 gr.	h.	9 hours to 30 min.
d.	8 thimbles to 16 thimbles	i.	5 yards to 15 yards
e.	46 girls to 138 girls	j.	16 in. to 4 yards

UNIT IV - RATIO AND PROPORTION

Relation Between Quantities **Lesson No. 1**

OBJECTIVE: To learn how to compare numbers in terms of ratio and proportion.

RELATED INFORMATION:

The mysterious word "ratio" merely means "relationship". The relationship of your weight to your height, of the length of the school day to the whole day, of the money your family pays for housing compared with the family income - all these are ratios. We are constantly using ratios in our thinking and our speaking. We might say: my house is twice as long as it is wide; my father earns four times as much as my brother; this dress uses three times the yardage of that one.

If during the summer vacation Joyce earned twice as much as Joan, that is, if for every dollar earned by Joan, Joyce earned two dollars, the ratio of their earnings would be 2 to 1.

There are occasions when the needle trades worker is given amounts and must compute their relationship to other amounts. This occurs in estimating shirring, smocking, tuckings, and pleatings.

We may express ratio in three ways. If we wish to compare the quantities 3 and 5, we could use any of these methods:

1. 3:5 (read 3 is to 5)
2. $3 \div 5$
3. $\frac{3}{5}$ (fraction)

As a matter of custom, a ratio is generally written in fractional form. We can, therefore, do anything to a ratio, without changing its value, that we can to any other fraction. Consequently, both terms of a ratio can be either multiplied or divided by the same number without changing its value.

Complete the following statements so that a new ratio, equal to the first, will result:

$\frac{2}{3} = \frac{6}{?}$ $\frac{8}{12} = \frac{2}{?}$ $\frac{20}{25} = \frac{4}{?}$ $\frac{12}{15} = \frac{?}{5}$

A proportion is a true statement of equality of two ratios. If you completed the above exercises correctly, each is a proportion. Thus, $\frac{2}{3}$ and $\frac{6}{9}$ are equal and the statement $\frac{2}{3}$ equals $\frac{6}{9}$ (or, as it is commonly written, 2:3 :: 6:9) is a proportion. The fractional form is more convenient for computation.

There are four terms in a proportion. The first and third terms are the numerators of the fractions; the second and fourth terms are the denominators. The first and the last terms (2 and 9) are called the extremes; the second and third (3 and 6) are called the means.

PROCEDURE:

I. Ratio

The ratio of one number to another is the quotient of the first number divided by the second.

A. Example: Joan is 30 years old and her sister is 15 years old. The ratio of Joan's age to her sister's is 30 to 15 or 2 to 1.

Solution: $\frac{30 \text{ (divide by 15)}}{15 \text{ (divide by 15)}} = \frac{2}{1}$ You would read this ratio as 2 to 1.

If the scale of a drawing says "one inch to one yard", it does not mean a 1 to 1 ratio, but a ratio of 1 to 36, because both quantities must be in the same unit of measure.

B. Example: Separate 35 into two parts so that their ratio shall be 3 to 4.

Solution: The simplest way to solve this problem is as follows: Using a question mark (?) in place of the unknown numbers, let:

3 x ? = the smaller part
4 x ? = the larger part

The sum of the parts is 35; thus the equation is:

$$\begin{array}{l} 3 \times ? = \\ \underline{4 \times ? =} \\ 7 \times ? = 35 \end{array} \qquad \begin{array}{r} 5 \\ \overline{7/35} \end{array}$$

The smaller part is $3 \times 5 = \frac{15}{20} = \frac{3}{4}$
The larger part is $4 \times 5 =$

II. Proportion

Whenever we have a statement that two ratios are equal, we have a proportion. Since a proportion is an equation, we can use the rules that apply to equations to solve problems involving proportions.

Example: If 8 yards of silk cost \$12, how much will 13 yards cost at the same rate?

Solution: $\frac{8 \text{ yards}}{13 \text{ yards}} = \frac{12 \text{ dollars}}{? \text{ dollars}}$

that is, $\frac{8}{13} = \frac{12}{?}$

Using the rule of cross-multiplication,

$$\frac{8}{13} = \frac{12}{?}$$

we get:

$$8 \times ? = 156$$
$$? = \$19.50$$

That is, 13 yards of silk cost \$19.50

Rules for forming a proportion:

a. The two terms of each ratio must be like quantities, for example, in the above problem, each term of the first ratio is a number of yards; of the second, a number of dollars.

b. The two numerators and the two denominators must be corresponding quantities; that is, the value of one numerator must depend upon the value of the other numerator. Again, in the above problem, the value of the second numerator, \$12, depends upon the number of yards purchased, or 8 yards, and the value of the second denominator, ? dollars, depends upon the number of yards purchased, or 13 yards.

Note: There are other ways of forming proportions, but for the purpose of minimizing errors, we will stick to these rules.

ASSIGNMENT:

1. Express the ratios of the following in the simplest form:

a.	21" to 7"	g.	26 weeks to 1 year
b.	50 bolts to 20 bolts	h.	3 yards to 2 feet
c.	3 spools to 6 spools	i.	2 dimes to 1 dollar
d.	$12.75 to $102.00	j.	6 months to 9 days
e.	2 hours to 20 minutes	k.	32 cones to 8 cones
f.	$1\frac{1}{2}$" to $\frac{3}{4}$"	l.	120 yards to 15 yards

2. Virginia spends 6 hours in shop every day and Mary spends 4 hours. What is the ratio of the time Virginia spends to the time Mary spends? For every three hours Virginia spends, how many hours does Mary spend?

3. Operator A made 14 dozen blouses in one week. Operator B made $3\frac{1}{4}$ dozen. What is the ratio of the number of blouses made by A to the number made by B?

4. Write the following ratios as fractions (reduce in each case to the lowest terms)

a.	9:12	c.	18:15	e.	16:48
b.	36:3	d.	45:55	f.	24:26

5. If a length of percale is 48" long and 36" wide, find the ratio of the length to the width. Of the width to the length.

6. Find the ratio of 25 to (a) 30 (b) 50 (c) 60.

7. What is the ratio of 15 minutes to (a) 1 hour, (b) half-hour, (c) 45 minutes?

8. What is the ratio of 15¢ to 75¢?

9. Three numbers have the ratio 3:4:5. Find the numbers if their sum is 96.

10. If 10 girls operating power sewing machines can produce 140 dresses in 14 hours, how many dresses can 15 girls produce in the same amount of time?

11. On an annual income of $3600, $700 is set aside for rent. At the same rate, how much should be set aside from an income of $4000?

12. Twenty-four circular sections can be cut from $1\frac{1}{2}$ yards of 36" organdy. How many sections can be cut from $2\frac{1}{4}$ yards?

Estimates and Approximations **Lesson No. 2**

OBJECTIVE: To learn to estimate answers to problems.

RELATED INFORMATION:

In many cases it will be helpful to make a rough estimate of the answer to a problem before solving for the exact result. Errors are often made in placing the decimal point, thus giving results that are ridiculous.

Example: Find the cost of $3\frac{3}{4}$ yards of cloth at $1.10

Solution: First estimate the cost by rounding $3\frac{3}{4}$ yds. to the nearest whole number, 4 yards, which at $1.10 gives you an estimate of $4.40. Then by actual calculation you find the result is $4.125.

```
   3.75   yds.                    $1.10
  $1.10                            3.75 yds.
  ----                             ----
  3750                             550
 375                OR            770
 ----                             330
$41250                            ----
                                  $41250
```

By estimating in advance, such results as $41.25 or $0.41 are recognized to be wrong.

ASSIGNMENT:

In each of the following problems, first estimate the result, then solve for the exact result.

1. Find the cost of 22 yards of material at $1.10 a yard.
2. A man worked 42 hours in a week. His hourly wage was $1.77 an hour. How much did he earn?
3. Find the cost of $17\frac{1}{4}$ yards of percale at $23\frac{1}{4}$¢ a yard.
4. At $4\frac{1}{4}$ yards of material per dress, how many can be made from a bolt of $75\frac{3}{4}$ yds.?
5. At $10.75 per dress, how many can be bought for $130.00?

6. If each dress needs 8 buttons, how many dresses will a stock of $1\frac{1}{2}$ gross buttons trim?

7. $2\frac{1}{2} \times 3\frac{1}{2}$

8. $4\frac{1}{4} \times 3\frac{3}{4}$

9. $23 \times 3\frac{3}{4}$

10. $31 \times 4\frac{1}{2}$

11. $\$2.00 \div 16\frac{1}{2}$

12. $28\frac{1}{2} \div 7\frac{1}{2}$

UNIT IV - RATIO AND PROPORTION

Estimating Amounts for Tucking and Hems **Lesson No. 3**

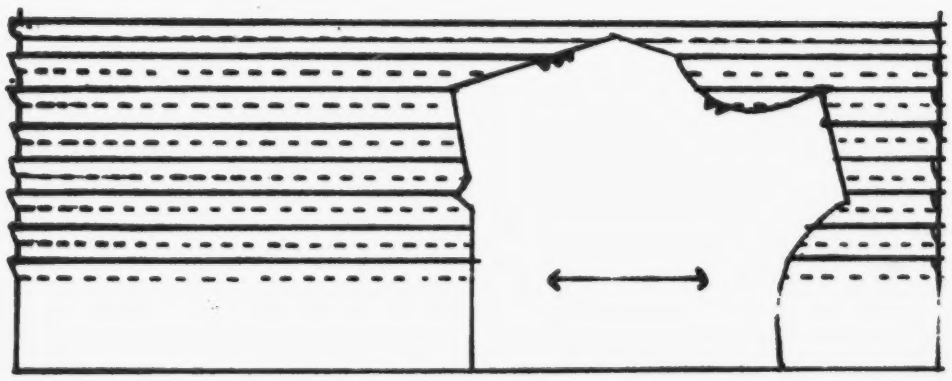
OBJECTIVE: To learn the basic rule for estimating amounts for tucking and hemming.

RELATED INFORMATION:

A tuck is a fold in the cloth for the purpose of trimming or decoration. A tuck takes up twice its own depth, that is, a one-inch tuck takes up two inches of fabric.

In the garment industry there are special firms that handle tucking, shirrings, and pleatings to be used in the making of garments. When figuring tucking it is important to know the width of the material to be tucked, the size of the tuck, and the finished size needed to cut the pattern needed for the dress.

This is the procedure that is followed: after a sample has been made in the sample room and the garment is ready to be put into production, the estimated yardage is sent out to be tucked. When the tucking is completed and returned to the manufacturer, the pattern is placed on the tucking and cut.



A hem on a piece of cloth is an edge turned over to form a border or finish. In making a hem, the edge must always be turned or taped to prevent fraying, except for heavy or loosely woven cloth. The amount turned under is usually $\frac{1}{4}$" or, for narrower hems, $\frac{1}{8}$" is allowed. For example, for a one-inch hem, plus $\frac{1}{4}$" for turning, you would have to allow $1\frac{1}{4}$" of cloth.

PROCEDURE:

You must remember that, no matter what size tuck is used, the same rule applies: "Twice the width of the tuck from stitch to fold is the amount of material used for one tuck."

Example A:

This child's dress was completed in the sample room and is now ready to put into production.

In checking the skirt, you find the finished length of the skirt is 20", there are four $\frac{1}{2}$" tucks, and a 2" hem with $\frac{1}{4}$" allowed for turning.

What is the width of the material to be sent out for tucking?

Solution:	20"	finished length of skirt
	4"	taken up by tucks (4 tucks @ 2 x $\frac{1}{2}$")
	$2\frac{1}{4}$"	width of hem and turning
	$26\frac{1}{4}$"	width of material needed to be sent out for tucking

Example B:

The above sample blouse has a tucked yoke. In the manufacture of garments with tucking used in this manner, the width of the fabric is completely tucked. All the stitching of tucks is done on the length. This is known as "all-over tucking".

Broadcloth 36" wide was used for this tucking. Thirty-six tucks, each $\frac{3}{16}$" wide, were made across the width of the fabric.

What is the width of the fabric after tucking? If each yoke requires 11" of tucked fabric, how many yokes can be cut out of the width?

Solution:

36"	width of the broadcloth before tucking
$-\ 13\frac{1}{2}$"	taken up by the tucks ($\frac{3}{16}$" x 2 = $\frac{6}{16}$ = $\frac{3}{8}$" $\quad \frac{3}{8}$" x 36 tucks)
$22\frac{1}{2}$"	width of broadcloth after tucking
$11/\frac{22}{2}$	yokes can be cut out of the width.

PRACTICE:

1. Make a gauge to be used in making $\frac{1}{4}$" tucks with $\frac{1}{4}$" space.

2. Using a $\frac{1}{4}$" gauge, make a $\frac{1}{4}$" tuck in a piece of paper. How much material is taken up by the tuck?

3. Using your gauge, turn a one-inch hem on a paper and see that it is perfectly straight. How much material is taken up by the hem?

4. Take a piece of paper 6" wide and, using your gauge, make a half-inch hem with $\frac{1}{8}$" allowance for turning and three $\frac{1}{4}$" tucks, with $\frac{1}{4}$" space between tucks. How much material is taken up by the hem and tucks?

Example C:

In checking this sample, we find the designer used fabric tucked with $\frac{1}{4}$" tucks with a $\frac{1}{4}$" space between tucks.

How many tucks were made in this fabric, which was 42" wide?

What was the finished width of the material?

Solution:

$\frac{1}{2}$" or $\frac{2}{4}$" = material taken up by tuck ($\frac{1}{4}$" x 2)

$\frac{1}{4}$" = space between

$\frac{3}{4}$"

42" (width of the material) ÷ $\frac{3}{4}$"

$\frac{42}{1} \div \frac{3}{4} = \frac{\cancel{42}^{14}}{1} \times \frac{4}{\cancel{3}_{1}} = 56$ tucks

42" = width of material before tucking

- 28" = material taken up by the 56 tucks x $\frac{1}{2}$"

14" = width of material after tucking

ASSIGNMENT:

1. How many tucks, each $\frac{1}{4}''$ wide, can be made from a piece of material one yard wide, if the tucks are $\frac{1}{4}''$ apart?

2. How many $\frac{1}{8}''$ tucks, $\frac{1}{4}''$ apart, can be made from a piece of material twenty-four inches wide?

3. A piece of cloth contains eight $\frac{1}{2}''$ tucks, $\frac{1}{4}''$ apart. If the tucks start 4" from each edge of the cloth, how wide is it? How wide would it be if the tucks were ripped out?

4. A piece of cloth originally $29\frac{1}{4}$ inches wide contains how many $\frac{1}{4}''$ tucks, $\frac{1}{4}''$ apart, if the first and last tucks are $\frac{1}{4}''$ from the edge of the cloth? How wide will the finished piece be?

5. If three 2" tucks, $\frac{1}{2}''$ apart are to be put around a skirt which is to be 28" long when finished, how long must the skirt be cut to allow for the tucks and a $3\frac{3}{4}''$ hem with a $\frac{1}{4}''$ allowance for turning?

6. Material is sent to a commercial tucker. How wide will this 24" material be after tucking with $\frac{1}{16}''$ tucks set $\frac{1}{8}''$ apart?

7. How many $\frac{1}{32}''$ tucks, $\frac{1}{16}''$ apart can be made from a piece of muslin 24" wide?

8. How many $\frac{1}{8}''$ tucks, $\frac{1}{8}''$ apart can be made from a piece of lawn 30" wide?

9. If a piece of cloth contains thirty 1" tucks and is 30" long, how long would it be if the tucks were ripped out?

10. Give the amounts of material allowed for one tuck in the following sizes:

a. $\frac{1}{16}''$	_____	e. $\frac{1}{4}''$	_____
b. $\frac{1}{8}''$	_____	f. $\frac{1}{2}''$	_____
c. 1"	_____	g. $1\frac{1}{2}''$	_____
d. $\frac{3}{8}''$	_____	h. $\frac{3}{4}''$	_____

Estimating Fullness for Ruffling and Shirring — Lesson No. 4

OBJECTIVE: To learn the basic rules for estimating ruffling and shirring.

RELATED INFORMATION:

A ruffle is a strip of cloth gathered in narrow folds on one edge and used for trimming. When making ruffles, allowance must be made for fullness. In determining allowances, one and one-half times the distance is usually allowed for ordinary ruffles; but where less fullness is desired $1\frac{1}{3}$ or even $1\frac{1}{4}$ times is allowed. The amount of fullness required for ruffling depends on the garment and the type of fabric used. A heavier fabric will not need as much gathering as a sheer fabric. Different proportions of material are allowed according to the use to which it is to be put. A ruffle cut along the width is generally moresatisfactory, but they are often cut along the length of the cloth.

Double rows of ruffles are very effective in some cases and sometimes when ruffles are very narrow, three or five rows are used.

PROCEDURE:

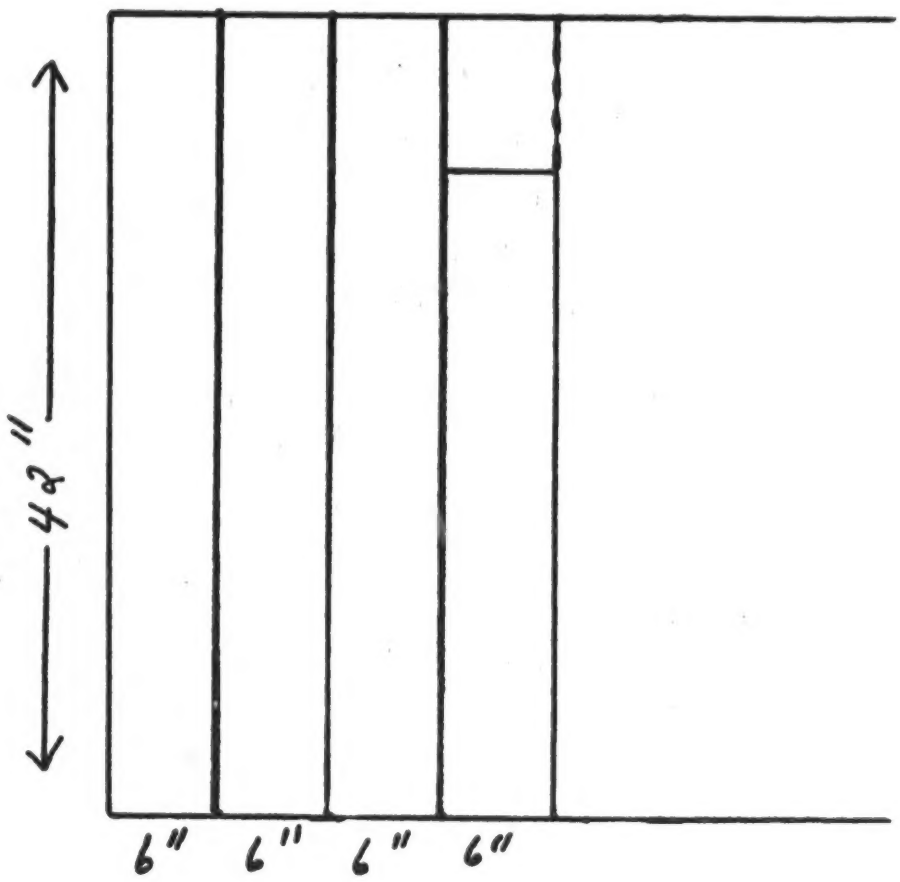
In estimating how much material is required for ruffles or shirring, the fullness desired is the determining factor.

Example A:

This skirt has a 6" ruffle sewed to the bottom of the skirt. The skirt measures 3 yards wide and the fabric used is 42" dacron/cotton.

How much material is required for the ruffle if the allowance is $1\frac{1}{2}$ times the width of the skirt for fullness? (The ruffle is to be cut along the width of the fabric.)

Solution:



3 yds. (width of the skirt) x $1\frac{1}{2}$ (allowance for fullness) = $4\frac{1}{2}$ yds. (length of ruffle needed)

$4\frac{1}{2}$ yds. ÷ $1\frac{1}{6}$ yds. (material is 42" wide) = $3\frac{6}{7}$ <u>strips</u> of material needed for ruffle.

4 strips ($3\frac{6}{7}$ = 4 Any fraction of a width must be counted as a whole width)

$$\begin{array}{r} 4 \\ \times\ 6'' \\ \hline 24'' \end{array}$$ width of ruffle of material needed for the ruffle (or $\frac{2}{3}$ yard).

Example B:

This blouse has a shirred batiste ruffle in the front. Two yards of embroidered batiste for each blouse was sent out to be shirred. The front space to which this trimming was to be sewn measured 14".

What was the ratio or allowance for shirring?

Solution:

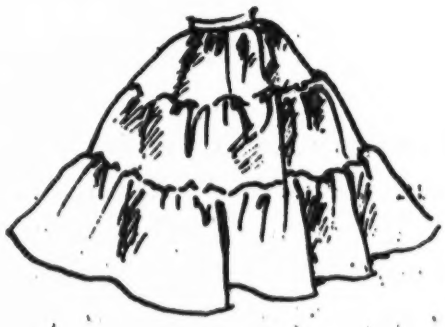
2 sides to the front of the blouse ÷ 2 yds. of embroidered batiste = 1 yard used for each side of blouse front.

36 ÷ 14" (finished length) $14\overline{)36}$ $2\frac{1}{2}$

$2\frac{1}{2}$: 1 = the ratio

$2\frac{1}{2}$ times the length is the allowance for shirring

Example C:



In computing the material needed to make this 3-tier gathered skirt, the width at the bottom of each tier is the determining factor.

The top tier measures 7" long and 2 yards wide. The second tier measures 9" long and the allowance for fullness is 2 times the width of the top tier. The third tier measures 12" long and is 2 times the width of the second tier.

How much fabric is needed to make this 3-tier gathered skirt, if 36" fabric is used?

Note: All seams and the hem allowances are included in these figures.

Solution:

The yardage needed for each tier must be computed individually.

Top tier: 2 yards of 7" width are needed for the top tier. Since the material is 1 yard wide, two yards will require 2 strips each 7" wide.
2 x 7" = 14" of material for the top tier.

Second tier: 2 x 2 yds. = 4 yards of ruffling needed. In this case, 4 yards means 4 strips, each 9" wide.
4 x 9" = 36" or 1 yd. of material needed for second tier.

Bottom tier: 2 x 4 yds. = 8 yards of ruffling needed (width of second tier with fullness allowed).
8 x 12" = 96" or $2\frac{2}{3}$ yards of material needed for bottom tier.

Total material needed:

Top tier	14"
Second tier	36"
Bottom tier	96"
	146" or 4 yards and 2 inches needed.

You would have to purchase $4\frac{1}{8}$ yards.

ASSIGNMENT:

1. A nylon net petticoat measures 3 yards around the bottom. We have decided to add a ruffle 9" deep and to figure the fullness at $2\frac{1}{2}$ times. Nylon net is 72" wide. How much net is needed for the ruffle? (Hint: if the number of strips is fractional, use the next highest whole number).

2. How many pieces of percale 36" wide are needed for 3 yards of ruffling?

3. How many yards of ruffling are needed for 14 aprons if each apron is one yard wide, and half the width of the apron is added for fullness?

4. If gathering stitches are made approximately $\frac{1}{16}$" long, how many stitches are there in an inch?

5. How much material would you need for a gathered skirt, if the waist measurement is 26" and the length is 27" including all seams and hem, and the allowance for fullness is 4:1? The material used is 36" wide.

6. In making a gathered skirt, $3\frac{3}{4}$ yards of 36" material was used. The waist measurement was 24", the length was 27" including all seams and hem. What was the fullness allowed?

7. In finishing a slip, it was decided to add an 8" ruffle. The bottom of the slip was 44" wide; the allowance for shirring was $1\frac{1}{2}$ times. How many strips of 44" material would be needed for 1 slip? How many yards for 150 slips?

8. If the side and bottom edges of one pair of net curtains measures 4 yards each, how much additional material will be needed to cut a 5" ruffle including seams and hem for the side and bottom edge? The net is 50" wide and the ratio is 2:1.

9. How much additional 42" rayon taffeta will be necessary to make an 8" shirred ruffle including seams and hem, around the bottom of two gross slips, if the lower edge of one measures 41" and the ratio is 2 to 1?

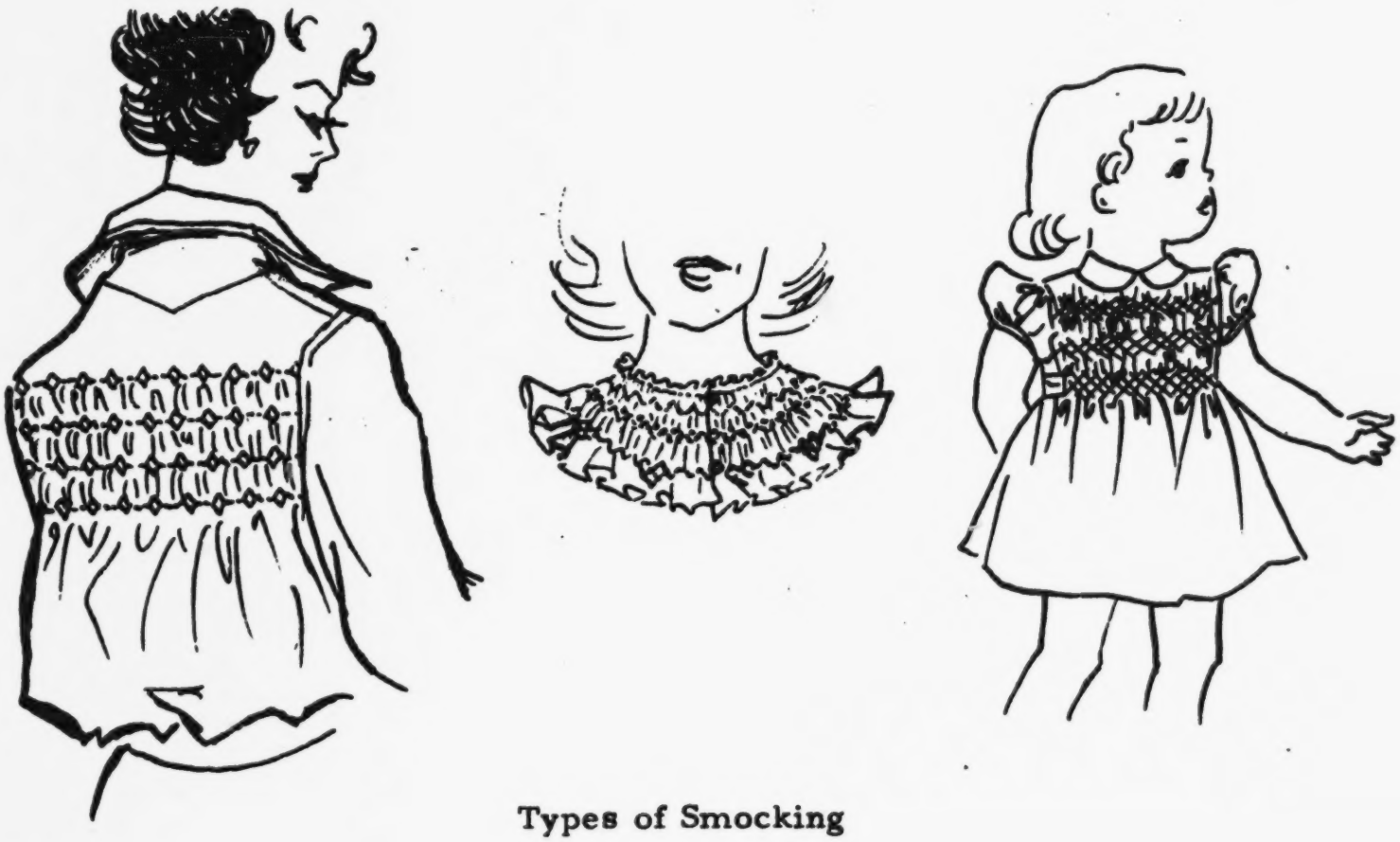
10. What width of cloth is needed for making a ruffle $3\frac{7}{8}$" deep allowing $\frac{7}{8}$" for a heading and $1\frac{1}{4}$" for hem and $\frac{1}{4}$" for first turn of hem? Find the amount of material required to make 3 yards of ruffling if made of material 36" wide.

Estimating Fullness for Smocking **Lesson No. 5**

OBJECTIVE: To learn the method used in figuring material used in smocking.

RELATED INFORMATION:

Smocking is the gathering in lines at regular intervals so as to produce a shirred effect (see below). The type of garment being made determines the style of smocking used. You will find smocking used mostly in children's wear. It has traditionally been done by hand, but recently machine smocking has come into use.



Types of Smocking

PROCEDURE:

The general rule for smocking is to allow three times the width of the finished design (ratio 3:1). The fullness desired determines the width of fabric needed.

Example: In a 2" finished design, 6" of material was used. This particular smocking used 3 times the finished design.

$2/\overset{3}{\overline{6}}$ Ratio 2:6 = 1:3

ASSIGNMENT:

1. The smocking at the head of a sleeve measured 3" when finished. If the material measured $7\frac{1}{2}$" before smocking, what was the additional fabric allowed for the smocking? What was the ratio?

2. How much material is required for a smocking design measuring $2\frac{1}{2}$" finished at $3\frac{1}{2}$ times the width?

3. A skirt measuring 22" around the waist is being trimmed with smocking around the top. How much material is needed at 3 times the width of design?

4. A smocking design measuring $5\frac{3}{4}$" when finished requires $3\frac{1}{4}$ times the width of the design. Find the width of material needed.

5. Find the material needed for the following smocking designs:

	Width	Ratio
a.	16"	$1\frac{3}{4}$
b.	$5\frac{1}{2}$"	$2\frac{1}{4}$
c.	$2\frac{1}{2}$"	2
d.	$4\frac{1}{4}$"	3
e.	24"	4

Estimating Allowance for Pleating — Lesson No. 6

OBJECTIVE: To learn the basic rules in figuring material needs in the making of pleats.

RELATED INFORMATION:

Perhaps you are fond of wearing the ever-popular pleated skirt. This is a style that remains in fashion always; in children's wear, through teen-age, to women's wear. Pleats used this way not only add fullness but also give line interest to clothing.

Pleats can be prepared by the dressmaker or, as in the garment industry, sent out to a shop that will do steam pleating, - sometimes called machine pleating. Steam pleating usually proves an economy in time and also stays in very well.

A pleat is a fold in the fabric that releases fullness. As you look around in your class, you may observe a number of different kinds or arrangements of pleats. They will probably fall into one of the following groups. The first group covers straight pleats pressed into the desired type such as: box pleats, inverted pleats, kick or side pleats, and unpressed pleats. Novelty pleating done by the machine pleaters, the second group, includes accordion, crystal, fine knife pleating, and variations and combinations of box pleats.

PROCEDURE:

When the edges of pleats touch, how much material must you allow for the pleats? A one-inch pleat requires three inches of material, or a fitted all-around pleated skirt with pleats touching requires three times the hip measurement.

1. From material or paper, make a one-inch pleat with a one-inch underlay. Mark where your pleat ends.

2. Open the pleat and measure the surface needed to make a single pleat.

3. You will find that the underlay measures two inches.

4. The complete surface or material needed would be two inches for underlay plus one inch for the width of the pleat.

5. To make a single pleat, the material must be cut three times the width of the pleat, if the underlay is the same width as the pleat.

The important facts in the construction of a pleat are:

A. The depth of the pleat or the underlay, which is the amount of material from outside fold of pleat to the inside fold of the pleat. (The actual measurement of the material needed to form underlay will be twice the depth.)

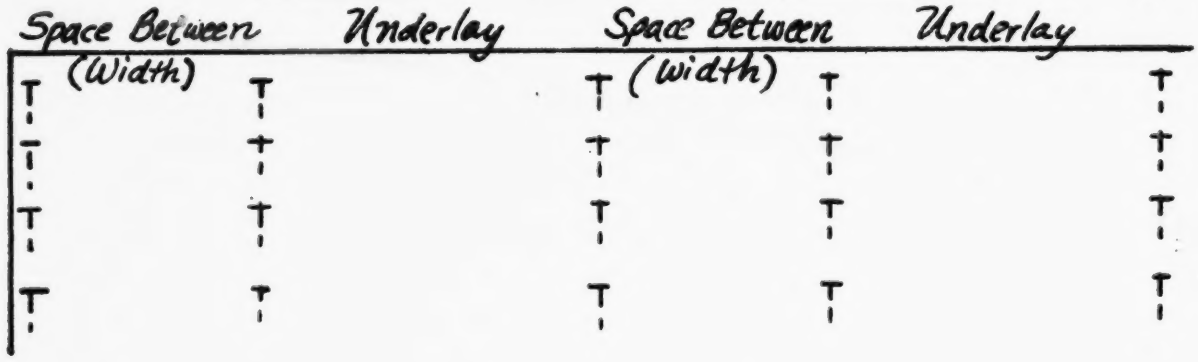
B. The width of the pleat or the space between pleats. It is the amount of each pleat that shows between folds on top of skirt.

C. The type of pleating to be made.

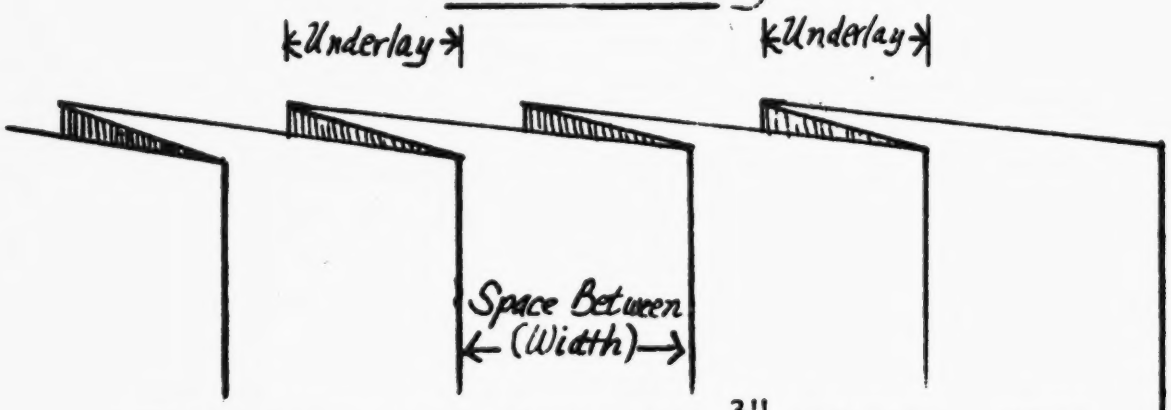
A box pleat requires twice as much as a single pleat and a double box pleat twice as much as a box pleat.

The following diagrams show the formation of a single pleat:

Fabric Prepared for One-Inch Side Pleats with 3/4" Underlay



Finished Pleating



This is a one-inch pleat with a $\frac{3}{4}$" underlay. (Note that $1\frac{1}{2}$" of material is needed to form the complete underlay.)

Example: In making an unpressed pleated skirt with a one-inch space between each pleat and an underlay of one inch, the total material needed for one pleat would be three inches. In making an unpressed pleated skirt, the other measurements needed are the waist and the length. If the waist is 24" and the length 27" including hem, how many yards of 36" material would we need?

Solution: 24" (waist measurement) x 3" (needed for each pleat)
72" of material ÷ 36" material = 2 lengths needed
27" length of skirt x 2 = 54" or $1\frac{1}{2}$ yards.

ASSIGNMENT:

1. Estimate the amounts required for these pleats:

   a. one 2" box pleat
   b. four 3" side pleats
   c. two 1" side pleats
   d. one 2" side pleat
   e. one 4" inverted pleat
   f. a 12" cut will make how many 2" side pleats?

2. How many yards of 54" woolen material will be needed for a skirt with a one-inch pleat and a 2" underlay, measuring 36" at the hip? The length of the skirt is 27" long including hem.

3. How many box pleats 2" wide with a full-size underlay can be made out of material 72" wide?

4. If it takes 81 inches to make 9 box pleats, how many inches will it take to make 7 box pleats of the same size?

5. How much material is required to make ten single pleats 2" wide with a 1-inch underlay? How many box pleats of the same width can be made out of the same piece of material?

6. How many single pleats, one inch wide with a 1-inch underlay can be made from a piece of material 24 inches wide? 42" wide? 14" wide?

7. The front of a child's dress was cut 28" wide, but when pleated it measured just 16". How many one-inch pleats with a 1-inch underlay were made in the dress front?

8. If it takes 72" to make 16 single box pleats, how many double box pleats could be made out of the same piece of material?

9. How many one-inch box pleats with a 1-inch underlay can be put into 42"?

10. How much material will be needed to make a pleated ruffle, $\frac{1}{2}$" wide with a $\frac{1}{4}$" underlay, for a taffeta slip which measures 48" around the lower edge? The ruffle is to be 4" deep with a $\frac{1}{8}$" hem. The material is 42" wide.

11. How many yards of finished pleating would you need on three tiers of this dress: the first tier measures 42", the second 50", and the third 60". For 135 dresses?

Pre-Test No. 5

1. Add the following:

   a. 24.75, 33.29, 8.35, 25.64
   b. 45.643, 8.295, 4.64, 35.63
   c. 25.64, 63.25, 29.74, 35.25
   d. 24.00, 32.24, 9.50, 10.00, 4.75

2. Subtract the following:

   a. 24.65 - 13.82
   b. 24.8 - 8.63
   c. 105.00 - 75.25
   d. 28.35 - 12.16
   e. 35.25 - 16.98
   f. 57.00 - 7.62

3. Tell how many decimal places there will be in each of these products.

   a. 2.5 x 3.4
   b. 23.5 x 22.4
   c. 1.67 x 2.34
   d. 60.8 x 3.47
   e. 1.25 x 2.25
   f. 2.64 x 43.7

4. Multiply the following:

   a. 25 yards of lace @ $6\frac{1}{2}$¢
   b. 66 yards of dotted swiss @ $0.6975
   c. 27 buttons @ $0.027
   d. 16 spools of thread @ $0.057
   e. 112 yards of organdy @ $0.605

5. Deduct the cost of the trimmings from the cost of materials used in the following garments:

	Material	Trimmings
a.	$9.43	$1.58
b.	6.75	1.86
c.	4.75	$\frac{3}{10}$ of a dollar
d.	7.46	$\frac{7}{10}$ of a dollar
e.	3.33	$\frac{1}{2}$ dollar

6. The price of $\frac{1}{4}$" elastic is quoted @ \$0.035 per yard. The price is increased to \$0.0433. How much more will it cost per yard than the original quotation? Compute the additional cost of 435 yards.

7. A discount of \$3.56 is allowed from a bill of \$32.25. What is the amount of the bill after deducting the discount?

8. Find the total cost of making a dress, if you purchased $3\frac{5}{8}$ yards of dacron/cotton @ 69¢, zipper @ 45¢, 4 buttons @ $12\frac{1}{2}$¢ each, 2 spools of thread @ 10¢ a spool.

9. From a 54" length of serge, a 24" piece was sold. Find the cost of the remainder at \$1.75 per yard.

10. If a man owes \$325 and pays 25% of it, how much does he pay? How much remains to be paid?

Review | Lesson No. 1

OBJECTIVES: To develop an understanding of the relation of decimals to fractions.
To learn the proper way to read and write decimals in word form and to develop a concept of their size or value.

RELATED INFORMATION:

The following ad appeared in a newspaper: "Collars reduced from $0.98 to $0.50". If you can read $0.98 or $0.50 without using the word "cents", then you recognize $0.98 and $0.50 as decimal parts of a dollar. This is the most common use of decimals.

Decimals are a special way of writing fractions whose denominators are 10, 100, 1000, or any multiple of ten. Since decimals are only fractions in a different form, you must keep in mind that decimals are only parts of a unit. In reading decimals, the number to the right of the decimal point is the top number (numerator) of the fraction, while the bottom number (denominator) is determined by the number of places to the right of the decimal point. The digits to the right of the decimal point are known as certain decimal places.

PROCEDURE:

The following is a table that will help to recall the reading of decimals:

.6	One decimal place:	tenths	$(\frac{6}{10})$
.06	Two decimal places:	hundredths	$(\frac{6}{100})$
.006	Three decimal places:	thousandths	$(\frac{6}{1000})$
.0006	Four decimal places:	ten thousandths	$(\frac{6}{10000})$

Example A: $.98 = \frac{98}{100}$

There are two places to the right of the decimal point; therefore, the decimal place is hundredths.

Example B: A number like .125 means $\frac{1}{10} + \frac{2}{100} + \frac{5}{1000}$

But $\frac{1}{10} = \frac{100}{1000}$ and $\frac{2}{100} = \frac{20}{1000}$

Therefore $.125 = \frac{100}{1000} + \frac{20}{1000} + \frac{5}{1000}$ or $\frac{125}{1000}$

The easy way to read a decimal is to read the number after the decimal point and then give it the name of its last decimal place, as, in the above example, one hundred twenty-five thousandths.

A number like 12.125 is read as twelve and one hundred twenty-five thousandths. The word <u>and</u> is read <u>only</u> when you come to the decimal point.

The value of the decimal changes according to the position of the decimal point. Moving the decimal point one place to the left divides the value of the number by 10, while moving it one place to the right multiplies the value of the number by 10. This important relation is illustrated in the following arrangement of the number 3.055:

3.055	
30.55	This is 10 times the value of the number above it.
305.5	This is 10 times the value of the number above it.
3055.	This is 10 times the value of the number above it.

ASSIGNMENT:

Exercise I. Write the following numbers in words:

1.	9.46	6.	16.005
2.	.346	7.	19.48
3.	24.06	8.	.34
4.	.0156	9.	178.8953
5.	34.7	10.	54,325.789

Exercise II. Read each number and then write it as a common fraction or as a mixed number.

1.	3.5	5.	.65
2.	9.98	6.	.8
3.	.785	7.	4.333
4.	8.37	8.	550.064

Exercise III. Write these numbers as decimals:

1.	$\frac{16}{100}$	6.	$\frac{702}{1000}$
2.	$\frac{248}{1000}$	7.	$28\frac{6}{10}$
3.	$\frac{55}{100}$	8.	$2\frac{56}{100}$
4.	$2\frac{9}{10}$	9.	$14\frac{1}{10}$
5.	$16\frac{315}{1000}$	10.	$\frac{630}{1000}$

Exercise IV. Write the following words in decimals:

1. Three hundred twenty-eight thousandths
2. Three thousand and five ten-thousandths
3. Eighty-six hundredths
4. Eighteen and two hundred ninety thousandths
5. Four hundred twenty-eight and four hundredths
6. Two and seven hundredths
7. Fifteen and eighty-four thousandths

Exercise V. Which of the following numbers have the same value?

1. .6 60 .60 .06 .600 600

2. 78 .78 7.80 780 .780 .0780

Exercise VII.

From a magazine or newspaper cut out or copy and bring to class five sentences or articles that contain decimals.

B. Changing decimals to fractions

1. Use the figure in the decimal as the numerator.

2. The figure for the denominator is 1 (one) followed by as many zeros as there are figures to the right of the decimal point.

Example: $.7$ equals $\frac{7}{10}$ The 7 is placed over 1 plus one zero because we have but one number after the decimal point.

$.75 = \frac{75}{100}$ Here we have two numbers after the decimal point, hence 2 zeros.

C. Sometimes you will need to change a decimal or "disguised fraction" back to its fractional form. Follow this method:

Change .375 to 16ths

$$.375 = \frac{?}{16}$$

Multiply the decimal by the denominator of the fraction you want: 16 in this case. (Note that 3 decimal places must be marked off in the answer.)

$$\begin{array}{r} .375 \\ 16 \\ \hline 2250 \\ 375 \\ \hline 6.000 \end{array} = \frac{6}{16} = \frac{3}{8} \quad \text{(ans.)}$$

Check this by changing $\frac{3}{8}$ to a decimal, as shown in A above.

D. Below is a sample of a decimal equivalents chart, a handy reference in the trade.

EQUIVALENT FRACTIONS AND DECIMALS

Fractions				Decimals	Fractions				Decimals
$\frac{1}{64}$	..	..	..	0.015 625	$\frac{33}{64}$	..	..	..	0.515 625
..	$\frac{1}{32}$	..	..	0.031 250	..	$\frac{17}{32}$	..	..	0.531 250
$\frac{3}{64}$	..	..	..	0.046 875	$\frac{35}{64}$	..	..	..	0.546 875
..	..	$\frac{1}{16}$	..	0.062 500	..	..	$\frac{9}{16}$	..	0.562 500
$\frac{5}{64}$	..	..	..	0.078 125	$\frac{37}{64}$	..	..	..	0.578 125
..	$\frac{3}{32}$	..	..	0.093 750	..	$\frac{19}{32}$	..	..	0.593 750
$\frac{7}{64}$	..	..	..	0.109 375	$\frac{39}{64}$	..	..	..	0.609 375
..	..	..	$\frac{1}{8}$	0.125	..	..	..	$\frac{5}{8}$	0.625
$\frac{9}{64}$	..	..	..	0.140 625	$\frac{41}{64}$	..	..	..	0.640 625
..	$\frac{5}{32}$	..	..	0.156 250	..	$\frac{21}{32}$	..	..	0.656 250
$\frac{11}{64}$	..	..	..	0.171 875	$\frac{43}{64}$	..	..	..	0.671 875
..	..	$\frac{3}{16}$	..	0.187 500	..	..	$\frac{11}{16}$	..	0.687 500
$\frac{13}{64}$	..	..	..	0.203 125	$\frac{45}{64}$	..	..	..	0.703 125
..	$\frac{7}{32}$	..	..	0.218 750	..	$\frac{23}{32}$	..	..	0.718 750
$\frac{15}{64}$	..	..	..	0.234 375	$\frac{47}{64}$	..	..	..	0.734 375
..	..	..	$\frac{1}{4}$	0.25	..	..	..	$\frac{3}{4}$	0.75
$\frac{17}{64}$	..	..	..	0.265 625	$\frac{49}{64}$	..	..	..	0.765 625
..	$\frac{9}{32}$	..	..	0.281 250	..	$\frac{25}{32}$	..	..	0.781 250
$\frac{19}{64}$	..	..	..	0.296 875	$\frac{51}{64}$	..	..	..	0.796 875
..	..	$\frac{5}{16}$	..	0.312 500	..	..	$\frac{13}{16}$	..	0.812 500
$\frac{21}{64}$	..	..	..	0.328 125	$\frac{53}{64}$	..	..	..	0.828 125
..	$\frac{11}{32}$	..	..	0.343 750	..	$\frac{27}{32}$	..	..	0.843 750
$\frac{23}{64}$	..	..	..	0.359 375	$\frac{55}{64}$	..	..	..	0.859 375
..	..	..	$\frac{3}{8}$	0.375	..	..	..	$\frac{7}{8}$	0.875
$\frac{25}{64}$	..	..	..	0.390 625	$\frac{57}{64}$	..	..	..	0.890 625
..	$\frac{13}{32}$	..	..	0.406 250	..	$\frac{29}{32}$	..	..	0.906 250
$\frac{27}{64}$	..	..	..	0.421 875	$\frac{59}{64}$	..	..	..	0.921 875
..	..	$\frac{7}{16}$	..	0.437 500	..	..	$\frac{15}{16}$	..	0.937 500
$\frac{29}{64}$	..	..	..	0.453 125	$\frac{61}{64}$	..	..	..	0.953 125
..	$\frac{15}{32}$	..	..	0.468 750	..	$\frac{31}{32}$	..	..	0.968 750
$\frac{31}{64}$	..	..	..	0.484 375	$\frac{63}{64}$	..	..	..	0.984 375
..	..	..	$\frac{1}{2}$	0.5	..	..	..	..	.....

ASSIGNMENT:

Exercise I. Change the following fractions to decimals. Do not use the chart except for checking.

1.	$\frac{3}{8}$	6.	$\frac{6}{12}$	11.	$\frac{8}{12}$
2.	$\frac{1}{16}$	7.	$\frac{1}{8}$	12.	$\frac{7}{8}$
3.	$\frac{15}{32}$	8.	$\frac{3}{16}$	13.	$\frac{1}{20}$
4.	$\frac{5}{5}$	9.	$\frac{7}{16}$	14.	$\frac{5}{16}$
5.	$\frac{9}{16}$	10.	$\frac{5}{8}$	15.	$\frac{9}{32}$

Exercise II. Change the following decimals to fractions and reduce to their lowest terms.

1.	.8	5.	.4375	9.	.55
2.	.225	6.	.0625	10.	.90
3.	.75	7.	.8125	11.	.780
4.	.875	8.	.15	12.	.125

13. Change two feet, ten inches to the decimal part of a yard.

14. Change 11" to the decimal part of a foot. Carry your answer out to four decimal places.

15. What decimal part of a yard is 18"?

16. What common fraction has the same value as:
    .4 .40 .400 .4000

17. What decimal part of an hour is 12 minutes?

18. Change the following decimals to the nearest 16th of an inch. Use the chart to check your answer.
    a. .8125 b. .4375 c. .1875 d. .5625

19. Using the decimal chart, change these decimals to fractions:
    a. .28125 b. .40625 c. .96875 d. .59375

20. Since there are 12 units in a dozen, what decimal part of a dozen are the following:
    a. 8 units b. 5 units c. 7 units d. 6 units

21. What decimal part of an hour is:

a. 24 min. b. 30 min. c. 15 min. d. 50 min.

22. What decimal part of a yard is:

a. $4\frac{1}{2}$" b. 27" c. $13\frac{1}{2}$" d. 24"

Addition and Subtraction — Lesson No. 3

OBJECTIVE: To review the procedure of adding and subtracting decimals.

RELATED INFORMATION:

The addition and subtraction of decimals will be very simple for you if you remember just one rule -- Keep the decimal points under each other in a straight line.

A. Example: 67.5 + 4.125 + 8.96

$$\begin{array}{r} 67.500\ * \\ 4.125 \\ 8.960\ * \\ \hline 80.585 \end{array}$$

* Zeros have been added to fill the column. The value of a decimal does not change if zeros are added after the figures to the right of the decimal point.

Ex.: $.5 = \frac{5}{10}$, $.50 = \frac{50}{100}$, $.500 = \frac{500}{1000}$

All the above are equal to $\frac{1}{2}$. Their value was not changed by adding the zeros.

B. Example: Subtract 8.96 from 67.5

$$\begin{array}{r} 67.50\ * \\ -\ 8.96 \\ \hline 58.54 \end{array}$$

* Should the larger number in subtracting not extend to as many decimal places as the smaller, zeros may be added to the right of the decimal without changing its value.

PROCEDURE:

Remembering to keep the decimal points in a straight line, write the following as the teacher dictates, and add the columns.

1. 1.34 + .0254 + .706 + .00503 + .0704
2. 36.04 + 9.00 + 547.0161 + 5.056 + 39.98
3. 14.0014 + 7.43 + 5.5 + 6.006
4. 2.1 + .003 + 103.5 + 17.205
5. 75.07 + 5.945 + 116.05 + 9.028

Subtract the following:

6. 306.6 - 32.09
7. 205.06 - 140.
8. 302.09 - 215.387
9. 1035.61 - 907.47
10. 78.5137 - 59.306

ASSIGNMENT:

1. Change $\frac{4}{5}$, $\frac{2}{3}$, $\frac{5}{6}$ and $\frac{3}{4}$ to decimals and add.

2. Change .5, 3.5, .75, and .4 to common fractions and add.

3. What is the difference between the first number and the second in the following problems?

a.	11.90	3.05
b.	5.98	4.50
c.	6.125	3.02
d.	402.5	23.09
e.	67.5132	49.607
f.	.263	.096

4. Add and check the following examples:

a.	b.	c.	d.
1.25	1.8	.379	24.056
57.	2.6	2.05	18.287
.32	.759	.876	.94
.18	.375	.91	7.876
48.	1.48	.8	.093

5. 35.8 + 8.07 + 81.54 - 2.69 + 38. - 12.20 =

6. .053 + 5.15 + .5 - 2.935 + .007 =

7. \$9.56 + \$3.65 + \$15.95 - \$6.98 + 75¢ =

8. 7.886 + 25.08 + 17.92 + 9.0 + 25.477 =

9. How much more than \$6.85 is \$12.10?

10. What number subtracted from \$30 gives \$8.25?

OBJECTIVE: To practice multiplication of decimals as used in the trade.

RELATED INFORMATION:

Next to addition, multiplication is the most frequently used operation in arithmetic. It is used not only in figuring materials costs and labor costs, but also in the extension of invoices, purchase orders, etc. The terms used in multiplication are shown in the following example:

	2.5	multiplicand
x	5	multiplier
	12.5	product

PROCEDURE:

In multiplying, the most common error made is the wrong placement of the decimal point. To keep from making this mistake, follow these simple rules:

a. Multiply, as in whole numbers, paying no attention to the decimal point.

b. Count the number of decimal places in the two numbers you are multiplying.

c. In the product, count off from the right the combined number of places and insert the decimal point.

For example:

A. 3.69 x 7.8 2 places + 1 = 3 places in the product

```
  3.69
   7.8
  ----
  2952
 2583
 -----
 28782  =  28.782
```

Since there is one decimal place in the multiplier and 2 in the multiplicand, there is a total of 3 decimal places. Therefore, the decimal point in the product is placed before the 3rd figure counting from the right.

B. 12.75 x 12 — 2 places in just the multiplicand.

```
   12.75
x     12
  -----
   2550
  1275
  -----
  15300 = 153.00
```

Point off two places.

C. .25 x .25 — 2 places + 2 places = 4 places

```
   .25
x  .25
  ----
   125
   50
  ----
   625 = .0625
```

Rule: Point off four places. Note that your answer consists of only three places. Therefore, a zero must be inserted to create the needed fourth place.

ASSIGNMENT:

1. Multiply the following:

   a. 23 x .3
   b. .25 x 5
   c. 30.5 x 12.5
   d. 302 x .009
   e. 22.75 x 11
   f. .235 x .25

2. If the cost of one 14" O. T. zipper was $0.1234, what would be the cost of 144 zippers?

3. A dressmaker bought 2 pieces of batiste, at $42\frac{1}{2}$¢ per yard. One piece measured $41\frac{3}{4}$ yards and the other $48\frac{1}{2}$ yards. What was the total cost?

4. Find the cost of the following:

   a. 20 yards of drill cloth @ $22\frac{1}{2}$¢ per yard
   b. 24 yards of dacron/cotton @ 75¢ per yd.
   c. 13 yards of taffeta @ 85¢ per yard
   d. 5 yards of organdy @ $62\frac{1}{2}$¢ per yard
   e. 15 yards of percale @ $39\frac{1}{4}$¢ per yard

5. The following items were received at the beginning of the month. Figure the cost of each item.

   a. 15 cones of white thread @ $1.42 per cone
   b. 36 cards of middy braid @ 9¢ a card
   c. 24 sets of chevrons @ 25¢ a set
   d. 11 boxes of thread @ $2.48 a box

Division | Lesson No. 5

OBJECTIVE: To practice division of decimals as used in the trade.

RELATED INFORMATION:

The division of decimals is done essentially the same as for whole numbers except that the position of the decimal in the quotient is important. You know from previous lessons that the incorrect placement of the decimal point can completely change the value involved. The terms used in division are shown in the following example:

	2.15	quotient
divisor	5/10.75	dividend

PROCEDURE:

In the division of decimals you will come across three different types of problems:

A. Dividing a whole number into a number containing a decimal.

5/10.75

First place the position of the decimal point for the quotient directly above the decimal point in the dividend.

5/10.75

Then divide 2.15
5/10.75

This is the simplest of all types of division of decimals.

B. Dividing a whole number into a number where an exact answer is required to at least 3 decimal places.

3/1073

First place the decimal point at the end of the dividend and add a zero or as many zeros as needed.

3/1073.000

Place the decimal point for the quotient directly above the decimal point in the dividend.

3/1073.000

Then divide 357.666$\frac{2}{3}$
3/1073.000

C. Dividing a decimal number into a decimal number.

.78/93.99

First, to mark the correct position of the decimal point in the quotient:

a. Move the decimal point in the divisor to the extreme right, - in this case 2 places. .78 becomes 78.

b. Move the decimal point to the right the same number of spaces in the dividend (in this case, two places). 93.99 becomes 9399.

c. Mark the position in the quotient directly above the decimal point in the dividend.
78/9399.

d. Divide. You can see that this problem needs an additional zero. You may add as many zeros as needed to complete the problem.

```
      120.5
78/9399.0
      78
      159
      156
        390
        390
```

D. Dividing a whole number by a decimal number.

Ex. Divide 326 by .25

First make the divisor a whole number by moving its decimal point to the right of the last figure (two places). .25./326

Add as many zeros to the dividend as are necessary to equal the number of places moved in the divisor (two places). 25/32600

By removing the decimal point in this manner, the quotient is a whole number.

```
      1304
25/32600
```

Can you explain what we are doing when we move the decimal point the same number of places in both divisor and dividend?

ASSIGNMENT: (Be sure to include the dollar sign in your answer when needed.)

1. $24.57 ÷ 9
2. 2.886 ÷ 6
3. $1.92 ÷ 8
4. .01875 ÷ .625
5. $8.38 ÷ .335
6. .1368 ÷ 38
7. 4.958 ÷ 74
8. 213.726 ÷ 537
9. 1.125 ÷ 10.3125
10. $10.28 ÷ 27½¢

11. In figuring the cost of a dress, $4.23 was allowed for fabric. How many yards @ 72¢ a yard can be used?

12. At $2.98 a yard, how many yards of silk can be bought for $17.14?

13. The area in shop that could be used for work tables was 8.5 feet wide and 25.5 feet long. How many times the width is the length?

14. At 24¢ a box, how many boxes can be purchased for $125.52?

15. A firm received 236 yards of fabric. The invoice amounted to $159.89. What was the cost per yard?

16. If an operator works 36 hours a week and makes a dress every 1.5 hours, how many dresses does she complete at the end of the week?

17. At $0.165 a dozen, how many dozen buttons can be bought for $18.15?

18. Divide each of the following by 3.1416

    a. 15, b. 17, c. 340

Short Processes | Lesson No. 6

OBJECTIVE: To learn short cut methods of working with decimals.

RELATED INFORMATION:

Time is one of the most important factors in successfully accommodating customers. Anything that helps to save time is of utmost importance. Whenever we wish to multiply or divide by such numbers as 10, 100, 1000, etc., we can save time by using short processes.

PROCEDURE:

Short processes for multiplication:

A. Find the following products:

(1) 10 x .035 (2) 10 x .35 (3) 10 x 3.5

What happens to the decimal point of the multiplicand when you multiply by 10?

B. Multiply the following:

(1) 100 x .035 (2) 100 x .35 (3) 100 x 3.5

What happens to the decimal point of the multiplicand when you multiply by 100?

C. Multiply the following:

(1) 1000 x .035 (2) 1000 x .35 (3) 1000 x 3.5

What happens to the decimal point of the multiplicand when you multiply by 1000?

The above examples teach you this simple rule:

To multiply a number

a. by 10, move the decimal point one place to the right.
b. by 100, move the decimal point two places to the right.
c. by 1000, move the decimal point three places to the right.

Remember that a whole number may be considered to have a decimal point after it.

59 = 59.

Practice: In the following examples write the product only:

1. 10 x 10.75	4. 1000 x 32.1	7. 100 x 280
2. 100 x .1134	5. 100 x 6.75	8. 10 x .67
3. 10 x 652	6. 1000 x .0065	9. 100 x 10.19

To multiply by 200, multiply by 2 and then move the decimal point two place to the right. How would you multiply by 300? 500?

Example: 200 x $4.75 = $950.00

Short Processes for Division:

To divide a number by:

a. 10, move its decimal point one place to the left.
b. 100, move its decimal point two places to the left.
c. 1000, move its decimal point three places to the left.

Practice: Using the short processes, divide:

1. 67.50 ÷ 10	4. 750.693 ÷ 1000
2. 29.80 ÷ 10	5. .57 ÷ 10
3. 68.00 ÷ 100	6. .069 ÷ 10

ASSIGNMENT:

1. If it costs $3.17 to make one dress, how much would 100 dresses cost at the same rate?

2. In a community chest drive, $98.50 was collected from 100 employees. What was the average per person?

3. If the average price of wool is $0.406 a pound and cotton is $0.2974 a pound:
   a. What is the price of 100 lbs. of each?
   b. What is the price of 1000 lbs. of each?

4. A buyer ordered 100 dresses @ $10.75 each. What was the total cash amount of her order?

5. Ten yards of taffeta @ 89¢ a yard was used in the making of a slip. What was the total cost of the taffeta?

6. If the bill for 100 zippers came to $27.85, what was the average cost per zipper?

Rounding Off Decimals — Lesson No. 7

OBJECTIVE: To learn the rule for rounding off decimals in the needle trades.

RELATED INFORMATION:

Many problems in decimals do not come out evenly and it is hard to determine just where to stop the process and still have a sufficiently accurate result. The number of decimal places to which answers should be carried is largely determined by the trade practice. In needle trades, it is sufficiently accurate to continue the problem until there are three decimal places in the answer. Then the answer is rounded off to two decimal places. The process of expressing a decimal to the degree of accuracy used in the trade is called "rounding off decimals".

PROCEDURE:

The following rules apply to most of the problems in the needle trades where the answer contains three decimal places "rounded off" to two decimal places:

1. If the third figure after the decimal point is 5 or more, the figure in the second decimal place is increased by 1 (and the third figure is dropped),

2. If the figure in the third decimal place is less than 5, it is dropped.

Example: $2.5 \div .06 = 06.\overline{)250.000}$

$$\begin{array}{r} 41.666 \\ 06.\overline{)250.000} \end{array}$$

a. Note that in the problem $.06\overline{)2.5}$, zeros are added in order to carry the quotient to three places.

b. Look at the third decimal place to determine whether or not the second digit should remain the same or be increased. (.66$\underline{6}$)

c. In this case the digit, 6, is more than 5. The second-decimal-place figure is increased to 7. The answer is "rounded off" to 41.67.

Practice: Round off the following:

1. .756
2. $1.9575
3. 7.324
4. 29.409
5. 2.5644
6. 18.2702
7. 221.7557
8. .8967
9. $.625
10. 18.762

ASSIGNMENT: Round off the answers to the following problems to two decimal places:

1. 25.0097 + 0.9237 + 1.125
2. .7895 + .6842 + 12.7 + 231.0924
3. .1134 x 125
4. .7895 x 111
5. 4.125 x 1.51
6. 44.002 x 21.10
7. 3.1416 x 1.03
8. 8.75 ÷ .063
9. 1.5 ÷ 8.724
10. 215.00 ÷ 46
11. 936.06 ÷ 2.25
12. 128.5 ÷ 7.56
13. 19.575 - 8.756
14. 8.967 - .625
15. 25.6445 - 1.8762
16. 0.282 - 0.0924
17. .1134 - .0987
18. 1.056 - .565
19. 129.00 - 10.328
20. 11.7 - 8.032

Computations Using Decimals **Lesson No. 8**

OBJECTIVE: To practice the use of decimals in various computations in the needle trades.

RELATED INFORMATION:

You have noticed that most of the calculations thus far have involved the use of money. Everything in a business costs money and every sound business must pay strict attention to money details. Thus far, we have considered materials costs and shipping costs. Later we will cover other costs that must be taken into consideration for a successful and profitable business.

PROCEDURE:

The following problem is used to show the losses that a firm could have if it did not figure its production to fill the demands of the day and if it did not keep a close check on waste. Many firms overproduce certain garments. In so doing, they may have more merchandise "on the racks" than they can really sell. These garments eventually are sold at a loss.

Example: A "lot" consisting of 350 dresses in style #802 was cut. A check showed that only 209 garments were sold. The materials cost for this style was $2.93. What would be the total materials cost of the complete lot? What is the materials cost of the unsold garments? If, at the end of the season these garments were sold at a loss of $\frac{1}{2}$ the materials cost, what would the total loss be?

ASSIGNMENT:

1. The trimming buyer of Claudia Co. kept a stock of 6" neck zippers on hand. Due to the changes in fashion, there was no need for 6" zippers. If at the end of the year, 265 zippers were sold @ 3¢ and their original cost was $0.065, what is the loss on one zipper? on the 265 zippers?

2. A manufacturer purchased 1050 yards of spun print @ 68¢ a yard to be used in style #805. In cutting the first lot, $455\frac{1}{2}$ yards were used. The manufacturer soon found out that this particular style was not "reordering". Finding no other use for this fabric, the manufacturer sold it at $0.435 per yard. What was the loss per yard? What was the total loss?

3. A firm purchased 675 zippers from Belbro Notion Company @ $0.1387 each. At a later date, the firm decided to purchase the same amount of zippers directly from a zipper manufacturer and paid $0.1134 each for the same type zipper. What was the saving per zipper when purchased directly from the manufacturer? What was the total saving?

4. A set of four rhinestone buttons costing 50¢ each appeared on the designer's "original" of style #607. To reproduce the style cheaply in quantity, the production department decided to use a similar but less expensive button selling @ 37¢ each. What was the total saved by using the less expensive button on 320 garments?

UNIT VI - PERCENTAGE

Pre-Test No. 6

Exercise I. Fill in the missing figures.

	Fraction	Decimal	Percentage
1.			50%
2.	$\frac{1}{3}$		
3.		.0625	
4.	$\frac{5}{12}$		
5.		$.66\frac{2}{3}$	
6.	$\frac{3}{8}$		
7.		.60	
8.			$87\frac{1}{2}\%$
9.			5%
10.		.5625	

Exercise II.

1. What is the 2% sales tax on $748.50?
2. Change $6\frac{1}{5}$ to a decimal.
3. Find $\frac{1}{4}\%$ of 300.
4. What is the interest on $1500.00 @ $2\frac{1}{2}\%$?
5. What is the percentage mark-down on a dress that originally sold for $69.00 and is now selling for $46.00?

Exercise III. Determine what percent

1. 36 is of 48.
2. 50 is of 75.
3. 8 is of 64.
4. 2 is of 5.
5. $\frac{1}{2}$ is of 4.

Exercise IV. Figure the following discounts:

1. 2% of $118.63.
2. 8% of $10.75.
3. $33\frac{1}{3}$% of $49.95.
4. 2% of $254.14.
5. 25% of $89.95.
6. 8% of $127.50.

Exercise V. Find the missing numbers if:

1. $12\frac{1}{2}$% of a number is 32 _____.
2. 6% of a number is 36 _____.
3. 80% of a number is 10.20 _____.
4. 15% of a number is 6.45 _____.
5. 35% of a number is .7945 _____.

CLEARANCE

33 1/3 % to 50 % off

Profit Ratio At Big Stores Off To 2.8%; Sales Up

75% of Fall Budgets Spent By Apparel Buyers in June

Big Store April Sales Down 6%; Stocks Off 4%

Fur Workers, Makers Okay 3-Year Pact

Pay Raised 9-12%; Contracting Hit

Sales in Week At Department Stores Up 5%

RAYON MOVEMENTS DOWN 11% IN JUNE

65% Dacron & 35% pima cotton

THESE NEWSPAPER CLIPPINGS ILLUSTRATE THE USE OF PERCENTAGE TO EXPRESS SOME SITUATIONS RELATED TO THE NEEDLE TRADES.

Review | Lesson No. 1

OBJECTIVE: To recall the terms and the uses of percentage.

RELATED INFORMATION:

Needle trades calculations in percentage have to do with determining rates or amounts of increase, decrease, discount, interest, commission, gain, loss, average, etc.

The term "per cent" means hundredths and instead of writing the word "per cent" each time, the symbol % is used. For instance, 12% means $\frac{12}{100}$. You will find the word used frequently in papers, magazines, on the radio, and television.

The principles of arithmetic found in percentage are similar to problems found in fractions. There can never be enough emphasis placed on accuracy in the use of fractions, as the needle trades worker uses fractions throughout her math work.

The only difference between finding a "per cent" of a number and finding the fractional part of a number is that in percentage a per cent (%) changed to a decimal fraction is used, and in finding a fractional part of a number a common fraction is used. Thus to find 50% of a number, 50% is changed to .50 (which is the same as finding $\frac{1}{2}$ of the number).

PROCEDURE:

The use of $\frac{100}{100}$ or 100% is the basis of comparison used in percentage. The percentage value is changed to the decimal system for ease in computing and accuracy in pointing off the number of decimal places.

Following is a table showing different ways of expressing fractions, decimals, and percentage:

Expressed in Words	Fraction	Decimals	Percentage
One-hundredths	$\frac{1}{100}$	.01	1%
Ten-hundredths	$\frac{10}{100}$	.10	10%
One hundred hundredths	$\frac{100}{100}$	1.00	100%
One hundred fifty hundredths	$\frac{150}{100}$	1.50	150%
One hundred seventy-five thousandths	$\frac{175}{1000}$	.175	17.5%

A. The rules for changing per cent to decimals:

Example: 12%

1. Remove the % sign. 12

2. Change to a decimal by placing a decimal point 2 digits to the left of the number for the given per cent.
(Note that this is the same as dividing by 100.) .12

B. There are times when you will need to change a fraction into "percentage".

Example: $\frac{1}{8}$

1. First change the fraction into a decimal by dividing the numerator by the denominator as learned in the previous unit.

$$\begin{array}{r} .125 \\ 8\overline{)1.000} \end{array}$$

2. The decimal .125 is then changed into percent by moving the decimal point two places to the right. 12.5%

ASSIGNMENT:

Exercise I. Work out the following:

	Fraction	Decimal	Per Cent
1.	$\frac{7}{8}$		
2.	$\frac{5}{12}$		
3.	$\frac{1}{3}$		
4.	$\frac{5}{16}$		
5.	$\frac{3}{10}$		

Exercise II. Change these per cents to decimals:

6. $3\frac{4}{5}\%$

7. 110%

8. 18%

9. $16\frac{1}{2}\%$

10. 6%

Exercise III. Change these decimals to per cent:

11. .875

12. 1.625

13. .8

14. .1875

15. 2.15

16. If a cutter was asked to cut only $33\frac{1}{3}\%$ of 396 yards of material on hand, how many yards would he cut?

17. In checking your pre-test paper, you found you had $12\frac{1}{2}\%$ of the questions wrong. What fraction of the questions were wrong? There were 32 problems. How many were wrong?

18. A box holds 16 spools of thread when full. There are 5 spools left in the box at the end of the month. What per cent of spools remain in the box?

19. At the end of the summer season, bathing suits were marked down 20%. What would be the sale price of a suit that originally cost $17.95?

20. Bring to class 5 articles from newspapers or magazines that use per cent.

Types of Percentage — Lesson No. 2

OBJECTIVE: To learn to solve the types of problems encountered in percentage.

RELATED INFORMATION:

In working with percentage it is important to completely understand the problem. Three terms are used in percentage: base, rate, and percentage. The base is the number on which the percentage is computed; it represents the whole or 100%. The rate shows how many hundredths are used. The percentage is the product of the base and the rate. For example: in the problem of finding 5% of $625, $625 is the base, 5% is the rate, and $3.25 is the percentage.

PROCEDURE:

There are three distinct kinds of problems involving percentage:

TYPE A. Finding a certain per cent of a number.

Example: A store advertised that dresses originally priced at $12.98 would be reduced 25%. How much is actually deducted from the selling price?

1. Change the per cent to a decimal. 25% = .25

2. Multiply the number by the decimal.

```
 $12.98
   x.25
  6490
 2596
 32450 = $3.25
```

Rule: Base x rate = percentage
$12.98 x 25% = $3.25 (amount of reduction)

TYPE B. Finding what per cent one number is of another.

Example: Fabric which had been selling for 96¢ a yard was reduced 35¢ on a yard. What per cent of the original selling price was the discount price?

1. Write the fractional part one number is of the other. $\frac{35}{96}$

2. Change this fraction to a decimal.

```
      .3645
96/35.00
   28 8
    6 20
    5 76
      440
      384
       56
```

3. Change the decimal to per cent.

.365 = 36.5%

Rule: Percentage ÷ base = rate
35 ÷ 96 = 36.5%

TYPE C. Finding a number when the per cent of it is known.

Example: At the end of the season, fabric was sold for $1200. This amount was 64% of its original cost. What was the original cost of the fabric?

1. Change the per cent to a decimal. 64% = .64

2. Divide the per cent into the number given. .64/1200.00
1875.00

Rule: Percentage ÷ rate = base
$1200 ÷ 64% = $1875

ASSIGNMENT:

1. Work the following problems:

a.	10% of 65	f.	100% of 764
b.	12% of 14	g.	25% of 1086
c.	72% of 450	h.	2% of 28
d.	65% of 48	i.	86% of 230.30
e.	3% of 100	j.	34% of 17.6

2. If $9.00 was 16% of a girl's weekly salary, what did she earn in a week? In 24 weeks?

3. A sewing machine costing $255.00 was sold at a loss of $33\frac{1}{3}$%. What was the selling price?

4. $37\frac{1}{2}$% of an operator's yearly income is $1135.00; what is her yearly income?

5. A two-piece dress which takes an operator 3 hours to make requires 12% of the time on the skirt. How many hours were spent on the jacket?

6. In calculating the selling price of a garment, 30% of the selling price was allowed for mark-up. What is the cost of a garment that sells for $12.75?

7. The following ad appeared in a newspaper:

FINAL CLEARANCE ON ALL SUMMER FASHIONS

a.	Dresses	$69.95	Reduced	$33\frac{1}{3}$%
b.	Suits and Coats	159.00	Reduced	30%
c.	Gowns	245.00	Reduced	25%
d.	Separates	14.95	Reduced	33%

What is the amount of reduction and final discount price on each item?

8. In a school of 450 students 22% were absent one day due to a heavy storm. How many students were absent?

9. A forelady in a shop who was being paid $1.90 an hour, received a notice in her pay envelope stating that because of good work her hourly rate would be increased 10%. What will be her daily increase if she works 7 hours?

10. The net profits of a business for one year were $190,000. The following year they were $4\frac{3}{4}$% greater. How much was the increase in profits in the second year?

11. Following is a list of items that are being sold at a discount. Figure the percentage of discount on each.

	Original Price	Selling Price	% Discount
a.	$387.00	$129.00	
b.	169.00	98.02	
c.	129.00	79.98	
d.	69.95	34.97	
e.	89.95	67.47	

Commercial Discounts — Lesson No. 3

OBJECTIVE: To develop an understanding of the application of percentage as used in commercial discounts.

RELATED INFORMATION:

As you know, goods are often sold for less than the marked price. When goods are sold for less than the marked price, they are said to be discounted. Of the four chief kinds of discount, which are cash, quantity, special sale, and trade discounts, the last (trade discounts) is the most common in the needle trades field. Trade discount is discount given by a wholesaler to a retailer. In the manufacturing of garments the allowance of 8% discount is generally given to the retailer. The terms stated are usually 8/10 E. O. M. which means eight per cent discount is allowed up to ten days after the end of the month.

The manufacturer in turn is allowed trade discounts, usually 1% or 2%, on fabrics, findings, etc.

PROCEDURE:

The following terms are a few of the discounts allowed in the needle trades field, both in manufacturing and retailing.

A. 8/10 E. O. M.

$76.50
.08
$6.1200

Example: On June 23rd a retail customer bought 6 dresses @ $12.75 making a total of $76.50 due the manufacturer. The discount allowed was 8/10 E. O. M. What was the discount allowed and up to what date could this deduction be made?

Answer: A discount of $6.12 was allowed up to July 10th.

B. 1% net E. O. M. (One per cent allowed before the end of the month)

$29.10
.01
$.2910

Example: A manufacturer was allowed the above discount on a bill for zippers dated June 10th, amounting to $29.10. What was the discount allowed and up to what date could this deduction be made?

Answer: A discount of 29¢ was allowed up to June 30th.

C. 2% net 10/60

$565.00	Example: A manufacturer was allowed the above discount
.02	on a bill for piece goods amounting to $565.00 purchased on
$113000	June 14th. What was the discount allowed if the bill was
	paid on July 30th?

Answer: The above term means that 2% is allowed up to 70 days. Since July 30th falls within that time, 2% or $11.30 can be deducted from this bill.

D. Series Discounts

Some dealers allow two or more discounts, called chain discounts or series discounts. This method of discount is figured as follows: find the discount allowed at the first rate and subtract it from the price; then find the discount on the balance at the given rate, and subtract it from the first discounted price. This is the new cost.

Example: For a cash payment, a $350.00 television set is given chain discounts of 7% and 5%. Find the cash payment.

$350.ØØ	$350.00	$325.50	
.07	- 24.50	- 16.28	
$24.50	325.50	$309.22	cash payment
	.05		
	$16.2750		

ASSIGNMENT:

1. During an end-of-the-season sale, a store offered spring coats at a discount of 25%. What would be the discount allowed on a coat marked $50.00?

2. The following amounts were billed to a retail store for garments purchased: $100.50, $64.50, $21.50, $12.75. The discount allowed was 8%. What was the amount of the check needed for the payment of these bills?

3. A manufacturer received the following bills for shipments of fabrics during the month of June: $470.25, $201.85, $565.01, $121.41. What is the amount of discount allowed @ 2% net/60?

4. On June 10th, a manufacturer received a package of buttons amounting to $46.50. The discount allowed was 1% E.O.M. What is the amount of the discount and when is the discounted bill due?

5. Some retail stores give a 2% discount for cash. If you purchased several items amounting to $22.50 and you paid cash, how much did you pay for them?

6. A 6% discount was allowed on a formal gown marked $98.95. A month later the same gown was again reduced 8%. Find the final selling price.

7. Employees in a retail shop are allowed 30% discount. If an employee bought a coat marked $90.00, what did she pay for it?

8. Find the amount due on the following statements received:

	Amount of Statement	Discount Allowed	Amount of Discount	Amount Paid
a.	$96.40	8%		
b.	$3628.50	2%		
c.	$335.45	$33\frac{1}{3}$%		
e.	$297.24	3%		
f.	$352.56	1%		

9. Clara bought a typewriter for $74.00 and received chain discounts of 3% and 2%. Find the cost of the typewriter.

10. Make out a bill for the following items:

$3\frac{1}{4}$ yds. of silk @ $1.25 per yd.

$1\frac{1}{4}$ yds. pellon @ 59¢ per yd.

$5\frac{1}{8}$ yds. dacron/cotton @ 79¢ per yd.

9 buttons @ 72¢ adoz.

4 spools of thread @ 39¢ a spool

Discount 5% for cash.
What is the amount of the cash payment?

11. Are chain discounts of 4%, 4%, and 2% greater, less, or the same amount as a flat 10% discount? Explain your answer.

Commissions Lesson No. 4

OBJECTIVE: To learn how to use percentage in figuring commissions.

RELATED INFORMATION:

Some people are paid for their work at the end of each week, others at the end of two weeks, and still others at the end of each month. The money that these people receive is called wages or salaries. As you know, people who sell things are often paid a certain per cent of the sale price of what they sell. The money that these agents receive is called commission. Commissions are usually expressed in per cent.

PROCEDURE:

Commissions can be paid at any agreed figure. Some salesmen are paid both a salary and commission, others are paid a commission only, and still others are paid a salary plus a commission on merchandise sold above a certain figure.

Example: Joan is a salesgirl and receives a salary of $40.00 a week plus 2% commission on all sales made. What is her commission on sales of $235.00? What are her total earnings?

Answer:

$235.ØØ	$40.00
.02	5.70
$ 5.70	$45.70 total earnings

ASSIGNMENT:

1. Mr. Jones works for Junior Miss Dress Company and receives a commission of 7% of the total net monthly sales. For the month of June his net sales were $21,350.75. What are his total earnings for the month of June?

2. Find the commission earned by each of the following salesmen for the month of May. The commission rate is 6%.

Salesmen	Amount of Sales
A.	$18,750.50
B.	$25,675.75
C.	$16,320.00
D.	$10,550.50
E.	$20,125.25

What was the total of commissions paid out to salesmen?

3. Suppose you are a clerk and are given $4\frac{1}{2}$% commission on the amount of your sales. What is your commission on a sale of (a) $1.00? on (b) $10.00? on a sale of (c) $100?

4. Mr. Lee is paid a salary of $200 a month plus 5% commission on net sales. For the month of May his gross sales were $15,250.25 and returns amounted to $1400.00. What were his earnings for the month of May?

5. What is the commission at 8% on (a) a dress that sells for $12.75? (b) on 25 dresses? (c) on 75 dresses?

6. Mr. Jones received a commission of 5% on the first $10,000 of merchandise sold and 2% on any amount over $10,000. At this rate what would he earn on $18,750.00?

Interest | Lesson No. 5

OBJECTIVE: To learn to figure simple interest on money borrowed.

RELATED INFORMATION:

When you borrow money, a certain sum, called interest, is paid for the use of this money. The amount of money, for the use of which interest is charged, is called the principal.

Very often businessmen borrow money to help them in their business. With good management they can often make more money by borrowing than by not borrowing.

PROCEDURE:

The amount of interest paid for the use of money depends upon three things: (1) the principal, that is, the amount of money borrowed; (2) the time for which the principal is used; (3) the rate of interest charged. The term rate of interest means a certain per cent of the principal for one year. For computing interest, the year is divided into 12 months of 30 days each. The date of maturity, or the day the money is due, is found by counting the days.

The following formula is a helpful way to find interest:

Interest = principal X rate X time (expressed in terms of years.)

You can write the formula I = prt.

Example A: Find the interest for one year on $575.00 at the rate of 6%.

$575.ØØ
x .06
$ 34.50

1. Change the per cent to a decimal.

2. Multiply the principal by the per cent.

Find the interest if the above loan was made for just 60 days. Using 30 days as one month, 60 days equals two months or $\frac{2}{12}$ of a year, which equals $\frac{1}{6}$.

$ 5.75
6/$34.50

Divide the amount of yearly interest by 6.

Notice that the interest on any sum of money @ 6% for 60 days is 1% of the principal. Therefore, this simple rule applies: To find the interest on any sum for 60 days at 6%, just move the decimal two places to the left.

Example: $575.00 = principal
$5.75 = interest for 60 days @ 6%

Example B: Find the interest on $2400 for 3 years, 7 months, 18 days at 6%.

Solution:

Interest on $1 for 3 yrs. at 6%	=	$0.18
Interest on $1 for 7 mos. at 6%	=	0.035
Interest on $1 for 18 days at 6%	=	0.003
Interest on $1 for 3 yrs. 7 mos. 18 days	=	$0.218

Therefore the interest on $2400 equals

$$2400 \times \$0.218 = \$523.20$$

Example C: Sometimes you know the amount of interest paid and wish to calculate the rate. You can also use the formula to find the missing rate of interest.

The formula is then changed into the form:

$$r = \frac{I}{pt.}$$

What is the annual rate of interest if the annual interest on a principal of $250 is $10?

Solution:

$$r = \frac{10}{250} \qquad 250\overline{)10.00}\ .04 = 4\%$$

ASSIGNMENT:

1. Mr. Green borrowed $4000 from the bank for 6 months @ 5%. How much interest did Mr. Green pay?

2. Lois can buy a sewing machine if she borrows $120. She will have to pay $8 a month for 18 months. If she buys the machine she can make 36 dresses in a year. She figures she will make an average profit of $7 a dress. Do you think she should borrow the money and buy the sewing machine? Prove you are right.

3. Find the interest on the following sums for 60 days @ 6%.
(a) $865, (b) $14.50, (c) $893.75, (d) $1355, (e) $367.80

4. Find (a) the date of maturity for each of the following loans; (b) the amount of interest due on the notes at the date of maturity:

	Date	Time	Interest Rate	Principal
a.	May 1	60 days	6%	$600
b.	May 15	2 mos.	6%	$750
c.	March 11	150 days	6%	$500

5. Find the interest on each sum for 60 days @ 6%, 7%, 5%, and 4%:

(a) $150, (b) 216, (c) $960, (d) 120, (e) $90

6. Find the annual rate of interest for the following loans:

	Amount Borrowed	Time	Amount Paid Bank
a.	$300.00	6 mos.	$318.00
b.	150.00	90 days	153.00
c.	200.00	6 mos.	206.00
d.	200.00	1 yr.	206.00
e.	200.00	3 mos.	206.00
f.	350.00	1 yr.	374.50
g.	80.00	30 days	81.00
h.	674.00	60 days	680.74

7. Compare the rate of interest on a loan of $500 for a year on which $30 interest was paid and a loan of $1000 for 6 months on which $30.00 interest was paid.

8. Find the interest on the following:

a. $4000 for 3 yr., 4 mos., 18 days @ 6%
b. $3200 for 1 yr., 1 mo., 15 days @ 6%
c. $500 for 2 yr., 3 mos., 11 days @ 6%
d. $4400 for 4 yr., 3 mos., 9 days @ 6%

9. Find the missing item in each of the following exercises:

	I.	P.	R.	T.
a.	---	$1500	3%	4 yrs.
b.	$70	$350	---	5 yrs.
c.	$81	---	6%	3 yrs.
d.	$350	$2000	---	7 yrs.
e.	---	$1500	$3\frac{1}{2}$%	5 yrs.

Determining Selling Prices — Lesson No. 6

OBJECTIVES: To learn the use of percentage in determining selling price.
To understand the importance of overhead costs in determining selling price.

RELATED INFORMATION:

As a business is operated for profit, it is obvious that the owner will obtain for each item that he sells a price that is as high as is practicable.

The basic factors in determining the selling price of goods are: cost of materials used, labor costs, and operating expenses or overhead expenses, which include rent, taxes, heat, light and power, salaries other than factory, depreciation, supplies, etc. Quite often overhead costs run up as high as 25% of the total sales.

As the selling price includes everything (the cost of the merchandise, overhead expenses, and the net profit), it is the whole amount and should be used as the base, or 100 per cent. Then the cost of the merchandise, the various overhead expenses, the net profit, the margin, and practically all financial items, can be stated as percentages of the sales of the business.

PROCEDURE:

In determining the selling price, a manufacturer usually sets a certain per cent of materials and labor costs to cover his overhead and profit.

Example A: Determining selling price when the cost, the rate of overhead, and the rate of profit are known.

The president of Junior Miss Dress Co. has figured that 18% of the sales must be allowed for overhead expenses. He also wishes to make a net profit of 10% of his sales. At what price should he mark an article that costs him $10.80?

Solution:

Selling price = ... 100%

Overhead Expenses	=	18% of S. P.
Net Profit	=	10% of S. P.
		28%
Balance is cost		72%
		100%

That is, $10.80 = 72% of S. P.

Therefore $10.80 ÷ .72 = $15.00 Selling Price

Check:

18% of $15.00	=	$2.70
10% of $15.00	=	1.50
Cost of article	=	10.80
		$15.00 = 100% or Selling Price

Example B: A merchant buys a hat for $3.00 and sells it for $4.00. What is his per cent of profit?

Solution:

The base is $4.00 and the percentage is $1.00. The rate or per cent of profit is $\frac{1}{4}$ = 25%

Proof:

```
      $4.00
  x    .25
      2000
      800
  $1.0000 = $1.00 or 25% of S. P.
```

Example C: The Jean & Jane Dress Store sold a dress for $75.00 with a gross profit of 35%. What was the cost?

Solution:

Since the selling price is taken as 100%, the cost is 65% of the selling price, hence the cost is

$75.00 x 65% = $48.75 = cost of dress

ASSIGNMENT:

1. Find the selling price of each of the following:

	Cost	Overhead	Rate of Profit
a.	$12.50	20% of S. P.	15% of S. P.
b.	52.25	15% of S. P.	21% of S. P.
c.	15.00	17% of S. P.	8% of S. P.
d.	6.50	30% of S. P.	16.5% of S. P.

2. A haberdasher's overhead is $24\frac{1}{2}$% of his sales. He pays $1.33 each for men's shirts and clears 9% on his sales. At what price should he sell them?

3. Find the wholesale price of the following styles if the overhead expense is figured @ 22% of the sales and the profit at 12%:

a.	Style #896	cost $7.47
b.	Style #335	cost 8.96
c.	Style #819	cost 15.60
d.	Style #835	cost 25.45
e.	Style #847	cost 3.87

4. If you want to make a net profit of 10% on a coat that cost $40, and your cost of doing business is 16%, what should you set as its selling price?

5. If an article costs you $30 and you sell it for $40, what is your per cent of profit when your cost of doing business is 15%?

6. If you know the cost, selling price, and the profit, how can you find the per cent of overhead based on the selling price?

7. A merchant's overhead expenses average 17% of his sales. At what price must he sell an article which cost him $24.75, if he expects to make a net profit of 10% on his sales?

8. Find the cost of the following items for sale in the Kirsch Co. store:

		Selling Price	Gross Profit
a.	Dresses	$9.95	48.6%
b.	Coats	$59.95	39.8%
c.	Shorts	$4.99	36%
d.	Blouses	$2.99	25%
e.	Suits	$39.95	41%

UNIT VII - GEOMETRIC FORMS

Pre-Test No. 7

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1. How does a square differ from a rectangle?

2. All of a six-storey building's 204' by 78' inside measure is occupied by the R & K Department store. How many square feet of floor space are occupied?

3. How many square feet in two square yards?

4. Find the area of a square 6' wide and 6' long.

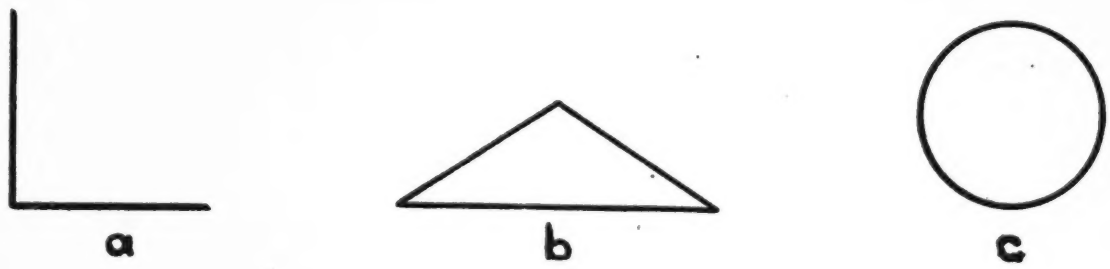
5. Find the area of a rectangle 3 feet wide and 6 feet long.

6. How many square feet of floor space will be taken up by a cutting table $4\frac{1}{2}$ feet wide and 28 feet long?

7. What is the perimeter of a placemat which measures 18" long and 12" wide?

8. Draw a 4" circle. Give its circumference and area.

9. Identify the following geometric forms:



10. Find the missing values in each of the following:

	Circumference	Diameter	Radius
a.	88 inches		
b.		35 feet	
c.	154 feet		

UNIT VII - GOEMETRIC FORMS

Definitions of Geometric Forms **Lesson No. 1**

OBJECTIVE: To learn to identify geometric forms.

RELATED INFORMATION:

In the study of geometry, we compare lines, angles, surfaces, and solids and we note the characteristics of such figures as the circle, square, rectangle, and triangle. A flat surface has two dimensions, length and width.

Needle-trade workers use angles and lines constantly in their work, especially in the making of patterns, placing of tucks, hemlines, necklines, and accessories.

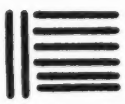
PROCEDURE:

It is important to recognize the following lines and angles:

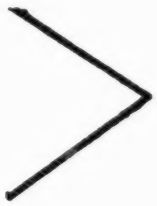
A vertical line is a straight line whose direction is toward the center of the earth.

A horizontal line is parallel with the horizon, and is perpendicular to a vertical line.

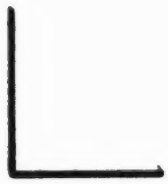
An oblique line is a straight line whose direction is neither vertical nor horizontal.



Parallel lines are two or more lines running in the same direction which are equidistant from each other, and which will never meet.



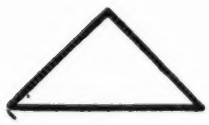
An angle is formed when two lines running in different directions meet.



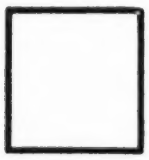
A right angle is one of the four equal angles formed by the intersection of two lines which are perpendicular to each other.

An obtuse angle is greater than a right angle.

An acute angle is smaller than a right angle.

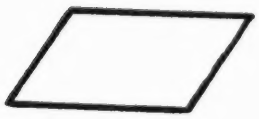


A triangle is a plane surface bounded by three straight lines.

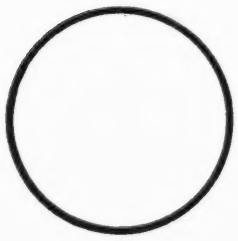


A square has four equal sides and four right angles.

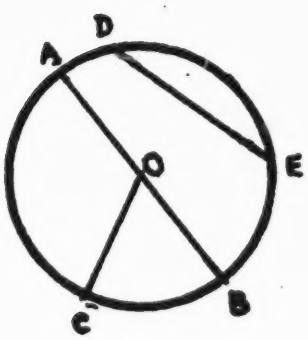
A rectangle has four straight sides with opposite sides equal and four right angles.



A parallelogram has four straight sides, the opposite sides of which are parallel to each other.



A circle is a plane surface bounded by a single curved line called its circumference, every point on which is equidistant from the center.



Parts of a circle:

A chord (DE) is a line joining any two points on a circle.

A diameter (AB) is a chord which passes through the center.

A radius (CO) is a line drawn from the center to any point on the circle. (OA and OB are also radii).

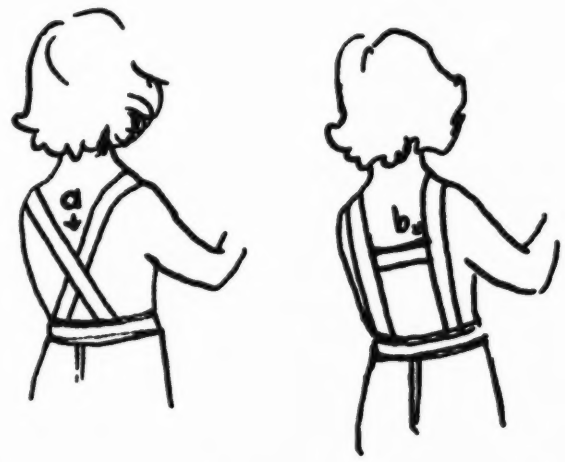
A circumference is the length of the circle.

ASSIGNMENT:

1. Using the clock as reference, tell what type of angle is formed when hands show the following time:

a.	3:00	d.	6:45	g.	4:15
b.	2:45	e.	1:30	h.	10:20
c.	5:45	f.	9:00	i.	12:55

2. What type of angle is formed where the overall straps cross in view a ? Where they join the cross-tab in view b?



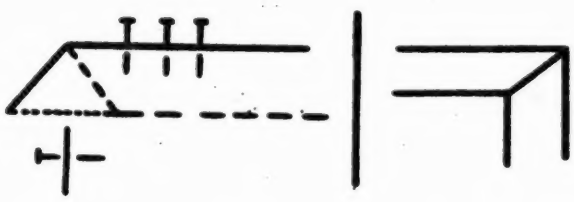
3. In preparing a dress for smocking, in what direction do the lines which form the transfer dots, or guide dots, run? .....
.....
.....
.....

4. In basting a center back or center front guide line, what kind of line is used?

5. What types of angles are found in collar (a)? (b)? (c)?

6. At what angle to the stitching are pins placed when the hem is pinned?

7. A mitered corner forms what kind of angle?



8. What kind of plane surface is a pocket 4" by 4"?

9. A linen guest towel measures 12" by 18". What is its shape?

10. From fashion magazine or newspaper, bring into class five designs using geometric forms.

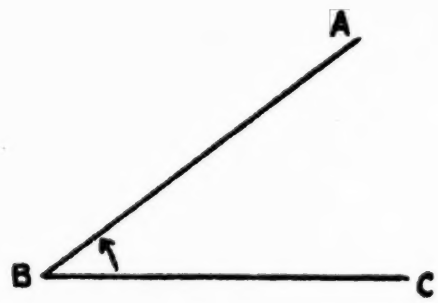
UNIT VII - GEOMETRIC FORMS

Angles **Lesson No. 2**

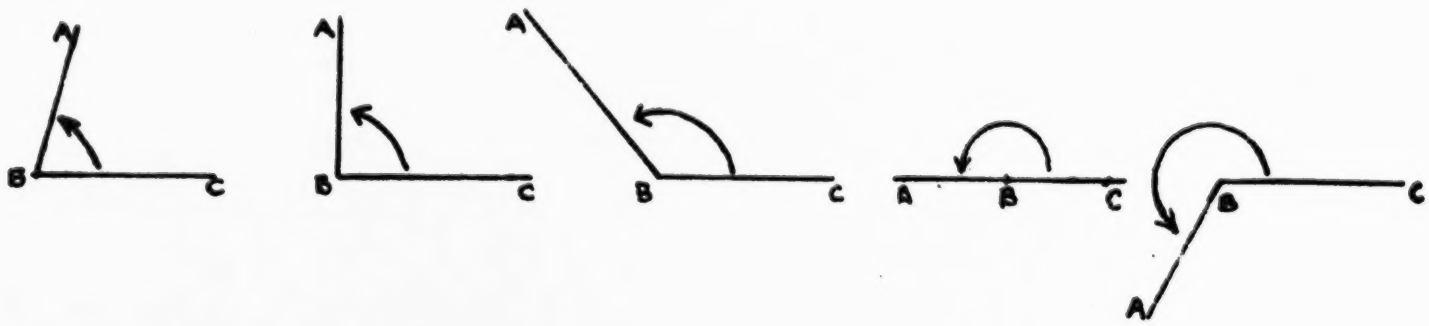
OBJECTIVE: To learn the kinds of angles and how to measure and draw an angle.

RELATED INFORMATION:

An angle is the amount of turning between two lines that meet at a point. The point where the two lines meet is called the vertex of the angle. In the figure shown, B is the vertex of the angle ABC ($\angle$ABC), and AB and BC are the sides.

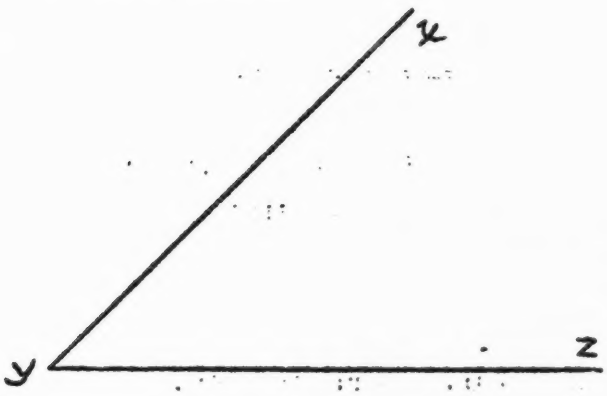


An arc drawn within the angle shows the amount of turning. In the series of angles shown below, as line AB turns in a counterclockwise direction, a larger angle is formed. To measure angles, a complete turn is divided into 360 equal parts, known as degrees (360°). A right angle is a quarter of a turn and has 90°. An angle that is less than a right angle is called an acute angle. An angle that is greater than a right angle is called an obtuse angle. If an angle is larger than a straight angle, it is called a reflex angle.



The tool used to measure or draw an angle is a protractor. The protractor has two semicircular scales. The outer one reads from 0° at the left to 180° at the right. The inner scale reads from 0° at the right to 180° at the left.

PROCEDURE:



To measure any angle, such as $\angle XYZ$, place the center of the protractor at vertex Y and the zero line exactly on side YZ. Begin at the 0° mark on the scale and follow to the point where the other side of the angle (XY) crosses the scale. You will see that the line crosses at 45°, which is the size of $\angle XYZ$. What kind of angle is $\angle XYZ$?

(If the side of an angle being measured is not long enough to meet the scale on the protractor, either lengthen the side or place the edge of a sheet of paper or a ruler so it falls on the side of the angle. Then read the scale where the paper or ruler crosses the protractor.)

To draw an angle of a given size, for example 45°, draw a line YZ with the edge of the protractor. Then place the protractor so that its center lies at the point where you wish the vertex to be. Be sure the zero line falls on line YZ. Locate 45° on the scale and make a dot with your pencil at that point. Label that point Z. Connect Y to that point with a line YZ.

ASSIGNMENT:

1. How many degrees are there in:

   a. $\frac{3}{4}$ of a complete turn of one side of an angle from the other?

   b. $\frac{1}{2}$ of a straight angle?

   c. $\frac{1}{2}$ of a right angle?

2. How can you tell whether an angle is acute, right, or obtuse by using the corner of a sheet of paper?

3. What effect has the length of the sides of an angle on its size?

4. Use the protractor to draw angles of 30°, 75°, 90°, 120°.

Geometric Constructions Lesson No. 3

OBJECTIVE: To learn a few fundamental constructions that will aid in constructing patterns and complicated designs.

RELATED INFORMATION:

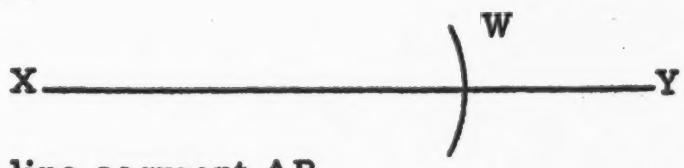
To make constructions, a straight edge and compass are needed.

A———————B To draw a line segment equal to AB:

1. Draw XY, any working line. X———————Y

2. Find the length of AB by adjusting the compasses so that the metal tip falls at one end and the pencil tip at the other end.

3. With point X as a center and a radius equal to AB, draw an arc intersecting XY at W.

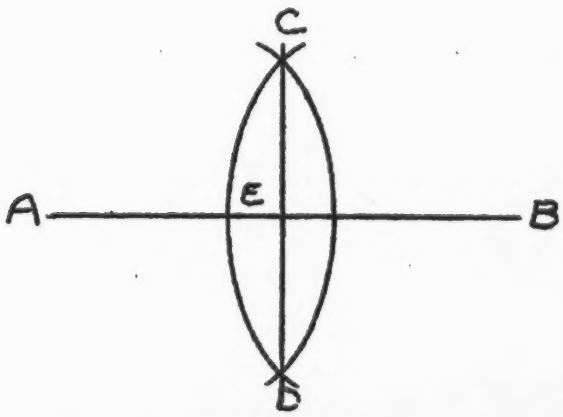


4. XW will equal the given line segment AB.

How can you construct a segment which is twice as long as a given segment?

PROCEDURE:

A. To bisect a given line segment.



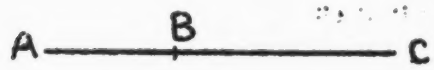
Suppose you wish to bisect line segment AB. With point A as a center and any radius more than half the length of AB, draw an arc as shown. With point B as a center, and the same radius, draw an arc intersecting the first arc, forming points C and D. Draw line CD intersecting AB at E. Then E is the mid-point of AB.

Notice that it takes two points to determine or fix the position of line CD.

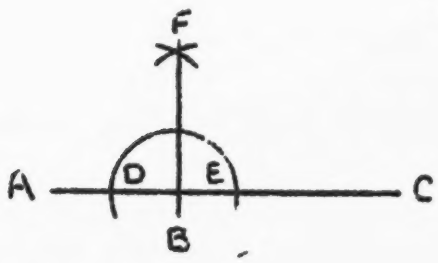
In this construction CD is also perpendicular to AB. Hence CD is called the perpendicular bisector of AB.

B. To construct a perpendicular.

To construct a perpendicular at a point on a line, not the center (point B on line AC):



1. With point B as a center and any convenient radius, draw an arc intersecting AC at points D and E.

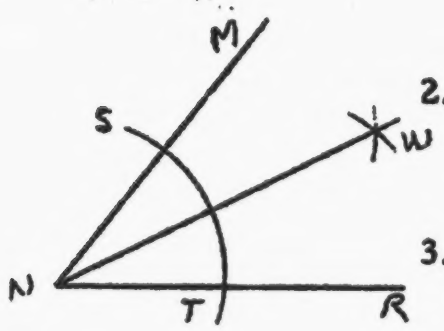


2. With any greater radius and points D and E as centers, draw arcs intersecting above line AC at point F.

3. Draw BF. BF is perpendicular ($\perp$) to AC at point B.

C. To bisect an angle.

$\angle$ MNR is to be divided into two equal parts.



1. With point N as a center and any convenient radius, draw an arc intersecting the sides of the angle at S and T.

2. With the same radius, or any radius over half the distance between S and T, and with point S as a center, draw an arc within the angle.

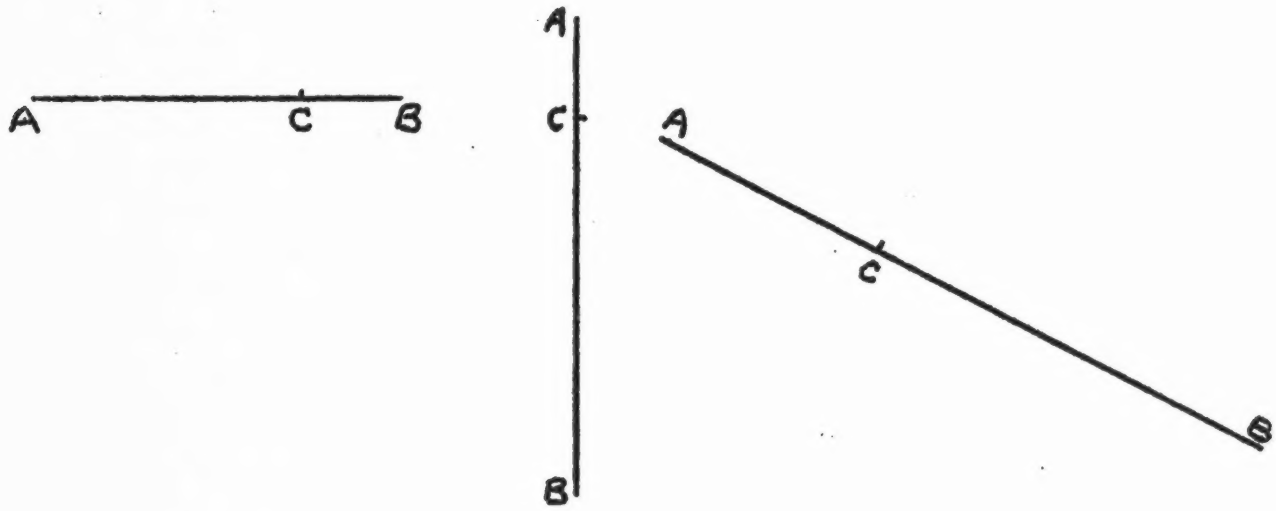
3. With point T as a center and the same radius used in step 2, draw an arc intersecting the first arc at point W.

4. Draw line NW. NW bisects $\angle$ MNR.

ASSIGNMENT:

1. Draw a line on your paper $3\frac{7}{8}''$ long. Bisect it using compass and ruler.

2. Draw lines on your paper equal to those shown here. Construct a line perpendicular to AB at point C in each case.



3. Construct a 45° angle with only a compass and an unmarked straight edge.

Rectangle and Square — Lesson No. 4

OBJECTIVES: To learn how to find the area and the perimeter of a rectangle and a square.
To learn how to apply this information to the trade.

RELATED INFORMATION:

Areas are calculated by means of units of square measure in much the same manner that lengths and distances are calculated by units of linear measure. However, in calculating areas, the two dimensions representing length and width are multiplied together. Their product gives the area.

If the dimensions are in inches their product is square inches, and the area is in square inches, abbreviated sq. in. If the dimensions are in feet, their product is in square feet, abbreviated sq. ft.; if in yards, their product is square yards, abbreviated sq. yd. and the area is in square yards; and so on.

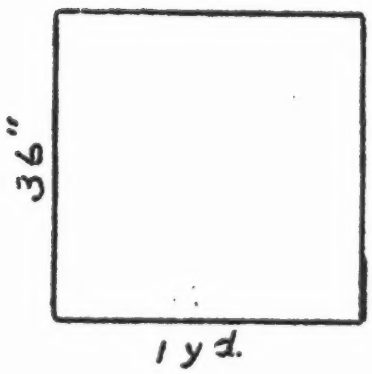
Square Measure

144	square inches (sq. in.)	=	1 square foot
9	square feet (sq. ft.)	=	1 square yard
1296	square inches	=	1 square yard

PROCEDURE:

In this lesson we will cover the calculation of areas of squares and rectangles.

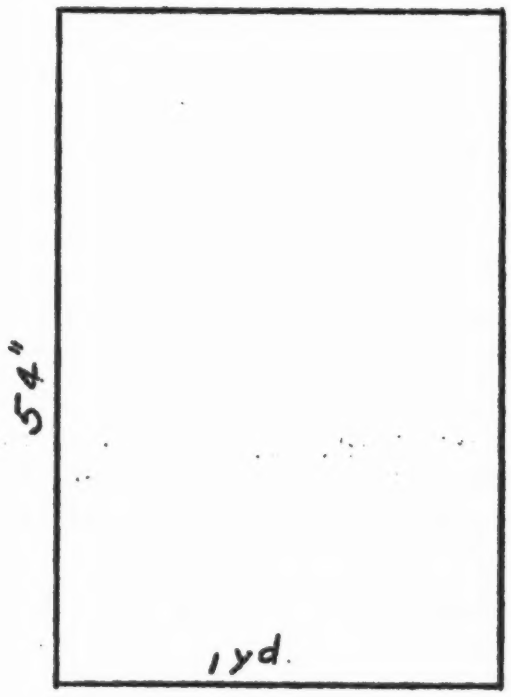
THE SQUARE



The square is a plane figure having four equal sides and four square or right-angle corners. Referring to the figure to the left, the area of a square is equal to the length multiplied by the width. Since the length is the same as the width, the area of a square is equal to the square of a side (that is, the length of a side multiplied by itself).

This figure represents fabric 36" wide and 1 yard long. Since 1 yard is 36", to find the area of this material in inches, you would multiply 36" x 36" = 1296 square inches. What is the area in square yards?

THE RECTANGLE



A rectangle, sometimes called an oblong, is a plane figure also having four sides and four square or right-angle corners. It differs from a square in that only the opposite sides are equal.

By referring to the figure at the left, the area of a rectangle is expressed as the product of the length and the width.

This figure represents fabric 54" wide and 1 yard or 36" in length. The area of this material is 54" x 36" or 1944 sq. in. What is the area in square yards?

A distinction must be made between area and perimeter. The perimeter of a plane surface is the distance around it, and the area is the number of units of area on its surface.

What is the perimeter of the rectangle at the right? Notice that there are two sides each 6 yards long, and 2 sides 54" wide. The perimeter may be expressed as

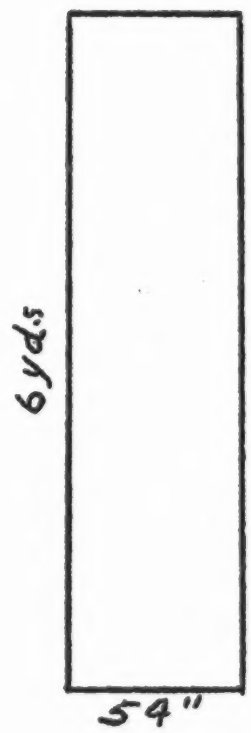
$$2L + 2W = p$$

Substitute the dimensions of the rectangle for the letters in this formula and see what the result is:

$$2 \times 6 + 2 \times 1\tfrac{1}{2}\ (54'') = \text{perimeter}$$

$$12 + 3 = 15 \text{ yards}$$

In a square, L would equal W. We could just use the letter S for any side. What then would be the formula for the perimeter of a square?



ASSIGNMENT:

1. How many square feet of floor space will be taken up by a cutting table 4 feet wide and 22 feet long?

2. How many square inches is taken up in a yard of 36" material if the pattern piece to be cut measures 12" wide and 18" long? How many pattern pieces can be cut from the yard of material?

3. How many square yards are in a piece of fabric measuring 60" wide and $4\frac{3}{4}$ yds. long?

4. How many square yards of 36" material are required to make four pairs of cafe curtains if each curtain measures 3 feet wide and 2 feet long?

5. How many handkerchiefs 10" square can be cut from a piece of linen whose width is 10" and whose length is (a) $1\frac{1}{9}$ yd.? (b) 2 yards 8"? (c) 4 yards? (d) 20 yards?

6. How many square feet of floor space is taken up in a shop by the following equipment?

26 sewing machines	24" wide and 48" long
2 cutting tables	$3\frac{1}{2}$ feet wide and 7 feet long
2 work benches	5 feet wide and 8 feet long
1 ironing table	5 feet wide and 7 feet long

7. What is the area of the following? Indicate for each the name of the plane figure.

45" by 45" tablecloth	64" by 104" tablecloth
52" by 68" tablecloth	52" by 52" tablecloth

8. The outside edge of the following tablecloths were trimmed with a three-inch fringe. How much fringe was needed for each tablecloth? for 144 tablecloths in each size? What is the total length of fringe needed for all 432 tablecloths? (Give your answers in inches and in feet.)

   a. 64" by 84"
   b. 72" by 90"
   c. 72" by 108"

9. If it takes 96 sq. yards of linoleum to cover a hallway 24 yards long, how wide is the hallway?

10. What is the cost per square foot of floor space if 12,000 square feet cost $750,000?

11. A department store is re-covering all its 3 floors with hardwood. If the store is 24 feet long and 90 feet wide, what will be the cost at $78 per 1,000 square feet?

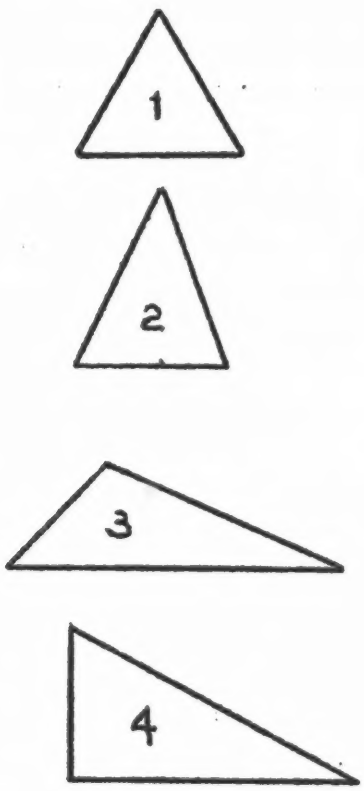
Triangles **Lesson No. 5**

OBJECTIVE: To learn about the types of triangles and how to find the area of triangles.

RELATED INFORMATION:

A triangle is a plane figure having three sides and three angles. Although they may be of various shapes, the area of any triangle equals one half the product of the base (the side on which the triangle appears to be standing) by the altitude or the vertical height, which is the same as saying one half the base times the height.

There are four types of triangles that we should learn to identify:



1. An equilateral triangle is one in which all sides are equal and all angles are equal.

2. An isosceles triangle is one in which two sides are equal and two angles are equal.

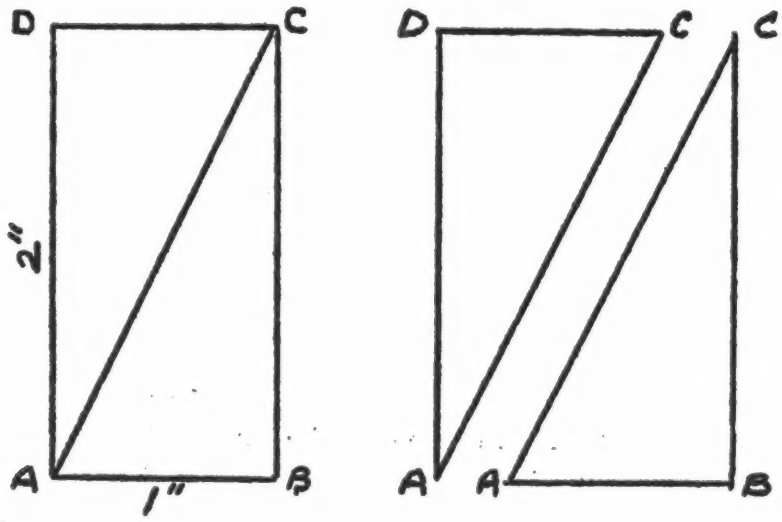
3. A scalene triangle is one in which none of the sides or angles are equal.

4. A right triangle is one which has one right angle. Could a right triangle also be equilateral? Isosceles? Scalene?

PROCEDURE:

The area of each of these triangles is equal to one-half the product of the base and altitude. $A = \frac{bh}{2}$

To show that this rule is true, cut out of paper a rectangle, as shown in the following drawings:



After drawing the diagonal as indicated, cut along it, cutting each piece into two triangular parts as shown. Check them against each other to see that they are identical in shape and size. Each one of these triangles, therefore, equals one half the whole area of the figure of which it is a part. Since the area of the rectangle equals the length (base) multiplied by the width (vertical height), then the area of each triangle would accordingly equal one half the base multiplied by the vertical height. Prove this by finding the area of the rectangle ABCD; of the triangle ABC.

Since the area of a triangle is equal to one half the product of the base multiplied by the height, the height may be found by dividing the area by one half the base; and the base may be found by dividing the area by one half the height.

Example: The area of a triangle is 48 square inches. If its base is 16", find the height.

$$h = \frac{A}{\frac{1}{2}b} = A \div \tfrac{1}{2}b$$

Therefore, $48 \div 8 = 6$ inches is the height.

Example: The area of a triangle is 108 sq. ft. Its height is 18 ft. Find the base.

$$b = \frac{A}{\frac{1}{2}h} = A \div \tfrac{1}{2}h$$

$108 \div 9 = 12$ feet in the base.

ASSIGNMENT:

1. Find the area of a triangle whose dimensions are as follows:

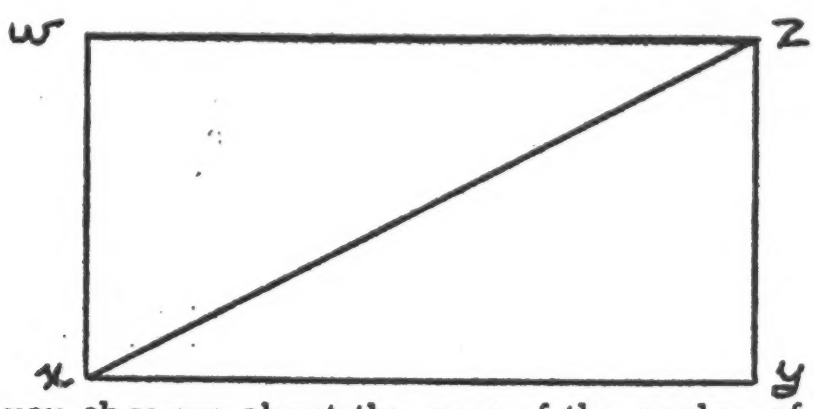
   a. Base 13", height 12"
   b. Base 8 ft., height 4 ft.
   c. Base 6 yds., height 8 ft.

2. Find the missing part in each of the following:

	Area of Triangle	Base	Height
a.	64 sq. in.	16"	?
b.	72 sq. ft.	?	12 ft.
c.	108 sq. ft.	8 yds.	
d.		14 yds.	16 yds.
e.	88 sq. ft.	22 sq. ft.	

3. A dress has 2 triangular pockets that measure 6" at the base and $5\frac{1}{2}$" in height. What is the area of one pocket? two pockets
   If sequins are set on the pockets $\frac{1}{4}$" apart, how many sequins must be purchased for the two pockets?

4. With your protractor measure the angles formed in the rectangle WXYZ.



   What do you observe about the sum of the angles of a rectangle? How many degrees are there in the sum of the angles of ΔXYZ? Of ΔXWZ? Do you see that the sum of the angles of these two triangles is the sum of all four angles of the rectangle?

5. Find the third angle of a triangle if two of its angles are:

   a. 40° and 65°?
   b. 43° and 47°?
   c. 18° and 76°?

6. What is the area of Δ XYZ in problem 4 if XY is 3" and YZ is 6"?

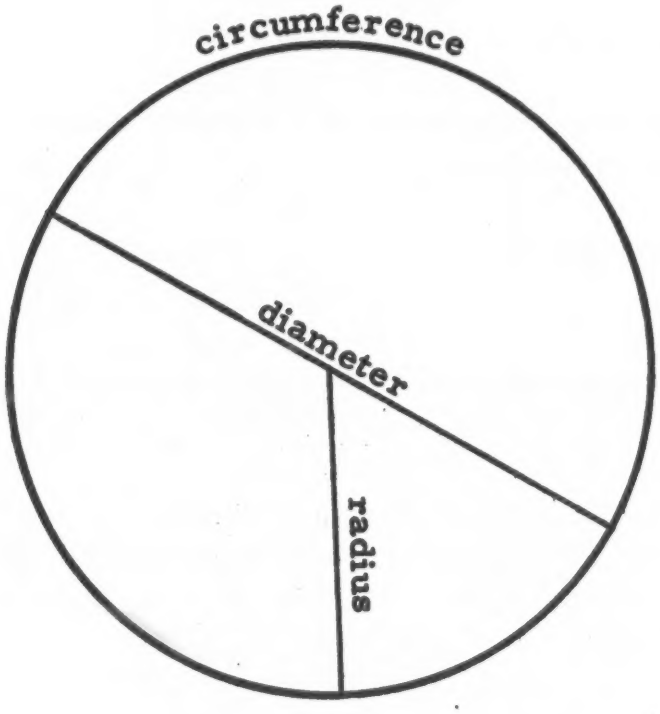
Area of a Circle | Lesson No. 6

OBJECTIVE: To learn how to measure the parts of a circle and how to find the area of a circle.

RELATED INFORMATION:

A circle is a plane surface bounded by a single curved line called its circumference. All points of a circle are equally distant from the center. The diameter is a line which passes through the center of the circle and divides the circle into halves. The radius is equal to $\frac{1}{2}$ the diameter; it is the distance from any point on the circumference to the center of the circle.

PROCEDURE:



Observe the circle at the left. Using a piece of string or thread, measure its circumference. Measure its diameter and radius. How does the length of the radius compare with the length of the diameter?

By actual measurement it can be found that the circumference of a circle is always 3.1416 times the diameter. This ratio of the circumference of a circle to its diameter (3.1416) has been given the Greek name pi, which is the Greek letter p, and is written π.

The circumference of a circle is, therefore, equal to π times the diameter.

The area of a circle is equal to π times r^2 (which means 3.1416 x radius x radius).

Since 3.1416 is very nearly $3\frac{1}{7}$, hence, unless an exact measure is required, we usually use $3\frac{1}{7}$ instead of 3.1416.

When a number is multiplied by itself, it is said to be <u>squared</u> or raised to the second power. This is usually indicated by placing a small 2 just above and to the right of the number. For example, 3 x 3 may be expressed 3^2. This is read as three squared or the square of 3. In the same manner, radius x radius becomes radius^2.

Radius may be abbreviated as rad., R, or r.

Diameter may be abbreviated as diam., D, or d.

Circumference may be abbreviated as circum., cir., or C.

The rule for the area of a circle is usually expressed in abbreviated form as: $A = \pi r^2$

Example A: Find the circumference of a circle when the diameter is given.

We have seen that the circumference of a circle is π times the diameter. This is conveniently expressed as:

$$C = \pi d, \text{ which means } C = 3\tfrac{1}{7} \times \text{diameter.}$$

For example: Find the circumference of a circle whose diameter is 14 feet.

Solution: $3\frac{1}{7} \times 14 = 44$ feet.

Example B: Find the diameter of a circle when the circumference is given.

Since the circumference of a circle is equal to the diameter multiplied by π, the diameter may be found by dividing the circumference by π. That is $\frac{C}{\pi} = d$, which means $\frac{\text{circumference}}{3\frac{1}{7}} = \text{diameter}$

ASSIGNMENT:

1. Find the area of a circle that is 28" in diameter.

2. Find the diameter of a circle whose circumference is 44".

3. Find the circumference of a circle whose diameter is 66 ft.

4. Find the missing values in each of the following:

	Circumference	Diameter	Radius
a.	88 inches	?	?
b.	?	35 ft.	?
c.	?	?	21"
d.	?	10' 6"	?
e.	154 ft.	?	?
f.	?	28 ft.	?

5. Find the areas of circles whose diameters are:

   a. 56" b. 70' c. 14 yds.

6. Find the areas of circles whose radii are:

   a. 7 inches b. 12 feet c. 3 yards

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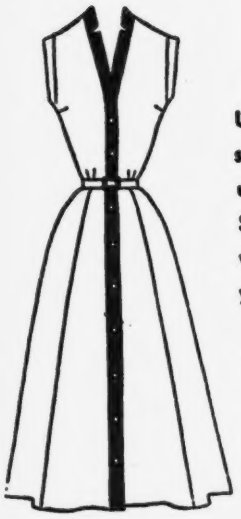
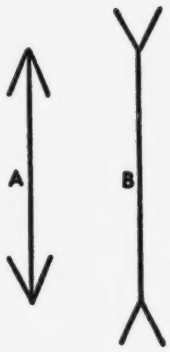
Flatter your Figure



Use vertical lines so the eye moves up and down. Self color belts will be best for your figure.

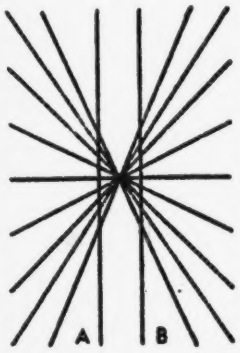
Look Taller



Both of these lines are the same length but doesn't B appear to be somewhat longer than A?

Use shirring to enhance your bosom. Soft cowl drapes, bows and pockets are also very helpful.

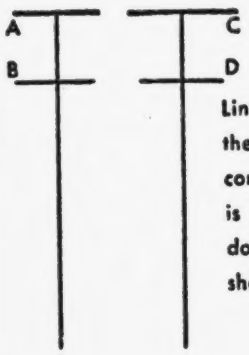
Enhance Your Bosom



The vertical lines A and B are parallel, but don't they appear to bulge in the middle?

Concentrate all interest above the waistline. Yokes, wide lapels and pockets will broaden your shoulders.

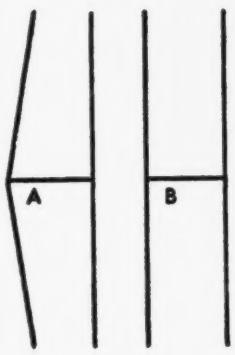
Taper Your Hips



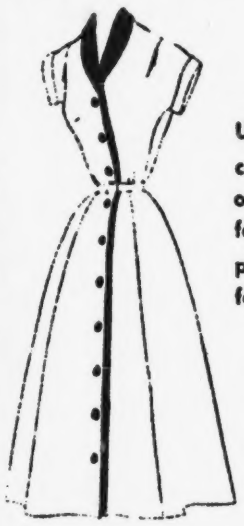
Lines B and D are the same but in contrast to C which is longer than A doesn't D seem shorter than line B?

Straighten your silhouette with unbelted two piece dresses and box jacket suits. "Easy fit" is your rule.

Hide Your Middle

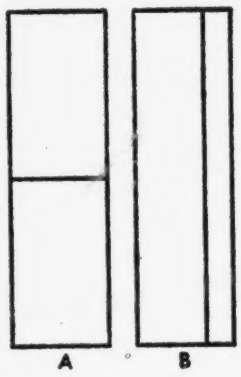


The horizontal lines are the same length but doesn't line A seem to be a bit longer than B?

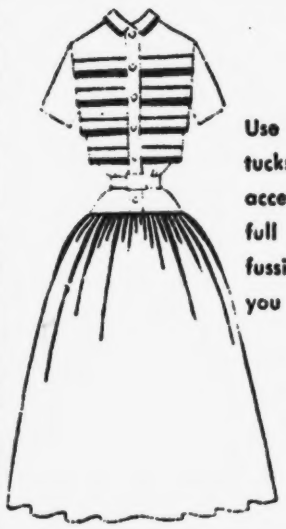


Use vertical lines, centered or at one side. Dull surfaced fabrics and plain sleeves are for you.

Look Slimmer

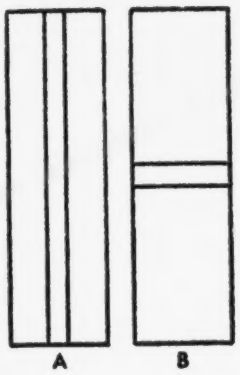


These oblong diagrams are the same size but doesn't B appear to be longer and slimmer than A?



Use horizontal tucks, shoulder accents, wide belts, full sleeves. No fussiness unless you are the type.

Add Pounds



These diagrams are the same size but doesn't the area of B look larger than the area of A?

Application of Geometric Forms to
Patternmaking and Fashion Accessories — Lesson No. 7

OBJECTIVE: To gain a clearer understanding of the application of geometric forms in the needle trades.

RELATED INFORMATION:

In the creation of a garment, it is important to study the design and determine what direction the lines of the garment will have. It is the direction of the line, whether it is vertical or horizontal, straight or curved, etc., that will determine whether or not the garment will enhance the figure.

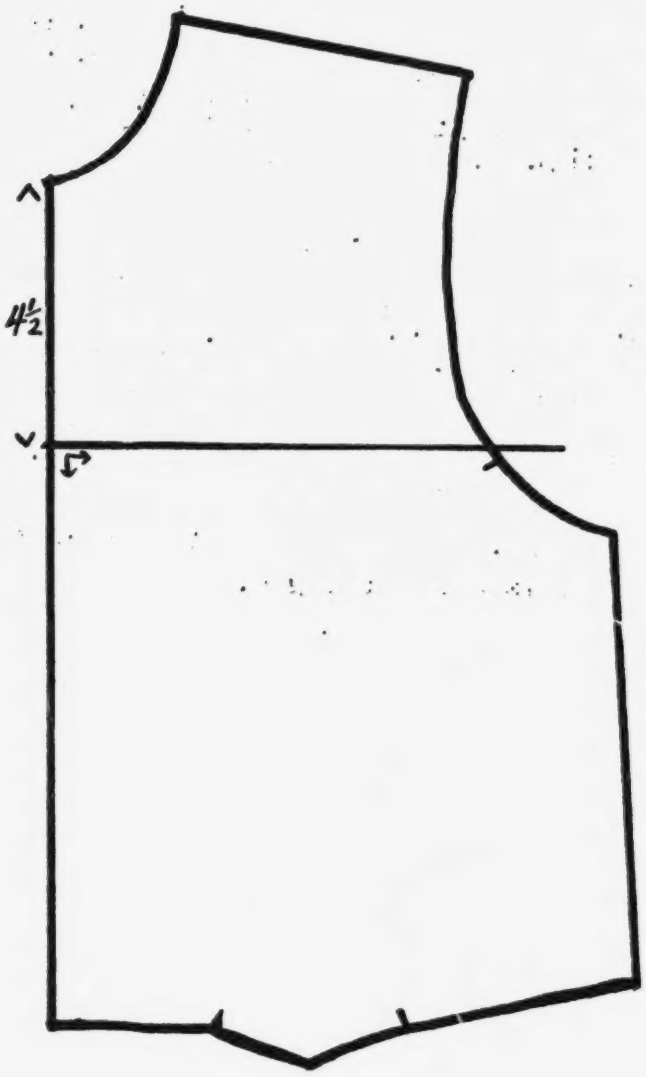
Seam lines are not the only lines that affect the way a garment looks. Other lines such as darts, tucks, pleats, and folds of fabric in the garment-- folds that result from gathers, unpressed pleats, or draping-- also affect the overall design. Pockets, a conspicuous belt, trimmings of lace, ruching, or rickrack, even the outline of the silhouette are lines that determine the style of a garment.

A tool that is frequently used to form angles is the square rule, whose shape is a right angle.

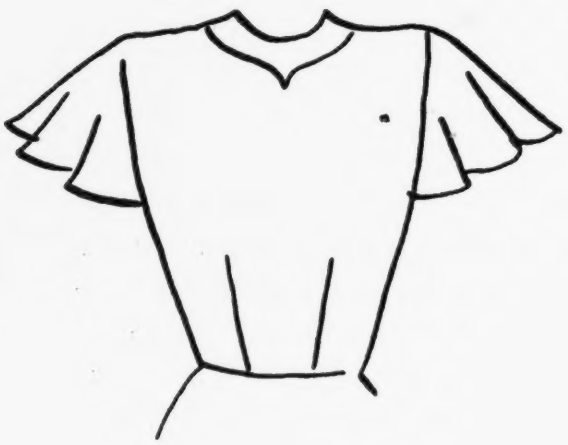
PROCEDURE:

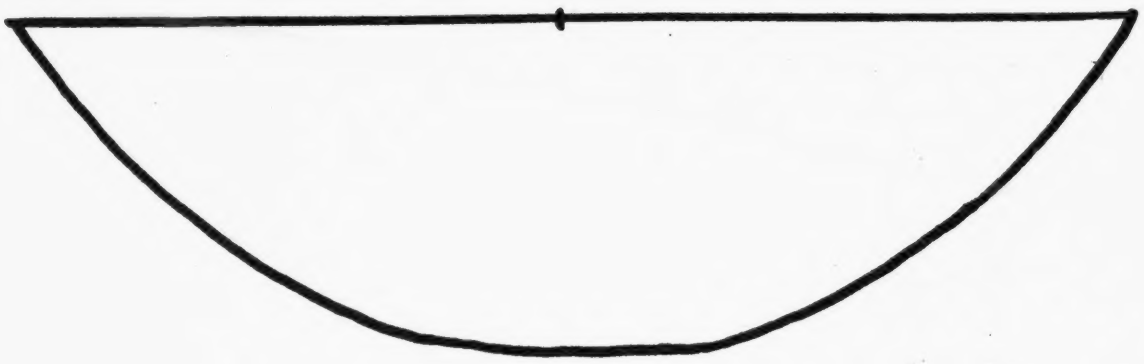
Example A: In the making of the yoke pattern, as shown in this blouse, it is necessary to understand the principle of forming a right angle.

By using a square rule placed on the center front line, at the desired distance from the center front neckline, a line was drawn across the front of the sloper pattern that was perpendicular to the center front line. These two lines form a right angle where they meet.



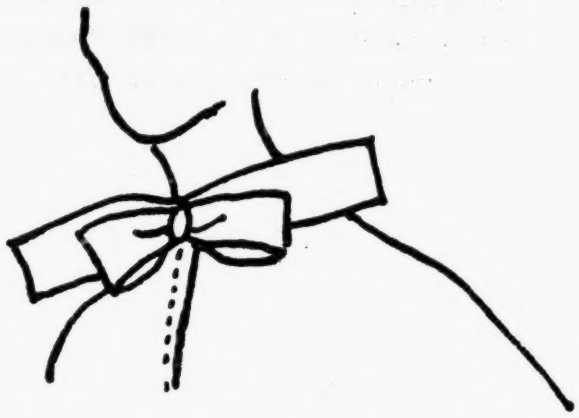
Example B: In the making of a cape sleeve, the amount of flare desired determines the curve of the circular shape needed. The following diagram shows a cape sleeve with exaggerated fullness. The straight line of this pattern represents the chord of a circle.

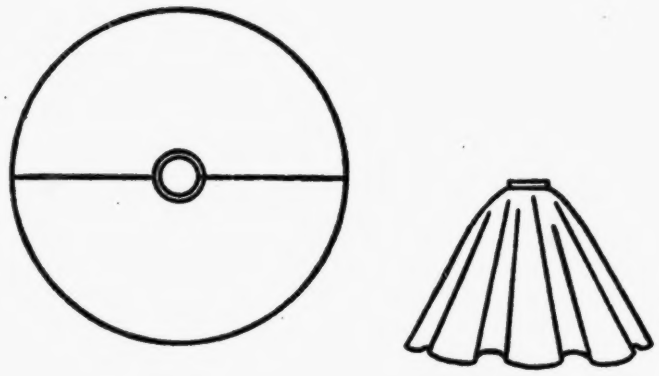




ASSIGNMENT:

1. A pique rectangle makes a bow at the neckline of a basic dress. The pattern measures two inches wide and 28 inches long. What is its area? The bows are to be cut along the length of the fabric. How much 36" pique would be needed to make bows for 140 dresses? (Draw a sketch.)





2. A circle is the basis for a circular skirt. How much novelty braid would be needed to trim the bottom edge of the skirt if the diameter of the circle is 54 inches? How much for 60 skirts?

3. What is the area of the largest circle that can be cut from a square piece of fabric 36" on one side? What is the total number of square inches remaining in the pieces that fall out? Express both answers to the nearest tenth of a square inch.

4. This pill-box hat is made from a circle whose diameter is $7\frac{1}{4}$ inches including seam allowances. The side band measures $1\frac{3}{4}$ inches including seam allowances. How much material is needed for two dozen pill-box hats?

5. This black basic dress was trimmed with a collar-band of satin. It measures $3\frac{1}{2}$ inches wide and 15 inches long, seams included. What is its surface area? What is the total area needed for 130 dresses? These are to be cut along the length of the fabric. How many yards of 39" material would be needed?

6. The rickrack used on this blouse is running vertically. How many yards would be needed for one blouse if the length of the blouse is 22" (hem included) and there are 9 rows of rickrack? How many yards for 132 blouses? What would be the total cost of the trimming if rickrack is .025¢ a yard?

7. In the making of this clown doll, a total of 79 circles $5\frac{3}{4}$" in diameter, are used. What is the total area of the circles? If $1\frac{1}{4}$ yards of 36" material is needed for 79 circles, how many square inches of material are wasted?

The Fundamental Elements of Keeping Accounts — Lesson No. 1

OBJECTIVES: To learn the importance of complete financial records for a successful business.
To learn to figure proprietorship in a business.

RELATED INFORMATION:

The success or failure of a business depends upon the management of the business. The object of bookkeeping is to record business transactions in a systematic manner so as to provide information which will aid in the management of a business.

A small business does not need elaborate records but should have simple, useful accounting records. Little time is required in keeping simple records but any successful small-business man must be kept posted on the condition of his business. Bad use of accounting controls is one reason so many small businesses fail.

Much of the success of a business depends on knowing what its assets and liabilities are at all times.

PROCEDURE:

The following terms are important in the understanding of record keeping.

Assets - resources of a business consisting of such items as cash, property, merchandise, fixtures, supplies, machinery, etc.

Liabilities - claims of creditors against the assets of the business.

Proprietorship - the interest of the owner of a business enterprise in the assets.

Account - a record of the debits and credits relating to property, persons, profits or losses, collected under an appropriate title.

The balance of an account - the difference between the debits and credits.

Books of Original Entry - the blank books in which the transactions are recorded as they occur; such as the Cash Book, Sales Book, etc.

The Ledger - contains the names of the accounts to which are transferred (or posted) all the debits and credits from the books of original entry.

Merchandise Inventory - the value of goods in stock at the close of a fiscal year.

Fiscal Period or business period - the time between statements; it may be from one month in length to one year.

Trial Balance - a list of the accounts in the ledger usually made monthly to test the accuracy of the posting.

Balance Sheet - a statement of assets, liabilities, and proprietorship made at the end of each fiscal period.

Profit and Loss Statement - a report of profits and losses for the fiscal period which shows the results of the operations for the period.

Accounts Receivable - accounts kept for record of sales of goods to customers on credit.

Accounts Payable - record of things purchased from creditors.

In this lesson we will cover one of the above mentioned terms:

A. Finding proprietorship

Let us assume that Mary Smith owns the following assets and has no liabilities: cash, $4000; merchandise, $3,200; accounts receivable (claims against customers), $750; office furniture, $450. A statement of the assets owned and her resulting proprietorship might be prepared as follows:

Assets

Cash	$4,000.00
Merchandise	3,200.00
Accounts Receivable	750.00
Office Furniture	450.00
Mary Smith, proprietorship	$8,400.00

Since the total value of the assets must equal the proprietorshop, we have the first fundamental equation:

Assets = proprietorship

B. Finding proprietorship when there are outstanding debts

It will rarely happen that the proprietor of a business will own the assets free from all debts. The rights in the assets must be divided between the proprietor and those who have claims against the assets. Let us assume that Mary Smith has the same assets listed above but owes $850 for merchandise purchased. This statement would be prepared as follows:

Assets

Cash	$4,000.00	
Merchandise	3,200.00	
Accounts Receivable	750.00	
Office Furniture	450.00	
Total Assets		$8,400.00

Liabilities

Accounts Payable (due to creditors)	850.00
Mary Smith, proprietorship	$7,550.00
	$8,400.00

The above statement employs the complete fundamental equation, which is:

Proprietorship = Assets - liabilities

ASSIGNMENT:

1. On June 1, 19__, Ethel Jones owned $1400 in cash and a stock of merchandise worth $1,750. What was Miss Jones' proprietorship in her business? Prepare a simple statement to show this.

2. On January 1, 19__, B. A. Dawson owned: cash, $325, merchandise inventory, $1250; furniture, $250; accounts receivable, $103.40; his liabilities were: notes payable $350; accounts payable, $224.80. What is Dawson's proprietorship? Prepare a simple statement to show this.

3. The assets of The Woodbridge Dress Shop on November 1, 19__, are $6,000.00 and the liabilities are $2,000; three months later the assets are $7,500 and the liabilities are $2,500. What change has taken place in proprietorship during the three months?

4. On July 1, 19__, Jane Smith owned $2650.25 in cash and merchandise worth $1975.50. Customers owed her $1,123 and she had furniture and fixtures worth $300. She owed creditors $935. Prepare a statement that will show the proprietorship of the owner.

5. If Miss Smith began the business mentioned in problem 4 above with a cash investment of $3,975 on May 1, what has happened to her proprietorship during the two months?

6. On October 1, 19__, Grace Keenan has the following assets and liabilities:

Cash	$2,875.25
Merchandise	1,890.00
Amounts due to creditors	1,025.00
Amounts due from customers	965.00
Furniture and fixtures	200.00
Delivery truck	2,050.00
Office supplies	45.00

Prepare a statement that will show the proprietorship of the owner.

7. How would you determine the proprietorship of the owner of a business?

8. A dressmaker tells you that she has "made money" during the past year. She has kept no records. What do you think makes her believe this? Might she be mistaken?

Financial Records Lesson No. 2

OBJECTIVE: To learn the proper procedure for adequate control of cash received and cash disbursed.

RELATED INFORMATION:

In a modern business office it is very important to arrange details so that the large number of business transactions may be recorded efficiently and quickly. Since so many business transactions involve the receipt or payment of cash, a separate journal in which to record only cash receipts and cash disbursements (payments) is used in most businesses to save time and work in recording cash transactions. The receipts and disbursements occupy opposite pages, the receipts on the left and the payments on the right. This will make it easy to compare them.

PROCEDURE:

In using a cash journal or cashbook, such as is illustrated on the following pages, all cash receipts are recorded on the left side of the cash journal and all cash payments are entered on the right side of the cash journal. The cash receipts book can be divided into the necessary columns, such as: Cash, Sales Discount, Accounts Receivable, Sundry, Name of Bank.

The cash payment book can be divided into the necessary columns, such as: Cash, Purchase Discount, Accounts Payable, and Sundry.

It is customary to balance the cash journal at the end of each month. A careful study of the illustration of the cash journal shows that, in balancing the journal, the horizontal rulings match across the two pages and that the final totals are in alignment.

Cash Receipts

19—			Cash	Sales Disc.	Accts. Rec.	Deposits
April	1	Bal. Brt. Fwd.	4911 09			
	2	Dickson + Ives	9 40	78	10 18	
		Style + Gift Shop	9 72	78	10 50	
		Style Shop	9 20	55	9 75	28 32
	9	Miss L. Friedman	15 00	2 75	17 75	
		Claire Gaupil	100 22	49	100 71	
		Ames + Brownley	92 73	8 02	100 75	
		Beau Monde	112 26	9 74	122 00	
		Bohon Co.	237 72	18 78	256 50	
		Conklin Style Shop	63 97	5 58	69 55	
		Sport Shop	120 13	10 32	130 45	74 203
	15	Gladys Bunting	54 60	4 68	59 28	
		Montaldo's	240 90	20 90	261 80	
		Frances Slater	35 90	3 06	38 96	
		Jones + Co.	91 08	7 92	99 00	42 248
	18	Mary Brown	73 23	6 04	79 27	
		Conner's	54 77	4 76	59 53	
		Mildred's	91 09	7 66	98 75	
		Mary's Dress	54 28	4 72	59 00	27 337
	25	Claire Andrews	190 85		190 85	
		Ruth's	175 84	15 41	191 25	
		Mary Rice	47 60	4 15	51 75	41 429
	29	Montaldo's	45 31	3 94	49 25	
		Irene	38 54	1 58	40 12	83 85
		Totals	6875 43	142 61	2106 95	1964 34
May	1	Balance Brt. forward	3119 40			

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Cash Payments

19— April			Ck. #	Cash	Purchase Disc.	Accts Pay.	Sundry
	7	Hemingway Bros.	1037	288		288	
	10	Robert Strauss Sales	1038	193 60			193 60
		Womens Wear Daily	1039	28 45		28 45	
		Gelfman Bros	1040	44 77	91	45 68	
		A. Hertz Co.	1041	13 23	27	13 50	
		L. Elmer	1042	25 94	26	26 20	
		Ardon Belt Co.	1043	89 53	1 83	91 36	
	14	Amari Textiles	1044	715 69	3 41	719 10	
	18	Madison Offset	1045	8 24		8 24	
		Robert Strauss Sales	1046	300 00			300 00
		Gotham Container	1047	8 12		8 12	
	23	Collector Int. Revenue	1048	56 40			56 40
		J. Goldstein Account.	1049	25 00		25 00	
	28	Railway Express	1050	1 61		1 61	
		Amari Textiles	1051	752 44	15 35	767 79	
		Payroll	1052	1380 83			1380 83
		Modern Pleating	1053	34 11	69	34 80	
		Seely Shoulder Pad	1054	75 19	6 35	81 54	
		Totals		3756 03	29 07	1854 27	1930 83
	30	Balance		3119 40			
				6875 43			

ASSIGNMENT:

1. Rule up a form for a cash receipts journal and record the following:

Oct.	1, 19__,	Ruth Bien invested $4000 cash in her dress business.
	4.	Received $250 cash from Frances Paine to apply on account.
	4.	Received cash $500, from Anna Smith for her note due today.
	4.	Fran Smith paid her account in full, $394.50.
	21.	Grace Kean paid cash for invoice of October 1, $925.50.
	26.	Received cash $155.75 from Ethel Green for merchandise received.
	31.	Received cash from Helen Elliot for invoice of October 11, $450.

Rule and close the cash receipts journal.

2. Use a cash payments journal and record the following transactions:

May	1, 19__,	Paid cash for office supplies, $18.00, check #101.
	8.	Paid R. Hollins in full $362.80, check #102.
	12.	Paid Helen Crawford for her invoice of May 5, $488.25, check #103.
	17.	Paid note due today in favor of Matthew Hinds, $500, check #104.
	24.	Helen Bjerken, proprietor, withdrew cash for personal use, $50, check #105.
	30.	Paid Helen Crawford for invoice of May 22, $471.80, check #106.

Rule and close the cash disbursements journal.

3. Use a double sheet of journal paper and write up the cashbook for the following:

June 1, 19__, Edna Adams began business with a cash investment of $4,500.

2. Paid F. C. Elliot, landlord, rent for June, $175.

4. Sold a lot of merchandise for cash, $125.

6. Paid $20 cash for office supplies.

9. Received cash from Joan Bane on account, $390.

11. Frank Lane paid his 10-day note due today, $450.

14. Paid office salaries in cash, $150.

15. Mrs. Adams withdrew $100 cash for personal use.

Close and balance the cashbook. Bring down the balance.

4. Write up the cashbook for the following:

Sept. 1, 19__, Balance $3,250.

2. Received cash from S. E. Leslie for invoices of Aug. 22, $923.75.

3. Purchased a typewriter for cash, $115.

5. Paid R. C. Cummings for his invoice of Aug. 26, $532.50.

6. Received cash, $750, from E. Lane for his note due today.

10. Paid freight on merchandise purchased, $17.50.

20. Betty Fordson paid her account in full, $825.

30. W. F. Wood paid cash, $566.75, for invoice of Aug. 10.

31. Paid salaries for the month, $510.

Close and balance the cashbook. Bring down the balance.

Reconciliation of Bank Balance

Lesson No. 3

OBJECTIVE: To learn how to prepare a bank reconciliation statement.

RELATED INFORMATION:

At the end of each month, banks send out a monthly statement to each depositor. The following is an illustration of a statement of account form used by banks:

Claudia Classics Inc.,
335 West 38th St.,
New York, N. Y.

CHECKS
CC - CERTIFIED CHECKS
DM - DEBIT MEMO
RT - RETURNED ITEM
LST - LIST
EC - ERROR CORRECT

DEPOSITS
CC - COLLECTIONS
L - LOANS - DISCOUNT
CM - CREDIT MEMO
EC - ERROR CORRECT

OD - OVERDRAFT

IN ACCOUNT WITH

MANUFACTURERS TRUST COMPANY

THE MAINTENANCE OF THIS ACCOUNT IS SUBJECT TO THE TERMS, CONDITIONS AND LIMITATIONS APPEARING IN THE DEPOSITOR'S CONTRACT ON THE REVERSE SIDE HEREOF.

NEW YORK

NOTIFY US PROMPTLY OF CHANGE IN ADDRESS

CHECKS		DEPOSITS	DATE	NO. OF CHECKS	BALANCE	
		BALANCE FORWARD	Jun 1-52		3,923.42	
111.70	44.32	263.89	Jun 2-52	2	4,031.29	*
400.00			Jun 4-52	3	3,631.29	*
200.00			Jun 6-52	4	3,431.29	*
		611.63	Jun 9-52	4	4,042.92	*
1,485.14 LS			Jun 10-52	11	2,557.78	*
13.08	174.80					
25.05	6.00					
7.00		848.68	Jun 11-52	16	3,180.53	*
216.31	45.90					
107.11	400.00		Jun 12-52	20	2,411.21	*
2.21		1,622.77	Jun 13-52	21	4,031.77	*
148.62		5,188.50	Jun 16-52	22	9,071.65	*
55.45	10.78	2,311.71	Jun 18-52	24	11,317.13	*
40.00			Jun 20-52	25	11,277.13	*
12.04		1.021.87	Jun 24-52	26	12,286.96	*
		1,790.78	Jun 25-52	26	14,077.74	*
2,250.93			Jun 26-52	27	11,826.81	*
52.91		800.63	Jun 27-52	28	12,574.53	*
332.74			Jun 30-52	29	12,241.79	*

3551 2-51

The Last Amount In This Column Is Your Balance

PLEASE EXAMINE STATEMENT OF ACCOUNT AND VOUCHERS AT ONCE

THE MAINTENANCE OF THIS ACCOUNT IS SUBJECT TO THE TERMS, CONDITIONS AND LIMITATIONS APPEARING IN THE DEPOSITOR'S CONTRACT ON THE REVERSE SIDE HEREOF. THE TRUST COMPANY DISCLAIMS RESPONSIBILITY FOR ANY ERROR IN THE ACCOUNT AS RENDERED UNLESS INFORMED IN WRITING OF IT WITHIN THIRTY DAYS OF THE DELIVERY OR MAILING OF ANY STATEMENT AND CANCELLED VOUCHERS.

OVER

This statement shows the balance at the beginning of the month, all deposits made during the month, all checks drawn and cleared by the bank during the month and the balance at the time the statement was made.

In any business, most payments are made by check and most customers pay by check. Many of these checks are sent to distant cities and often two or three weeks elapse before the checks are returned to the depositor's bank and charged to his account. As a result, the balance of cash in the bank rarely agrees with the balance shown in the depositor's checkbook or cashbook. Most of the difference is due to the fact that some of these checks had not been paid at the time the bank made up the statement. Such checks are called outstanding checks. The difference caused by the checks outstanding is accounted for by preparing in the check book, or elsewhere, a reconciliation statement.

PROCEDURE:

In the preparation of a reconciliation statement, checks outstanding may not be the only difference between the amount of the balance as shown in the check book and the balance shown on the bank statement. Items may appear on the depositor's books which have not yet been taken up on the bank's books, such as:

Deposits not yet received or recorded by the bank.

Items may appear on the bank's books which have not yet been taken up on the depositor's books, such as:

Service charges

Charges for checks returned N. S. F. (insufficient funds)

To reconcile the bank balance:

1. You must check all deposits listed on the statement with deposits entered in the check book or cash book.
2. You must check all checks charged to your account with checks drawn on your check book.

A bank reconciliation for the Brown Company for June 30, 19__ appears below:

Bank Reconciliation
June 30, 19__

Balance, per books			$3,625.97
Balance, per bank statement		$3,500.17	
Add deposit, not credited by bank		310.00	
Total		$3,810.17	
Deduct outstanding checks:			
#129	$100.00		
#130	84.20	184.20	
Adjusted balance		$3,625.97	$3,625.97

This reconciliation shows that $310 recorded by the company as a deposit in June had not been credited by the bank at the end of the month, and that checks for $100 and $84.20 were outstanding.

As the balance shown by the bank statement rarely agrees with the balance shown by the depositor's books, it is important to reconcile the bank statement as soon as possible after it has been received. Only in this way can errors be caught.

ASSIGNMENT:

1. Set up reconciliation statements for each of the following:

   A. January 1, 19__ the bank statement shows a balance of $2391.64. Checks not returned are #401 for $75, #403 for $101.60, #404 for $4.80, $405 for $1.25, and #406 for $17.66. The check book shows a balance of $2191.33.

   B. The check book shows a balance of $328.72. The bank statement shows a balance of $417.95. Three checks have not been returned: #76 for $32.95, #78 for $22.85, and #79 for $28.75. Interest item on loan for $4.68 has not been entered in check book. Prepare reconciliation statement.

C. On January 2, James Clark received from the bank his monthly bank statement, showing the bank's balance to be $3961.70. On comparing the report with the checks issued, it was found that the following checks had not been returned: #301 for $207.06, #304 for $58.23, and #305 for $437.10. The following items had not been recorded in the check book, but had been paid at the bank: $25, $30, and a note for $125.50. What balance should Clark's check book show?

D. On June 1, Joan Delman received her bank statement. Her check book balance is $1242.09. The following checks had not been returned by the bank: $40.20, $125.68, $75.50 and $286.90. Miss Delman neglected to enter on the check book stub the amount of one check for $50.60. She had also made an error by writing on the stub of one check $78.90 when it should have been entered as $87.90. What is the bank balance? Prepare a reconciliation statement.

E. According to the monthly bank statement, C. M. Rader's bank balance on October 31 was $2176.15. His check book balance was $1838.14 on the same date. By checking off the returned checks he found the following checks still outstanding: $215.20, $186.01, and $62.25. One check which Mr. Rader had deposited had been returned marked "no funds", and had been charged to his account, but no record of this charge had been made on his check book. What was the amount of the bad check? Reconcile the account.

F. The monthly bank statement received by Claudia Classics on April 1 listed a balance of $3594.55. The following checks had not been returned by the bank: #1072 for $81.03, #1074 for $277.32, #1076 for $1.61, and $1079 for $64.67. There was no record made of the deposit for May 31, for $165.25. The check book showed a balance of $3334.17. Prepare a reconciliation statement.

Wages Lesson No. 4

OBJECTIVE: To learn how to compute earnings on different time or piece rates.

To learn to check the amount of deductions from your pay.

RELATED INFORMATION:

Of the many sources of income, wages are the chief source to a large proportion of people. The wage-time of employees is generally figured by the hour or by the day. However, most operators, finishers, and pressers in the needle trades are paid by piecework. A certain price is paid for each piece of work. As the worker becomes skilled and is able to complete more pieces of work in a day, he earns more money per day.

It is important for you to know how to figure your earnings and also to figure the deductions from your pay. Some of the deductions made today are: Federal income tax, State unemployment insurance, social security, union dues, hospitalization insurance, savings bonds, etc.

The amount of money that you will make will depend upon many things, such as your ambition, attendance on the job, and application to your work.

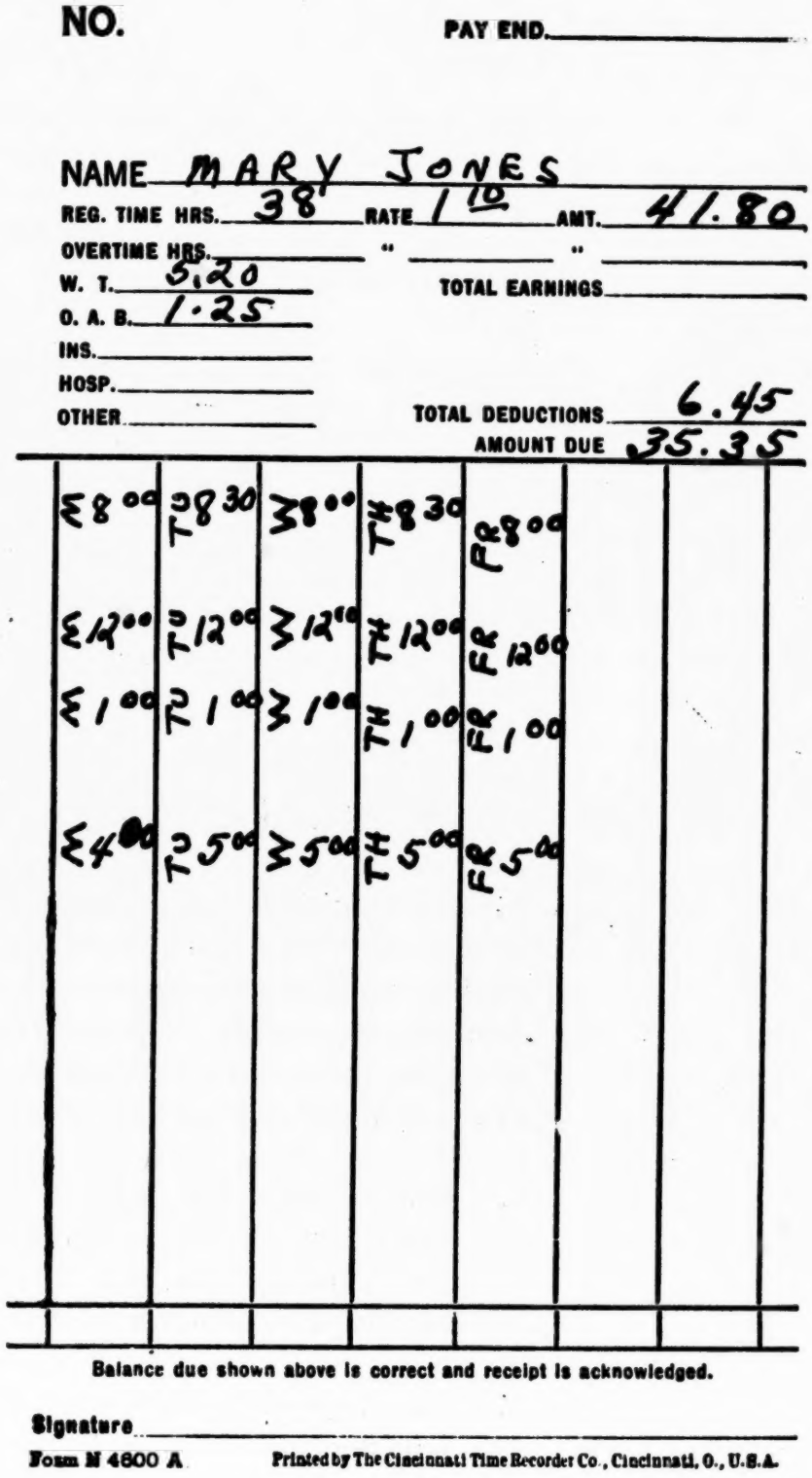
PROCEDURE:

A. Time Cards:

Many companies use a time clock which records the days and the hours each employee spends at work. Each employee has a time card, similar to the one pictured, with his or her name or number on it. These cards are kept in a rack next to the clock. Every time a worker reports for work, goes to lunch, returns from lunch and leaves at the end of the day, she will place her card in the time clock to record the time. As you can see, this keeps an accurate record of all the working time spent by each employee.

Your weekly earnings are determined by the time stamped on the time cards. Many companies make a rule to dock a worker (deduct some of his pay) if he arrives late. The worker may be docked as much as a half-hour's pay for lateness of from one to 30 minutes.

Example: You receive $1.10 an hour for the time you work between 8:00 a.m. and 5:00 p.m. What are your wages for the time recorded on the card above?



NO. PAY END.

NAME MARY JONES
REG. TIME HRS. 38 RATE 1 10 AMT. 41.80
OVERTIME HRS. " "
W. T. 5.20 TOTAL EARNINGS
O. A. B. 1.25
INS.
HOSP.
OTHER TOTAL DEDUCTIONS 6.45
AMOUNT DUE 35.35

M 8 00	TU 8 30	W 8 00	TH 8 30	FR 8 00			
M 12 00	TU 12 00	W 12 00	TH 12 00	FR 12 00			
M 1 00	TU 1 00	W 1 00	TH 1 00	FR 1 00			
M 4 00	TU 5 00	W 5 00	TH 5 00	FR 5 00			

Balance due shown above is correct and receipt is acknowledged.

Signature

Form N 4600 A Printed by The Cincinnati Time Recorder Co., Cincinnati, O., U.S.A.

Solution: The total working time was 38 hours x $1.10, which equals $41.80. On the basis of an eight-hour day and five days a week, you had a loss of $2.20 because you were late two days and left early another day. What per cent of your possible earnings did you lose? (5%). You can see that the loss of time can also means the loss of money.

B. Piecework:

When you work piecework, the more work you do, the more money you earn. Some operators are paid for a complete garment, others are paid for doing just one operation on a garment. They are both paid by the piece, whether in single units or by the dozen.

Example: An operator received $1.40 for style #883, $1.10 for style #804, and $1.25 for style #801. During the week of July 28th she made the following:

22 dresses of style #883 @	$1.40	=	$30.80
27 dresses of style #801 @	1.25	=	33.75
5 dresses of style #804 @	1.10	=	5.50
Total earnings		=	$70.05

C. Deductions withheld from employee's wages:

An individual record, as shown on the following page, should be kept for each employee, showing for each payroll period during the year: hours worked, gross earnings, and the amount of each deduction. There are certain deductions authorized by the government to be taken from your wages. These deductions are summarized as follows:

1. Employee's share of F. I. C. A. taxes. (Federal Insurance Contribution Act, which covers old age benefits and social security). The rate charged is 3% of the first $4,800 of employee's wages (1960).

2. Employee's share of S. U. C. & T. D. B. (State Unemployment Compensation and Temporary Disability Benefits) taxes. The rate charged is $\frac{3}{4}$% of earnings up to and including $3,000.

3. Income taxes withheld

   The amount withheld is affected by a number of factors, such as the length of the pay period, the amount of the pay, and the number of dependents claimed by the employee. On pages 208 and 209 is a weekly withholding tax chart.

4. Other deductions such as: hospitalization insurance, union dues, savings plans, and government bonds are more or less voluntary.

EMPLOYEE'S RECORD

YEARLY RECAPITULATION BY QUARTERS

QT'R	EARNINGS	F.O.A.	W'H'LD'G	SUIF	DUES	TOT. DED.	NET PAID
1ST	910 00	20.46	136 50	6.85	9.00	172 81	737 19
2ND	826 00	18.60	121 10	6.20	9.00	154 90	671 10
3RD	1019 60	22.97	150 30	7.62	9.00	189 89	829 71
4TH	956 80	21.53	140 40	1.58	9.00	172 51	784 29
TOTAL	3712 40	83.56	548 30	22.25	36.00	690 11	3022 29

NAME: John Jones EXEMPTIONS: 1
Address: 130 Smith St. Phone:
City: ELIZABETH., S.S. Acc't No: 147-18-5633
Position: Sex Single Married
Date Born: Where Born: Date Employed:
Clock No: Hrs. Per Day: 8 Per Week 40 Date Released:
Rate changes. Date: 10/29 $1.75 per hr.; Date: 7/20 $1.84 per hr.; Date: $ per

FIRST QUARTER — 19.....

PAYROLL PERIOD	REG. TIME TIME	REG. TIME AMT	OVER-TIME TIME	OVER-TIME AMT	TOTAL EARNINGS	DEDUCTIONS F.O.A.	W'HLDG	S.U.I.F.	DUES	NET PAID
12/29	40				70 00	1.57	10 50	.53	3.00	54 40
1/5	40				70 00	1.57	10 50	.53		57 40
1/12	40				70 00	1.58	10 50	.53		57 39
1/19	40				70 00	1.57	10 50	.52		57 41
1/26	40				70 00	1.57	10 50	.53		57 40
2/2	40				70 00	1.58	10 50	.53	3.00	54 39
2/9	40				70 00	1.57	10 50	.53		57 40
2/16	40				70 00	1.58	10 50	.52		57 40
2/23	40				70 00	1.57	10 50	.53		57 40
3/2	40				70 00	1.58	10 50	.52	3.00	54 40
3/9	40				70 00	1.57	10 50	.53		57 40
3/16	40				70 00	1.58	10 50	.52		57 40
3/23	40				70 00	1.57	10 50	.53		57 40
TOTAL 1ST QTR.					910 00	20.46	136 50	6.85	9.00	737 19

SECOND QUARTER — 19.....

PAYROLL PERIOD	REG. TIME TIME	REG. TIME AMT	OVER-TIME TIME	OVER-TIME AMT	TOTAL EARNINGS	DEDUCTIONS F.O.A.	W'HLDG	S.U.I.F.	DUES	NET PAID
3/30	40				70 00	1.58	10 50	.52		57 40
4/6	40				70 00	1.57	10 50	.53	3.00	54 40
4/13	40				70 00	1.58	10 50	.52		57 40
4/20	40				70 00	1.57	10 50	.53		57 40
4/27	32				56 00	1.26	7 90	.42		46 42
5/4	32				56 00	1.26	7 90	.42	3.00	43 42
5/11	40				70 00	1.58	10 50	.52		57 40
5/18	40				70 00	1.57	10 50	.53		57 40
5/25	40				70 00	1.58	10 50	.52		57 40
6/1	8				14 00	.32	30	.11	3.00	10 27
6/8	40				70 00	1.57	10 50	.53		57 40
6/15	40				70 00	1.58	10 50	.52		57 40
6/22	40				70 00	1.58	10 50	.53		57 39
TOTAL 2ND QTR.					826 00	18 60	121 10	6.20	9.00	671 10
TOTAL 6 MOS.					1736 00	39 06	257 60	13 05	18.00	1408 29

THIRD QUARTER — 19.....

PAYROLL PERIOD	REG. TIME TIME	REG. TIME AMT	OVER-TIME TIME	OVER-TIME AMT	TOTAL EARNINGS	DEDUCTIONS F.O.A.	W'HLDG	S.U.I.F.	DUES	NET PAID
6/29	40				70 00	1.57	10 50	.52		57 41
7/6	40				70 00	1.58	10 50	.53	3.00	54 39
7/13	40				70 00	1.57	10 50	.52		57 41
7/20	40				73 60	1.66	10 80	.55		60 59
7/27	40				73 60	1.66	10 80	.55		60 59
8/3	40				73 60	1.66	10 80	.55	3.00	57 59
8/10	40				73 60	1.66	10 80	.55		60 59
8/17	40				73 60	1.66	10 80	.55		60 59
8/24	40				73 60	1.66	10 80	.55		60 59
8/24	Vacation				147 20	3.31	21 60	1.10	3.00	118 19
8/31	40				73 60	1.66	10 80	.55		60 59
9/21	40				73 60	1.66	10 80	55		60 59
9/28	40				73 60	1.66	10 80	55		60 59
TOTAL 3RD QTR.					1019 60	22.97	150 30	7.62	9.00	829 71
TOTAL 9 MOS.					2755 60	62.03	407 90	20.67	27.00	2238 00

FOURTH QUARTER — 19.....

PAYROLL PERIOD	REG. TIME TIME	REG. TIME AMT	OVER-TIME TIME	OVER-TIME AMT	TOTAL EARNINGS	DEDUCTIONS F.O.A.	W'HLDG	SUIF	DUES	NET PAID
10/5	40				73 60	1.66	10 80	.55	3.00	57 59
10/12	40				73 60	1.66	10 80	.55		60 59
10/19	40				73 60	1.66	10 80	.48		60 66
10/26	40				73 60	1.66	10 80			61 14
11/2	40				73 60	1.65	10 80		3.00	58 15
11/9	40				73 60	1.66	10 80			61 14
11/16	40				73 60	1.65	10 80			61 15
11/23	40				73 60	1.66	10 80			61 14
11/30	40				73 60	1.65	10 80			61 15
12/7	40				73 60	1.66	10 80		3.00	58 14
12/14	40				73 60	1.65	10 80			61 14
12/21	40				73 60	1.66	10 80			61 14
12/28	40				73 60	1.65	10 80			61 15
TOTAL 4TH QTR.					956 80	21.53	140 40	1.58	9.00	784 29
YEAR'S TOTAL					3712 40	83.56	548 30	22.25	36.00	3022 29

WITHHOLDING TAX CHART

WEEKLY - Official Treasury Figures Effective January 1, 1960

the wages are—		And the number of withholding exemptions claimed is—										
At least	But less than	0	1	2	3	4	5	6	7	8	9	10 or more
		The amount of income tax to be withheld shall be—										
$0	$13	18% of wages	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
13	14	$2.40	.10	0	0	0	0	0	0	0	0	0
14	15	2.60	.30	0	0	0	0	0	0	0	0	0
15	16	2.80	.50	0	0	0	0	0	0	0	0	0
16	17	3.00	.70	0	0	0	0	0	0	0	0	0
17	18	3.20	.80	0	0	0	0	0	0	0	0	0
18	19	3.30	1.00	0	0	0	0	0	0	0	0	0
19	20	3.50	1.20	0	0	0	0	0	0	0	0	0
20	21	3.70	1.40	0	0	0	0	0	0	0	0	0
21	22	3.90	1.60	0	0	0	0	0	0	0	0	0
22	23	4.10	1.70	0	0	0	0	0	0	0	0	0
23	24	4.20	1.90	0	0	0	0	0	0	0	0	0
24	25	4.40	2.10	0	0	0	0	0	0	0	0	0
25	26	4.60	2.30	0	0	0	0	0	0	0	0	0
26	27	4.80	2.50	.20	0	0	0	0	0	0	0	0
27	28	5.00	2.60	.30	0	0	0	0	0	0	0	0
28	29	5.10	2.80	.50	0	0	0	0	0	0	0	0
29	30	5.30	3.00	.70	0	0	0	0	0	0	0	0
30	31	5.50	3.20	.90	0	0	0	0	0	0	0	0
31	32	5.70	3.40	1.10	0	0	0	0	0	0	0	0
32	33	5.90	3.50	1.20	0	0	0	0	0	0	0	0
33	34	6.00	3.70	1.40	0	0	0	0	0	0	0	0
34	35	6.20	3.90	1.60	0	0	0	0	0	0	0	0
35	36	6.40	4.10	1.80	0	0	0	0	0	0	0	0
36	37	6.60	4.30	2.00	0	0	0	0	0	0	0	0
37	38	6.80	4.40	2.10	0	0	0	0	0	0	0	0
38	39	6.90	4.60	2.30	0	0	0	0	0	0	0	0
39	40	7.10	4.80	2.50	.20	0	0	0	0	0	0	0
40	41	7.30	5.00	2.70	.40	0	0	0	0	0	0	0
41	42	7.50	5.20	2.90	.50	0	0	0	0	0	0	0
42	43	7.70	5.30	3.00	.70	0	0	0	0	0	0	0
43	44	7.80	5.50	3.20	.90	0	0	0	0	0	0	0
44	45	8.00	5.70	3.40	1.10	0	0	0	0	0	0	0
45	46	8.20	5.90	3.60	1.30	0	0	0	0	0	0	0
46	47	8.40	6.10	3.80	1.40	0	0	0	0	0	0	0
47	48	8.60	6.20	3.90	1.60	0	0	0	0	0	0	0
48	49	8.70	6.40	4.10	1.80	0	0	0	0	0	0	0
49	50	8.90	6.60	4.30	2.00	0	0	0	0	0	0	0

$50	$51	$9.10	$6.80	$4.50	$2.20	$0	$0	$0	$0	$0	$0	$0
51	52	9.30	7.00	4.70	2.30	0	0	0	0	0	0	0
52	53	9.50	7.10	4.80	2.50	.20	0	0	0	0	0	0
53	54	9.60	7.30	5.00	2.70	.40	0	0	0	0	0	0
54	55	9.80	7.50	5.20	2.90	.60	0	0	0	0	0	0
55	56	10.00	7.70	5.40	3.10	.80	0	0	0	0	0	0
56	57	10.20	7.90	5.60	3.20	.90	0	0	0	0	0	0
57	58	10.40	8.00	5.70	3.40	1.10	0	0	0	0	0	0
58	59	10.50	8.20	5.90	3.60	1.30	0	0	0	0	0	0
59	60	10.70	8.40	6.10	3.80	1.50	0	0	0	0	0	0
60	62	11.00	8.70	6.40	4.10	1.70	0	0	0	0	0	0
62	64	11.30	9.00	6.70	4.40	2.10	0	0	0	0	0	0
64	66	11.70	9.40	7.10	4.80	2.50	.20	0	0	0	0	0
66	68	12.10	9.80	7.40	5.10	2.80	.50	0	0	0	0	0
68	70	12.40	10.10	7.80	5.50	3.20	.90	0	0	0	0	0
70	72	12.80	10.50	8.20	5.90	3.50	1.20	0	0	0	0	0
72	74	13.10	10.80	8.50	6.20	3.90	1.60	0	0	0	0	0
74	76	13.50	11.20	8.90	6.60	4.30	2.00	0	0	0	0	0
76	78	13.90	11.60	9.20	6.90	4.60	2.30	0	0	0	0	0
78	80	14.20	11.90	9.60	7.30	5.00	2.70	.40	0	0	0	0
80	82	14.60	12.30	10.00	7.70	5.30	3.00	.70	0	0	0	0
82	84	14.90	12.60	10.30	8.00	5.70	3.40	1.10	0	0	0	0
84	86	15.30	13.00	10.70	8.40	6.10	3.80	1.50	0	0	0	0
86	88	15.70	13.40	11.00	8.70	6.40	4.10	1.80	0	0	0	0
88	90	16.00	13.70	11.40	9.10	6.80	4.50	2.20	0	0	0	0
90	92	16.40	14.10	11.80	9.50	7.10	4.80	2.50	.20	0	0	0
92	94	16.70	14.40	12.10	9.80	7.50	5.20	2.90	.60	0	0	0
94	96	17.10	14.80	12.50	10.20	7.90	5.60	3.30	.90	0	0	0
96	98	17.50	15.20	12.80	10.50	8.20	5.90	3.60	1.30	0	0	0
98	100	17.80	15.50	13.20	10.90	8.60	6.30	4.00	1.70	0	0	0
100	105	18.50	16.10	13.80	11.50	9.20	6.90	4.60	2.30	0	0	0
105	110	19.40	17.00	14.70	12.40	10.10	7.80	5.50	3.20	.90	0	0
110	115	20.30	17.90	15.60	13.30	11.00	8.70	6.40	4.10	1.80	0	0
115	120	21.20	18.80	16.50	14.20	11.90	9.60	7.30	5.00	2.70	.40	0
120	125	22.10	19.70	17.40	15.10	12.80	10.50	8.20	5.90	3.60	1.30	0
125	130	23.00	20.60	18.30	16.00	13.70	11.40	9.10	6.80	4.50	2.20	0
130	135	23.90	21.50	19.20	16.90	14.60	12.30	10.00	7.70	5.40	3.10	.80
135	140	24.80	22.40	20.10	17.80	15.50	13.20	10.90	8.60	6.30	4.00	1.70
140	145	25.70	23.30	21.00	18.70	16.40	14.10	11.80	9.50	7.20	4.90	2.60
145	150	26.60	24.20	21.90	19.60	17.30	15.00	12.70	10.40	8.10	5.80	3.50
150	160	27.90	25.60	23.30	21.00	18.70	16.40	14.10	11.70	9.40	7.10	4.80
160	170	29.70	27.40	25.10	22.80	20.50	18.20	15.90	13.50	11.20	8.90	6.60
170	180	31.50	29.20	26.90	24.60	22.30	20.00	17.70	15.30	13.00	10.70	8.40
180	190	33.30	31.00	28.70	26.40	24.10	21.80	19.50	17.10	14.80	12.50	10.20
190	200	35.10	32.80	30.50	28.20	25.90	23.60	21.30	18.90	16.60	14.30	12.00
		18 percent of the excess over $200 plus—										
$200 and over		36.00	33.70	31.40	29.10	26.80	24.50	22.20	19.80	17.50	15.20	12.90

You will note on the employee's individual record that the first entry, in the first quarter, shows the following deductions:

F. I. C. A.	$1.57	= $2\frac{1}{4}$% of $70.00 (This was the rate current at the time.)
Withholding Tax	10.50	= amount listed on Withholding Tax chart under <u>one</u> <u>dependent</u>, in line with $70.00
S. U. C. & T. D. B.	0.53	= $\frac{3}{4}$% of $70.00
Union Dues	3.00	
Total deductions	$15.60	
Net earnings	54.40	
Gross earnings	$70.00	

The money received after the various deductions is known as "net pay" but it is often termed "take home pay."

ASSIGNMENT:

1. Using the following schedules of rates for operators, figure the total weekly salary of the following women:

	Worker		Style #803 $1.56 per dr.	Style #883 $1.40	Style #804 $1.10	Style #805 $1.37
a.	Carr	(1)*	19 dresses	22 dresses	7 dresses	11 dresses
b.	Fuller	(0)	14 dresses	24 dresses	11 dresses	5 dresses
c.	Mason	(2)	17 dresses	15 dresses	10 dresses	8 dresses
d.	Paulson	(0)	18 dresses	19 dresses	12 dresses	10 dresses
e.	Peters	(1)	21 dresses	18 dresses	9 dresses	7 dresses
f.	Ward	(0)	15 dresses	17 dresses	8 dresses	5 dresses

Figure the "take home pay" of each of the above workers using a deduction rate of 3% for F. I. C. A. and $\frac{3}{4}$% for S. U. C. Use the Withholding Tax chart on the previous page.

* The number in parenthesis signifies the number of dependents.

2. Many workers are paid a special rate when they work over their regular 7-hour day. The number of hours worked over the stated number is called overtime. Usually the rate for overtime is $1\frac{1}{2}$ times the first rate.

Figure the total week's pay for each of the women listed in this table. They received overtime for work over 35 hours.

Worker	Hourly Rate	Hours Worked
Dunn	$1.58	35
Bien	1.85	37
Keyes	2.28½	42
Atkens	1.95½	40
Dale	1.25	35

3. The "floor girl" was paid $40.00 a week. She worked 5 days, seven hours a day. What was her rate of pay per hour?

4. The forelady received a salary of $90.00. She worked 5 days a week, seven hours a day.
   a. What is her rate of pay per day?
   b. What is her rate of pay per hour?
   c. What is her pay for the month of February?

5. Compute the net pay on the following: 35 hours @ $1.95½ per hour.
   Deductions:
   Withholding tax, one dependent
   Hospitalization ..... 97¢
   F. I. C. A. 2¼%
   S. U. C. ..... ¾%

6. Figure the gross earnings for the following women who do floor work (trimmers, hemmers, pinkers, sorters, etc.) A half hour is allowed for lunch (12:00 to 12:30). They received time-and-a-half for overtime (any time over 35 hours).

Worker	Rate per hr.	Mon. in out	Tues. in out	Wed. in out	Thurs. in out	Fri. in out
Lewis	$1.70	8:30-4:30	8:30-5:00	8:30-12:00	8:30-5:30	8:30-5:00
Dudec	1.25	12:30-4:30	8:30-4:00	8:30- 5:00	8:30-4:30	8:30-4:30
Clark	1.58	9:00-5:00	8:30-12:00	--------	8:30-5:00	8:30-6:00
London	1.38½	8:30-5:00	9:00-5:00	9:00-5:00	8:30-5:00	8:30-5:30

Writing Invoices and Checking
Daily Sales Records

Lesson No. 5

OBJECTIVES: To learn how to make out invoices.

To understand the procedures in checking daily sales records.

RELATED INFORMATION:

Once the garments are ready for shipment, it is customary for the seller to submit to the purchaser a bill of invoice. An invoice is an itemized bill given or sent to a customer with the goods ordered. The invoice or charges are written on a special billing machine by the billing clerk for every delivery made to each individual customer.

Invoices are usually made out in triplicate. The original or first copy is sent to the customer along with the shipment of garments. The duplicate or second copy is sent to the office for the bookkeeping department. The third and final copy is kept in the shipping department for a check on all shipments. The following information should appear on the invoice:

a. Date of shipment

b. Customer's name and complete address

c. Customer's order number

d. Salesman

e. Terms

f. Shipping method used

g. Quantity of dresses being shipped

h. Style numbers of garments being shipped

i. Price per garment

j. Extension

An examination of the following invoice will show that it contains the information listed above.

INVOICE

Claudia Designs, Inc.
152 WEST 36TH STREET
NEW YORK 18, N. Y.

OUR NUMBER	00853
DATE	6/14/59
CUSTOMER'S ORDER	17854
SALESMAN	T.C.
TERMS	S.B.E. o M.
F. O. B.	Railway

Sold To: Tina Rose
748 Broad St.
Phila, Pa.

Shipped To:

Address:

2	Dresses Style 614 @	11	75	23	50
2	Dresses Style 710 @	13	75	27	50
4				51	00

Rediform 7H721

PROCEDURE:

1. Check the number of garments that are ready for shipment.

2. Bill the customers for garments to be charged, remembering to include all items listed above.

3. Re-check the calculations before the invoi ces are sent out.

4. At the end of the day, a total of all garments charged to customers is taken, according to style and price.

Example: On April 24th, Claudia Dress Co. had total sales of $2,028.19. In cross-checking the total garments shipped according to style and price, the bookkeeper made up the following report:

Style #883	72 dresses	@	$9.75	=	$ 702.00
Style #886	56 dresses	@	9.75	=	546.00
Style #884	74 dresses	@	9.75	=	721.50
Style #1066	2 dresses	@	15.75	=	31.50
Style #1073	2 dresses	@	12.75	=	25.50
	P. P. & Ins.				1.69
					$2,028.19

ASSIGNMENT:

1. Make out invoices for the following shipments sent out on May 4th, 19__, terms 8/10 E.O.M.

   a. To Jones & Co., 114 Fifth St., Detroit, Mich., 4 dresses style #803 at $9.75; 5 dresses style #804 at $8.75; 6 dresses style #805 at $12.75. Package was sent by Railway Express.

   b. To R. Armstrong, 17 Oak Rd., Norfolk, Va., 12 dresses style #805 at $12.75; 7 dresses style #806 at $11.75; and 10 dresses style #807 at $9.75. Sent by Railway Express.

   c. To J. C. Perry, 119 Lee Av., Charleston, S. C., 2 dresses style #809 at $13.75 each. Package weighed 5 lbs., was sent by parcel post and insured. Use postal and insurance rates listed in Unit I, Lesson No. 7; consider Charleston in Zone 4.

d. To Town & Country Shop, 75 Hillsdale Av., Baltimore, Md., 3 dresses style #883 at $9.75; 5 dresses style #809 at $13.75; 6 dresses style #807 at $9.75. Sent parcel post, insured. Weight, 18 lbs.; zone 2.

e. Conners', Hartford, Conn.; 2 dresses style #805 at $12.75; 2 dresses style #812 at $15.75; 1 dress style #883 at $9.75. Parcel post, insured. Weight, 7 lbs.; zone 2.

f. Harold's, Inc. Cleveland, Ohio; 25 dresses style #883 at $9.75. Railway Express.

g. Maggie's, New Orleans, La.; 5 dresses style #883 at $9.75; 4 dresses style #805 at $12.75. Parcel post, insured. Weight, 11 lbs.; zone 6.

h. The Parisian, San Francisco, Calif.; 1 dress style #883 at $9.75; 2 dresses style #809 at $13.75. Parcel post, insured. Weight, 5 lbs.; zone 8.

i. Gift and Style Shop, New York, N.Y., 7 dresses style #807 at $9.75. Parcel post, insured. Weight, 9 lbs.; zone 1.

j. Jean's Dress Shop, New Orleans, La.; 3 dresses style #803 at $9.75; 3 dresses style #806 at $11.75; 1 dress style #804 at $8.75. Parcel post, insured. Weight, 12 lbs.; zone 6.

k. Dot's Dress Shop, Duluth, Minn.; 3 dresses style #807 at $9.75; 2 dresses style #806 at $11.75. Parcel post, insured. Weight, 10 lbs.; zone 5.

l. Bon Marché, San Francisco, Calif.; 1 dress style #812 at $15.75; 2 dresses style #809 at $13.75; 5 dresses style #883 at $9.75. Railway Express.

After all invoices are written out and checked, make out the daily total of styles, prices, etc. What is the total of all invoices? What is the total of styles shipped?

Purchase Orders and Requisitions — Lesson No. 6

OBJECTIVE: To learn how to make out purchase orders.

RELATED INFORMATION:

The purchasing department in most garment concerns consists of the trimmings buyer and piece goods buyer. Once the estimates are made for the fabric and trimmings needed (as in Unit I, Lesson 4), the next step is the placement of the purchase orders.

Purchase orders, like all other business papers, vary in size and form to meet the individual needs of a business. These orders are usually numbered and are made out in duplicate. The original is sent to the company with whom the order is to be placed and the duplicate is kept by the person placing the order (the trimmings buyer or piece goods buyer).

For each product that is purchased and consumed the buyer should keep detailed information with regard to sources, specifications, quantity consumed, quantity purchased in the past, prices, and price trends.

The buyer of any firm should:

1. Buy only from reputable firms.
2. Have a list of available sources from which materials can be obtained.
3. Be well informed on the specifications of all materials needed.
4. Have a knowledge of the prevailing prices of materials needed.
5. Consider his needs and avoid over-stocking.

PROCEDURE

The Trimmings Buyer should:

1. Re-check estimates of trimmings needed.
2. Check price of item with concern to which she is sending an order, before mailing order or calling in order by phone.
3. Make out purchase orders for all items needed. Be sure to state color, size, quantity, and price.

The Piece Goods Buyer should:

1. Refer to style number of garment which is being cut and check average yardage needed per dress.

2. Re-check estimate for total yardage.

3. Make out purchase order for fabric needed. Be sure to state name or type of fabric, color, quantity, and price.

   Example: Following is an illustration of a purchase order issued for trimmings for style #805:

PURCHASE ORDER

Claudia Designs, Inc.

MISSES – HALF SIZE DRESSES

152 WEST 36TH STREET

NEW YORK 18, N. Y.

June 20 19

M Belbro Bros.

338 W. 37th St.

New York, N. Y.

TERMS: 1%0

110	12" OT Zippers @	.087½	
	Mauve 32		
	Aqua 28		
	Blue 26		
	Pink 24		
	110		

ASSIGNMENT:

1. Make out the purchase orders that would be made by the trimmings buyer to cover estimates for garments ordered by customers and recorded on cutting tickets in Unit I, Lesson No. 4; combine all notions and trimmings of the same size and color, using the style descriptions given in Lesson No. 2 of the same unit. Separate purchase orders for different items, such as zippers, buttons, etc.

2. Make out the purchase orders that would be sent out by the piece goods buyer to cover estimates for the same garments as in question No. 1, combining all fabrics that are the same in type and color.

Inventories Lesson No. 7

OBJECTIVE: To become familiar with computing inventories.

RELATED INFORMATION:

A merchandise inventory is the value of the unsold goods. A merchant must obtain the value of the unsold merchandise before he can know the results of operating his business. The end-of-period inventory is determined by counting and listing all merchandise on hand held for sale, pricing such merchandise at cost, and totaling the money amounts.

PROCEDURE:

There is no universal procedure for taking an inventory. Probably the simplest procedure is as follows: Two people work as a team; one person counts, weighs, or otherwise measures the merchandise and calls the descriptions and quantities to the other person, who writes the information on inventory sheets. The unit value of each article, which is generally its cost price, is written after the description, and this value is multiplied by the quantity on hand to determine the total value of such unsold articles.

Each extension is written opposite the respective quantity description and unit price. These extensions are then added to obtain the total value of all merchandise listed in the inventory. This grand total is referred to as the value of the merchandise inventory. The taking of an inventory is sometimes referred to as taking stock.

INVENTORY June 30, 19 PAGE 1

SHEET NO. _____ PRICED BY a.j.c.

CALLED BY A.J.C. DEPARTMENT Piece Goods EXTENDED BY a.j.c.

ENTERED BY L.C.Y. LOCATION _____ EXAMINED BY S.N

CHECK	QUANTITY	DESCRIPTION	✓	PRICE	EXTENSIONS
✓	220 3/4	yds Combed Chambray	✓	.55	121 41
✓	170 1/2	yds Combed Chambray	✓	.60	102 30
✓	249 3/4	yds Dimity	✓	.475	118 63
✓	376 1/2	yds Colored Seersucker	✓	.675	254 14
✓	771	yds Spun Rayon	✓	.65	501 15
✓	232 1/2	yds Spun Rayon	✓	.70	162 75
✓	12	yds Chiffon Voile	✓	.625	7 50
✓	25	yds Pinewhale piqué	✓	.37	9 25
✓	40	yds waffle piqué	✓	.37	14 80
✓	49	yds unbleached muslin	✓	.24	11 76
✓	120	yds Broadcloth	✓	.65	78 00
✓	315	yds Tissue gingham	✓	.55	173 25
✓	635	yds Dotted Swiss	✓	.68	431 80
		Total Piece Goods Inventory			1986 74

ASSIGNMENT:

1. Prepare an inventory sheet with the headings used in the inventory illustrated on the previous page. List the following items and find the total value of this inventory:

$44\frac{1}{2}$ yds. solid color flannel	@ $37\frac{3}{4}$¢ per yd.
$75\frac{1}{4}$ yds. printed flannel	@ $.375 per yd.
295 yds. percale prints	@ $.355 per yd.
282 yds. solid percales	@ 34¢ per yd.
$108\frac{3}{4}$ yds. organdy	@ 40¢ per yd.
36 yds. $\frac{1}{4}$" elastic	@ 57¢ per dz. yds.
12 yds. $\frac{1}{2}$" elastic	@ 95¢ per dz. yds.
18 yds. 1" elastic	@ 1.60 per dz. yds.
$3\frac{1}{2}$ gross buttons Navy/30	@ 4.25 a gr.
$6\frac{1}{12}$ gross smoked pearl/24	@ 4.50 a gr.
30 cones white thread	@ 1.33 a cone
8 boxes #50 thread	@ 2.88 a box

2. The following inventory was taken by two employees of Mara Dress Company: (dress manufacturers)

Fabrics:

335 yards of pima broadcloth	@ $97\frac{1}{2}$¢ per yd.
530 yards of powder puff muslin	@ 60¢ per yd.
$1051\frac{1}{4}$ yards of spun rayon	@ 70¢ per yd.
$567\frac{3}{4}$ yards of spun rayon	@ 65¢ per yd.
105 yards birdseye piqué	@ 95¢ per yd.
385 yards of Bates Discipline	@ $64\frac{3}{4}$¢ per yd.
$294\frac{3}{4}$ yards woven denim	@ 38¢ per yd.
$316\frac{1}{2}$ yards combed chambray	@ $57\frac{1}{2}$¢ per yd.

Trimmings:

$8\frac{1}{2}$ gross asst'd colors/24 buttons	@ $4.25 a gr.
$7\frac{3}{4}$ gross /30 buttons	@ 6.00 a gr.
11 gross self-butt. flat/24	@ 1.25 a gr.

Notions:

512 12" pl. zippers	@ $0.0891 per zip.
836 14" O. T. zippers	@ 0.0987 per zip.
425 7" sk. zippers	@ 0.065 per zip.

Completed Dresses:

135 dresses style #883	@ 5.81 each
76 dresses style #887	@ 6.13 each
33 dresses style #1074	@ 6.24 each
23 dresses style #886	@ 5.75 each
15 dresses style #885	@ 4.95 each

List the above items and find the total value of this inventory.

3. The following inventory was taken by two employees of the dress department of the Woodbridge Department Store:

36 dresses	@ $5.75 each
24 dresses	@ 6.75 each
18 dresses	@ 7.75 each
58 dresses	@ 8.75 each
63 dresses	@ 9.75 each
32 dresses	@ 10.75 each
49 dresses	@ 12.75 each
37 dresses	@ 14.75 each

Copy the above items on an inventory sheet and find the total value of this inventory.

4. Make out an inventory sheet like the sample and list all of the supplies in the storage closets in the needle trades room. Sub-head the inventory into groups such as: fabrics, trimmings, notions, etc.

Business Forms - Profit and Loss Statement Lesson No. 8

OBJECTIVES: To learn the importance of a profit and loss statement to every businessman.
To learn how to prepare a profit and loss statement.

RELATED INFORMATION:

Not all business is profitable at all times. There are periods of time when profits are small, and other periods when actual losses are sustained. A business cannot be run without expense. One of the first things to consider in a business is to make sure that enough profit is made from transactions to cover expenses and have enough left to pay the owners of the business a reasonable compensation for running it. A business cannot long exist when expenses continue to exceed income.

To determine whether or not the business has been profitable, every business concern determines periodically how much the profit (or loss) has been. The proprietor is anxious to know whether there is a profit or a loss, and, from time to time, what may be the financial status. Accordingly, at least once a year, or monthly, as is the case in many lines of business, the bookkeeper prepares a profit and loss statement and a balance sheet, thus giving the owner valuable information about his business.

PROCEDURE:

To learn to prepare this important business statement, you must give careful study to the content and the arrangement of the illustrated forms of these statements.

The following terms used in the profit and loss statement must be studied:

Gross Sales - represents the amount of goods sold to customers, without considering the goods returned by customers, or allowances made for broken or damaged goods.

Return Sales - the term given to merchandise returned by customers. The value of the merchandise returned must be deducted from the gross sales.

Net Sales - the value of the goods actually sold and not returned. It is the difference between the gross sales and the returns and allowances.

Merchandise Inventory - the value of unsold goods.

Purchases - total cost of goods bought.

Gross Profit - the difference between the cost of goods sold and the net sales.

Operating Expenses - includes selling expenses, charges against income, and overhead expenses.

Net Profit - what is left of the gross profit after all expenses are paid. In its relation to sales, net profit indicates whether the volume of sales justifies the expenditure or not.

PROFIT AND LOSS STATEMENT

June 30, 19__

Gross Sales		$7475.00
Less: Goods Returned	$225.00	
Damaged Goods	115.00	
Total returns and allowances		340.00
Net Sales		$7135.00
Merchandise Inv. May 31	$5875.00	
Purchases	3143.00	
Total Cost of Goods for Sale	9018.00	
Less: Inventory June 30,	4250.00	
Cost of Goods Sold		4768.00
Gross Profit		2367.00
Selling Expense		1427.00
Net Profit		$ 940.00

In analyzing the above statement you can see that the first figure needed is the net sales, which is the gross sales less any returns or allowances made during the month.

To find the cost of goods sold, this simple rule applies: beginning-of-month inventory plus purchases, less inventory at the end of the month. The gross profit is found by subtracting the cost of goods sold from the net sales. The net profit is found by subtracting all operating expenses from the gross profit.

ASSIGNMENT:

1. Find the net sales in each of the following:

   a. In a certain store the sales for the month of May amounted to $6892.60. In the week following, goods amounting to $575.40 were returned.

   b. The sales for a given period in a dress manufacturing firm amounted to $28,921.50. Customers returned as unsatisfactory goods amounting to $1450.75.

   c. The gross sales of Claudia Dress Co. amounted to $115,821.50. Due to faulty packing some of the merchandise was damaged in delivery and they allowed their customers $1,275.00.

2. Find the cost of goods sold in each of the following:

	Inventory (beg. o. m.)	Purchases	Inventory (e. o. m.)
a.	$2191.50	$3284.63	$1876.98
b.	5678.32	6387.29	4724.88
c.	7287.61	4159.76	3948.90
d.	1928.50	8439.62	1729.54

3. Find the gross profit on sales in each of the following:

   a. A merchant's sales for 6 months were $23,450.00. He had $3245.00 worth of merchandise on hand at the beginning of the period, and he bought $18,750 worth of merchandise during the half year. At the end of the 6 months his inventory was $3825.00.

   b. A man's sales for one month amounted to $19,842.50. At the beginning of the month he had on hand merchandise worth $4326.80. During the month he purchased merchandise worth $14,596. and at the close of the month his inventory was $5321.64.

c. Inventory at the beginning of a period was $3642.50 and purchases were $12,367.80 for the period. The sales were $13,210.60. The inventory at closing was $1950.50.

4. Find the net profit in each of the following:

a. If your gross profit is $5675 and your expenses are $1960, how much is your net profit?

b. Your gross profit from sales of goods is $6450. Your selling expenses are: rent $500; salaries $1400; and other expenses $650. How much is your net profit?

5. Set up a statement of profit and loss for each of the following:

a. The net sales for a year were $65,000. Inventory at the beginning of the year was $13,960, and purchases were $48,540. The overhead expenses were: rent $3300; wages $5400; store and office supplies $1600; fuel and lights $1140; delivery expense $1800. At the close of the year the inventory of merchandise was $17,500.

b. A clothier's inventory of merchandise at the beginning of the month was $13,752. Purchases for the month were $51,968. He paid for rent $2800; light and fuel $750; wages $6600; delivery expense $2400; and miscellaneous expenses $1250. Merchandise inventory at the end of the month was $15,720. Sales were $71,300.

OBJECTIVES: To learn the importance of a balance sheet to every businessman.

To learn how to prepare a balance sheet.

RELATED INFORMATION:

The balance sheet shows all the assets and the liabilities of an individual or a firm. This form of report is frequently required when a business concern wishes to borrow money from a bank. It shows whether the applicant owns sufficient assets to pay debts (liabilities); that is, whether his business is solvent or not. The present worth, also called net worth or capital, is the difference between the total assets and the total liabilities.

PROCEDURE:

When preparing a financial statement one must keep in mind two simple definitions and one equation, called the "balance sheet equation". The definitions are:

Assets are things owned which have a money value.

Liabilities are debts owed to others.

The equation is:

Assets - Liabilities = Capital

Following is a balance sheet prepared by Claudia Dress:

CLAUDIA DRESS CO.
Balance Sheet

As of June 30, 1960

Assets

Cash	$21,130.00	
Accounts Receivable	5,500.00	
Notes Receivable	4,500.00	
Merchandise Inventory	5,600.00	
Office Furniture	850.00	
Delivery Equipment	950.00	
Total Assets		$38,530.00

Liabilities

Accounts Payable	$3,400.00	
Notes Payable	2,800.00	
Total Liabilities		6,200.00
Net Worth		32,330.00
		$38,530.00

ASSIGNMENT:

1. Prepare balance sheets from the facts given in each of the following problems:

   a. On August 31, 19__, Marvin Duff has: cash $840; debts of J. C. Smith $450 and of F. B. White $360; mdse. inventory $1870; store equipment $350; and office equipment $200. Duff owes R. M. Cooper $190 and C. D. Wilson $260. His investment at the beginning of August was $3500, and he made a net profit of $120 during the month.

   b. On September 30, 19__, L. M. Doyle has: cash $978; debt of C. D. Moore $550; mdse. inventory $1310; store equipment $175; and office equipment $140; Doyle owes James Newman $200 and Burns Co. $315. His investment at the beginning of September was $2500, and he made a net profit of $138 during the month.

c. On June 30, 19__, Joan Smith, a speciality store owner, had: cash $759; mdse. inventory $2060; accounts receivable $322; office equipment $145; store equipment $525; accounts payable $602. Her investment at the beginning of June was $3000, and she made a net profit of $189.

2. Copy the amounts given below on a sheet of paper. Fill in the blank spaces.

	Assets	Liabilities	Capital
a.	$2.745	$371	------
b.	------	680	$3,320
c.	------	965	13,735
d.	2,519	----	1,632
e.	4,675	610	------
f.	5,487	----	3,965

3. Define and give illustrations of (a) assets and (b) liabilities.

4. Who besides the owner might be interested in having a balance sheet of a business?

TRIAL EXAMINATION

Note to Teacher: This trial examination can be used as the basis for a final exam. Questions can be adjusted, added, or deleted to fit the extent of work covered.

ADDITION:

1.	2.	3.	4.
27,624	8,543	6,535	48,713
8,792	4,621	1,722	24,457
23,360	5,936	3,241	5,061
31,076	9,326	12,079	4,562
49,003	4,434	18,586	58,493
		5,768	

5. Vertical and horizontal addition:

$$2 + 9 + 4 + 7 + 8 + 9 =$$
$$8 + 4 + 3 + 8 + 6 + 4 =$$
$$9 + 4 + 6 + 3 + 9 + 6 =$$
$$7 + 2 + 5 + 8 + 2 + 9 =$$
$$6 + 5 + 8 + 9 + 6 + 8 =$$
$$\underline{13} + \underline{9} + \underline{7} + \underline{5} + \underline{7} + \underline{7} =$$
$$? \quad ? \quad ? \quad ? \quad ? \quad ? =$$

6. $23 + 106 + 295 + 519 + 63 + 54 + 75 =$

7. $\frac{1}{16} + \frac{3}{16} + \frac{1}{8} + \frac{11}{32} + \frac{7}{16} + \frac{19}{32} =$

8. $\frac{2}{3} + \frac{7}{18} + \frac{20}{36} + \frac{27}{36} =$

9. $0.0024 + 7.023 + 281.04 + .823 =$

10. $7.12\frac{3}{4} + .06\frac{1}{2} + 75\frac{1}{4} + 12\frac{3}{8} =$

SUBTRACTION:

1. A woman had a bank account of $1754.20. She bought a sewing machine for eighty-nine and three-tenths dollars; material for a dress, suit, and coat cost one hundred fifteen and four-fifths dollars; scissors, yardstick, and other sewing equipment came to twenty-seven and seven-tenths dollars. How much had she left in the bank?

2. A dealer had on hand $\frac{5}{6}$ of a dozen children's rompers and bought $3\frac{1}{2}$ dozen more. He sold 41 of them. How many rompers had he left?

3. $895\frac{3}{8} - 760\frac{5}{8} = ?$

4. $71\frac{3}{4} - 6\frac{5}{8} - 7\frac{1}{4} - 18\frac{1}{2} = ?$

5. The trimmings buyer had on hand $4\frac{3}{4}$ gross navy buttons/30. She used $2\frac{7}{8}$ gross for style #304. How many gross buttons were left? How many buttons?

6. $\frac{1}{2}$ lb. $- \frac{3}{8}$ lb. $+ 2\frac{7}{8}$ lbs. $- \frac{3}{16}$ lbs. $= ?$

7. $235\frac{1}{24} - 169\frac{1}{3} = ?$

8. $\$647\frac{3}{5} - \$249\frac{3}{20} = ?$

9. $324.82 - 8.63 - 24.8 - 75.25 = ?$

10. A retail store received the following shipments of dresses: $25.75, $37.50, $110.25 and $19.50. They returned two dresses @ $11.75 each. What was the amount due the wholesaler for merchandise received by the store?

MULTIPLICATION:

1. If the capital of a certain establishment is $75,500 and its annual business is 3.2 times its capital, what is its annual business?

2. In a yard goods department, Mary sold the following lengths of material:

a. 18" @ 70¢ a yd.
b. 24" @ 90¢ a yd.
c. 48" @ 69¢ a yd.
d. 54" @ 89¢ a yd.
e. $3\frac{3}{8}$ yds. @ 72¢ a yd.
f. $4\frac{1}{4}$ yds. @ $1.10 a yd.
g. $2\frac{5}{8}$ yds. @ 95¢ a yd.
h. $5\frac{1}{2}$ yds. @ $3.55 a yd.

Figure the cost of each length of material and compute the total cost of all material sold.

3. A man worked $13\frac{1}{2}$ hours and received $1.40 an hour. How much did he earn?

4. $19.13 x $3\frac{3}{4}$ = ?

5. 7.641 x $67\frac{2}{3}$ = ?

6. If one gross buttons costs $5.25, what would 23 gross cost?

7. An operator who earns an average of $76 a week saves 3% of her earnings. Find her yearly earnings and yearly savings, if she works 50 weeks a year.

8. A merchant paid $45.00 for a dozen broadcloth blouses and sold them at a gain of 30% on a blouse. Find the gain and selling price per blouse.

9. Find the cost of 125 dresses made of dacron/cotton at 69¢ a yard and buttons @ $4.75 a gross, if each dress requires seven and one-half yards and thirteen buttons. Labor cost for each dress is $4.10. Find the gross profit and selling price of the dress at a 12% mark-up.

10. Clara is given $1\frac{1}{2}$% commission on all sales she makes, in addition to her regular pay of $55.00 a week. If her sales amounted to $1758.50, what is her pay and commission in one week?

DIVISION:

1. Five buttons were used on style #604. At what gross price must the trimmings buyer purchase buttons, if the allowance per dress is 18¢?

2. If $9\frac{1}{2}$ yards of fabric cost $9.50, what will $2\frac{1}{2}$ yards cost?

3. If a manufacturer has 535 yards of fabric to be used for style #714, which takes $3\frac{1}{4}$ yards per dress, how many dresses will be produced?

4. At $9.75 per dress, how many can be bought for $244.00?

5. In the checking of her pattern, Mary found that it was $1\frac{3}{4}$ inches too long. What size tuck would she make in her pattern?

6. Joan purchased $2\frac{1}{2}$ yards of 36" material for a gathered skirt. Her waist measurement was 27" and her skirt length, including hem, was 32". She decided she wanted a 4 : 1 fullness. Did she have enough fabric? If not, how much did she need?

7. A firm received 255 yards of fabric. The invoice amounted to $106.95. What was the cost per yard?

8. What was the percentage mark-up allowed on a coat selling for $125.00, if the cost price was $93.75?

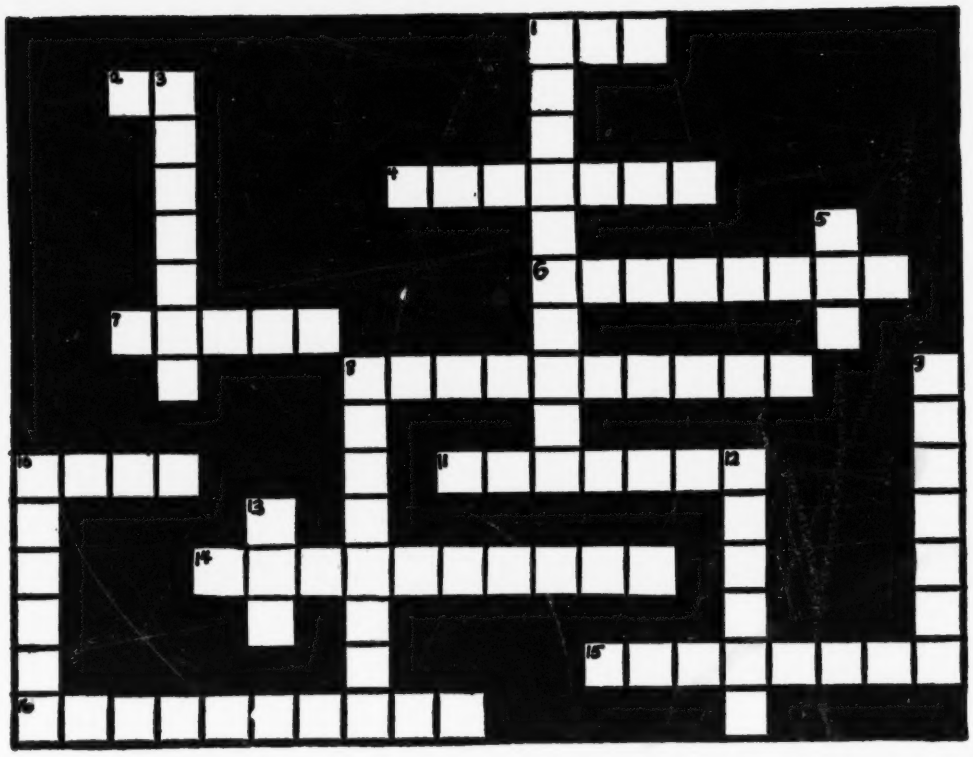
9. How many are there in:
   a. 12% of 10 gross of buttons
   b. $12\frac{1}{2}$% of 96 zippers.

10. If it costs $458.85 to produce 95 dresses, what is the cost of one dress? What would be the gross profit earned if the dresses were sold at $8.75 each?

11. What would be the diameter of a circular skirt if the circumference was 52"?

PUZZLE:

Arithmetic Terms Puzzle



ACROSS

1. To combine two or more numbers into one sum
2. The abbreviation for yard
4. The ones' product, tens' product, hundreds' product, and so on, in a multiplication problem are called ——— products.
6. To find the total number in a stated number of equal groups
7. The whole sum or amount
8. In the example, ¼ of 20 = 5, 5 is a ——— part.
10. The number of square units in a flat surface is its ———.
11. .5 is a ——— fraction.
14. In the example, 8 — 6 = 2, 6 is the ———.
15. The answer to a division problem
16. The answer to a subtraction problem

DOWN

1. The subject of this puzzle
3. In the example, 6 ÷ 2 = 3, 2 is the ———.
5. The formula for finding the area is —— = —— × ——.
8. A part of a number or object
9. The answer to a multiplication problem
10. A number to be added to another number to make the sum
12. The opposite of width
13. The answer to an addition problem

Douglas Sierks

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UNIT I · WHOLE NUMBERS

ACHIEVEMENT TEST NO. 1

EXERCISE I: Write the following numbers in words:

1. 150,000,000
2. 4,786,221
3. 62,050
4. 791,000
5. 12,080

EXERCISE II: Write the following numbers:

6. Eighteen thousand, sixteen
7. Ninety-two million, three hundred thousand
8. Seven hundred twenty-five thousand
9. One million, six thousand, forty-eight
10. Four thousand, eight hundred ninety-seven

EXERCISE III. Problems in fundamental combinations:

11. 6 x 5 + 7 - 5 ÷ 8 x 6 ÷ 24 =
12. 10 x 10 ÷ 10 + 10 - 10 =
13. 7 x 9 + 17 ÷ 8 + 10 ÷ 4 x 13 =
14. 8 ÷ 2 x 12 + 40 - 4 ÷ 2 =
15. 35 + 91 + 7 + 66 + 13 + 63 ÷ 11 =

16. If the enrollments in the high schools in a city are respectively: 1751, 1892, 2634, 1052, 2445, 2109, and 1474, what is the total number of high school pupils in that city?

17. In a "lot" of 328 dresses, how many would each operator be allotted if the shop consists of 41 operators?

18. 95 is how much less than 149?

19. Find the difference of 132 and 65.

20. Find the average yardage of nine bolts of material if they measure 101, 119, 96, 112, 130, 118, 127, 114, and 136 yards respectively.

21. At the end of the season the following number of dresses had been sold: 357 in style #217, 468 in style #221, 132 in style #218, 648 in style #219, 1327 in style #220. What was the total number of dresses sold? At an average materials cost of $5.69 each, what was the total materials cost?

22. In a lot of 239 dresses, a finisher had to sew 9 buttons on each dress. What was the total number of buttons to be sewed?

23. $\begin{array}{r} 8179 \\ \times\ \underline{5469} \end{array}$ 24. $\begin{array}{r} 4609 \\ -\ \underline{785} \end{array}$ 25. $\begin{array}{r} 5784 \\ \times\ \underline{906} \end{array}$ 26. $\begin{array}{r} 608 \\ \times\ \underline{907} \end{array}$

UNIT II - FRACTIONS

ACHIEVEMENT TEST No. 2

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1. In a needle trades class, $\frac{2}{5}$ of the girls did not complete the course. There were 40 girls in the class. How many did not complete the course?

2. Arrange the following fractions according to size, the largest first:

   a. $\frac{1}{8}$, $\frac{3}{4}$, $\frac{6}{16}$, $\frac{1}{2}$, $\frac{3}{16}$

   b. $\frac{3}{8}$, $\frac{7}{24}$, $\frac{1}{6}$, $\frac{3}{12}$, $\frac{20}{48}$

   c. $\frac{2}{3}$, $\frac{6}{4}$, $\frac{5}{12}$, $\frac{5}{6}$, $\frac{1}{2}$

3. Addition of fractions:

a.	b.	c.
$47\frac{7}{12}$	$6\frac{1}{8}$	$33\frac{1}{2}$
$8\frac{3}{4}$	$8\frac{7}{8}$	$9\frac{7}{8}$
$16\frac{1}{4}$	$19\frac{1}{4}$	$3\frac{1}{4}$

4. If $\frac{2}{3}$ of the 180 students enrolled in a school were not interested in the needle trades, how many students made up the needle trades class?

5. In most vocational schools, 3 hours of the 6-hour school day is spent in shop. What fractional part of the school day is this?

6. If there are 20 school days in one month and a student is absent 5 days, what fractional part of the school month was she in shop?

7. Multiplication of fractions:

   a. $15 \times 1\frac{1}{3}$

   b. $72 \times \frac{1}{4}$

   c. $4\frac{1}{2} \times 50$

   d. $30\frac{1}{2} \times 57\frac{1}{2}$

   e. $40\frac{1}{2} \times 65$

   f. $87\frac{3}{4} \times 65$

8. Select the correct answer to the following problems:

a. $\frac{2}{3}$ of 12 equals (18) (9) (6) (8)

b. $\frac{8}{16}$ of 144 equals (24) (36) (72) (90)

c. $\frac{2}{8}$ of 36 equals (6) (9) (12) (8)

d. $\frac{5}{12}$ of 288 equals (24) (102) (60) (120)

e. $\frac{3}{12}$ of 144 equals (36) (48) (72) (90)

9. Division of fractions:

a. $11\frac{2}{3} \div \frac{5}{6}$

b. $196 \div \frac{3}{8}$

c. $\frac{9}{36} \div \frac{5}{8}$

d. $1769 \div 30\frac{1}{2}$

e. $14\frac{2}{3} \div \frac{4}{9}$

f. $\frac{3}{4} \div \frac{3}{8}$

g. $1134 \div 17\frac{1}{2}$

h. $372 \div 8\frac{1}{4}$

10. Subtraction of fractions

a. $\begin{array}{r} 367\frac{3}{8} \\ -\ 89\frac{1}{4} \\ \hline \end{array}$

b. $\begin{array}{r} 309\frac{3}{4} \\ -\ 93\frac{3}{8} \\ \hline \end{array}$

c. $\begin{array}{r} 114\frac{1}{4} \\ -\ 56\frac{3}{4} \\ \hline \end{array}$

d. $\begin{array}{r} 612\frac{1}{4} \\ -\ 364\frac{3}{4} \\ \hline \end{array}$

UNIT III - MEASUREMENT

ACHIEVEMENT TEST No. 3

1. Complete the following:

   a. _____ buttons in $\frac{3}{4}$ of a gross

   b. _____ pairs in 6 units

   c. _____ minutes in $\frac{1}{4}$ hour

   d. _____ yards in 180 inches

   e. _____ dozens in $1\frac{3}{4}$ gross

   f. _____ inches in 3 feet

   g. _____ minutes in $3\frac{1}{2}$ hours

   h. _____ ounces in $\frac{5}{8}$ of a pound

   i. _____ yards in 54 inches

   j. _____ inches in $\frac{5}{8}$ of a yard

2. State whether the following answers are true or false:

   a. _____ 1 yard = 35 inches

   b. _____ $\frac{2}{3}$ of a yard is 24 inches

   c. _____ 11 gross equals 1 great gross

   d. _____ 6 hours equals $\frac{1}{3}$ of a day

   e. _____ 4 inches are used in four 1-inch tucks

   f. _____ $\frac{5}{8}''$ is more than $\frac{1}{2}''$

   g. _____ 9 gills equals 2 pints

   h. _____ $\frac{1}{8}$ of a yard equals 6 inches

   i. _____ $\frac{6}{4}$ are found in $1\frac{1}{2}''$

   j. _____ $\frac{1}{4}''$ of material is allowed for a $\frac{1}{8}''$ tuck

3. If one yard of cotton costs 48¢, find the cost of $\frac{5}{8}$ of a yard.

4. If one gross of buttons costs $4.50, find the cost of 6 buttons.

5. What is the cost of 10 jeweled buttons at $3.00 a dozen?

6. Make out a bill using the following items:

$2\frac{1}{2}$ yards of dacron/cotton	@	69¢ per yd.
$14\frac{1}{4}$ yards of canvas	@	89¢ per yd.
$2\frac{1}{2}$ lbs. pins	@	$1.10 per lb.
$4\frac{5}{8}$ yards of voile	@	62¢ per yd.
$7\frac{7}{8}$ yards of Bengaline	@	85¢ per yd.
$20\frac{3}{4}$ yards of gingham	@	44¢ per yd.
4 spools of thread	@	$4.80 a dozen spools
$2\frac{1}{4}$ dozen buttons	@	$4.50 a gross

7. Change each measurement to the unit indicated:

a. 15 feet = _____ yards

b. 8 feet = _____ inches

c. 176 inches = _____ feet

d. $6\frac{1}{2}$ yards = _____ inches

e. 9 ft. 8 in. = _____ inches

8. Perform the arithmetical process required in each case:

a. 3 yds. 9"
- 1 yd. 11"

b. 6 yds. 9"
x 28

c. 9' 10" ÷ 8

9. What part of a yard, in lowest terms, is the same as:

a. $\frac{18}{36}$ b. $\frac{27}{36}$ c. $\frac{24}{36}$ d. $\frac{30}{36}$ e. $\frac{9}{36}$

10. How many yards of fabric does a seamstress need if she must have:

a. $\frac{17}{4}$ yds. b. $\frac{27}{8}$ yds. c. $\frac{33}{6}$ yds. d. $\frac{45}{3}$ yds. e. $\frac{18}{2}$

11. If $\frac{7}{8}$ of a yard of imported 2" velvet costs 77¢, how many yards can be purchased for $10.12?

12. Change the following:

a. $\frac{3}{4}''$ = $\frac{\quad}{8}''$ = $\frac{\quad}{16}''$

b. $\frac{1}{4}$ yd. = $\frac{\quad}{8}$ yd. = $\frac{\quad}{16}$ yd.

c. $\frac{1}{2}$ dozen = $\frac{1}{\quad}$ gr.

d. $\frac{3}{8}''$ = $\frac{\quad}{16}''$ $\frac{\quad}{32}''$ $\frac{\quad}{64}''$

13. List the units of money received in change from $5.00 for $2.43 worth of merchandise.

14. The following is a list of cash received:

123 pennies
260 nickels
77 dimes
22 quarters
16 halves
145 dollar bills
25 five-dollar bills
12 ten-dollar bills
15 twenty-dollar bills

What was the total cash received for the day?

UNIT IV - RATIO AND PROPORTION

ACHIEVEMENT TEST NO. 4

1. A pleated skirt measures 36" around the hip, the pleats are 1" wide and 1" deep. How much extra fabric will have to be taken in for a 27" waistline? How much for each pleat?

2. Mary's hip measurement is 34". How much linen (36" wide) is needed for an all-around pleated skirt (the width between pleats is 1" and the underlay is 2", the finished length is 25" including hem?)

3. Jane plans to use a commercial blouse pattern, but discovers that the sleeve pattern is too long. If she shortens it $1\frac{1}{2}$", what size tuck does she take across the pattern?

4. Mary worked on a dress for 27 hours; Jane worked 3 hours. What is the ratio of Mary's time to Jane's?

5. If a length of percale is 48" long and 36" wide, find the ratio of the length to the width.

6. Of the $4.20 paid for making a dress, $1.05 was paid to the operator. What is the ratio of the operator's cost to that of other costs?

7. A morning class made 55 blouses, and the afternoon class made 75 blouses. What is the ratio of the work done by the former class to that of the latter?

8. The trimmings for 18 dresses cost $9.36. $11.96 will purchase trimming for how many dresses?

9. If 6 yards of seam binding costs 10¢, what is the price of 45 yards?

10. If 16 girls can complete an order of baby bibs in 30 hours, how long will it take 12 girls to complete the same work?

11. Twenty-six dickeys can be cut from $1\frac{1}{2}$ yards of piqué. How many dickeys can be cut from $2\frac{1}{4}$ yards of the same width piqué?

12. How much will 12 yards of muslin cost if 48 yards cost $12.12?

13. A graduate of our school earned $135 in three weeks. How long will it take her to earn $1080?

14. How many yards of 40" organdy did it take to make 8 yards of finished ruffling? The allowance for shirring is twice the finished length. The ruffle has a quarter -inch hem, two $\frac{1}{8}$" tucks, and is 5" wide when finished.

15. A piece of organdy one yard square is sent out to be cross-tucked. If the fabric is pin-tucked at intervals of one inch, how large will it be when it is completed? (Pin tucks use $\frac{1}{8}$" of material.)

16. A length of 40" wide rayon crepe was sent out to be tucked. The tucking machine was set for $\frac{1}{16}$" tucks with $\frac{1}{4}$" spaces. How wide was the fabric when it was returned?

17. What is the ratio of shirring in the following garments:

	Length of fabric used	Finished piece
a.	$31\frac{1}{2}$"	18"
b.	4 yards	24"
c.	20"	6"
d.	90"	36"
e.	20 yards	$3\frac{1}{3}$ yards

18. How many yards of wool (54" wide) will be needed for a skirt with full depth pleats measuring 36" at the hip line and 27" long including hem?

UNIT V - DECIMALS

ACHIEVEMENT TEST No. 5

1. In each part write only the result:

   a. 10 x 7.75
   b. 100 x .934
   c. 1000 x 59.3
   d. 35 ÷ 10
   e. 147.50 ÷ 10
   f. 3.7 ÷ 100

2. In each part write the value correct to the nearest cent:

   a. \$12.193
   b. \$2.876
   c. \$75.285
   d. \$90.075

3. Write each of the following numbers as decimals:

   a. 5 & $\frac{5}{10}$
   b. 10 & $\frac{7}{100}$
   c. 35 & $\frac{295}{1000}$
   d. 67 & $\frac{3}{4}$

4. Subtraction of decimals:

   a. \$4.24 - $\frac{3}{10}$ dollar
   b. \$6.48 - $\frac{3}{4}$ dollar
   c. \$8.35 - $\frac{9}{10}$ dollar
   d. 25.666 - 15.289
   e. 43206.9 - 2865.7

5. Multiplication of decimals:

   a. 6.13 x 6
   b. 38.2 x 197.6
   c. 29.11 x 9
   d. 158.75 x 62.5
   e. 9.16 x .702
   f. 352 x 4.372

6. Division of decimals:

a. 14.23 ÷ 8

b. 7.0925 ÷ .025

c. 374.072 ÷ 8.56

d. 4.914 ÷ .63

e. 25.25 ÷ .0625

f. 604.0125 ÷ 309.75

7. Addition of decimals:

a. 4.6, 35.8, 141.90, 8.17, 9145, 3.96, 38

b. .57, .32, 1.35, .19, .48

c. .379, 2.005, .876, .91, .8

d. 24.056, 18.287, .94, 7.876, .093

e. .983, 15.26, 9.0, 8.264, .007, 36, 25.08

UNIT VI - PERCENTAGE

ACHIEVEMENT TEST NO. 6

1. Write the following as decimals:

   a. 90%
   b. 5%
   c. $72\frac{1}{2}$%
   d. $67\frac{1}{4}$%
   e. $33\frac{3}{4}$%

2. Solve the following:

   a. 10% of 10 dozen buttons _____
   b. $66\frac{2}{3}$% of 30 yards of percale _____
   c. $12\frac{1}{2}$% of 32 zippers _____
   d. $37\frac{1}{2}$% of 24 dresses _____
   e. 12% of $12.75 _____
   f. 6% of $12.50 _____
   g. 20% of one hour _____

3. Figure the net cost of the following bills:

   a. 6 dresses @ $10.75
      2 dresses @ $12.75
      Discount 8%

   b. 600 zippers @ $0.11344
      55 pr. of pads @ 25¢ a pair
      2 gross butts. @ $4.25 a gr.
      Discount 1%

   c. 450 yards of material @ $0.657
      212 yards of material @ $.565
      Discount 2%

4. Find the commissions earned by each of the following salesmen:

	Amount of Sales	Commission
a.	$26,450.50	7% for earnings above $10,000
b.	$15,575.25	6%
c.	$25,430.25	5%
d.	$31,325.50	5% on the first $8000 and 2% on the balance
e.	$150,675.75	$4\frac{1}{2}$%

5. Find the interest on the following:

a. $625 @ 6% for 6 mos.
b. $3200 @ 6% for 2 yrs. 2 mos. and 2 days
c. $450 @ $4\frac{1}{2}$% for 1 yr.
d. $230 @ 6% for 3 mos.

6. Doris earned $1.25 an hour; her employer declared a 30% increase. How much is Doris earning now?

7. The labor costs of operating the shipping department amounted to $425 a week, which represents 12% of the amount billed to the customers. What was the amount of money received from customers?

8. What is the market price of one child's romper if the original cost is $9.00 a dozen and the markup is $33\frac{1}{3}$%?

9. Find the per cent of profit on an article bought for $12 and sold for $16 if the overhead expenses are 30% of the cost. Express answer to the nearest tenth of a per cent.

10. Marie bought a dress that was marked $25 at a reduction of 15%. What did she pay for the dress?

11. Janet bought a coat at the sale price of $66. The shopowner told her that the original price had been reduced by $33\frac{1}{2}$%. What was the original price?

UNIT VII - GEOMETRIC FORMS

ACHIEVEMENT TEST No. 7

1. A circular ruffle is made of seven 8" circles and is trimmed with 2 rows of narrow rickrack braid, on the edge and one inch from the edge. How much braid is needed?

2. How many square yards are there in a piece of nylon net measuring 72 inches wide and $6\frac{3}{4}$ yards long?

3. How many pin cushions can be made out of $\frac{1}{4}$ yard of felt 72" wide, if it takes a 4-inch square to make each side of the pin cushion?

4. How many chiffon scarfs 40 inches long and 20 inches wide can be cut from a piece of nylon chiffon 42" wide, if the length of the bolt is (a) 43 yards? (b) 31 yards? (c) 18 yards?

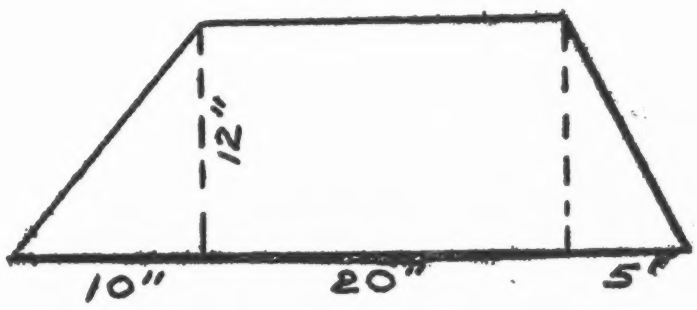
5. The following ad appeared in the Women's Wear Daily, "Contractor wanted, located within a radius of 75 miles from New York City." What is the total number of square miles covered in this area?

6. How much 39-inch cotton faille would be needed for a 12-inch square pillow with a 2-inch box edge? (Include a $\frac{1}{2}$ inch seam allowance on all edges.) Do not forget to include the length of the strip needed for the box edge.

7. A white piqué strip of material was placed vertically on the front of a dress for trimming. The length was 45 inches and the width was $2\frac{1}{2}$ inches, including seam allowances. How much 36" piqué is needed for 56 dresses?

8. If the circumference of a circular skirt is $4\frac{2}{3}$ yards, what is the diameter of the material needed to make it?

9. After cutting a pattern, Brenda finds that she has a substantial piece of material left over, as shown. How many square inches does she have?



UNIT VIII - ACCOUNTS

ACHIEVEMENT TEST NO. 8

1. Fill in the missing figures in the following:

	Cash Receipts	Cash Payments	Balance
a.	$11,719.32	?	$8,690.18
b.	8,123.25	$2,330.15	?
c.	?	5,657.68	15,748.25
d.	20,890.19	7,819.34	?

2. Fill the missing figures in the following:

	Inventory B.O.M.	Purchases	Inventory E.O.M.	Cost of Goods
a.	$4,159.76	$3,929.48	$3,150.00	?
b.	?	7,105.00	4,235.15	$8,504.85
c.	3,284.29	?	5,463.19	2,606.10
d.	2,191.50	8,439.62	?	5,132.62

3. Reconcile the bank balance in each of the following:

a. The check book balance was $376.52 and the bank statement showed a balance of $523.83. Checks for $69.20, $56.00, and $22.11 were still outstanding.

b. The bank statement listed the balance as $375.61, but the check book showed only $187.65. The service charge was $1.12. The three outstanding checks were for $29.75, $41.98, and $31.25. A deposit of $86.10 had not been recorded in the check book.

c. Ethel Martin's April bank statement for her dress shop showed a balance of $3,721.59 while her check book balance was $3,916.02. Three outstanding checks were for $103.48, $12.50, and $76.59. A deposit of $387.00 was not included in her statement.

4. The finishers sew buttons on style#617 at the rate of 18¢ per dozen. How many dresses, 10 buttons to the dress, must a finisher average daily to earn $45.00 weekly?

5. How many expert pressers, averaging 40 dresses a day, are needed for a factory having a weekly output of 1,000 dresses in a five-day week? What does each worker earn weekly when he is paid 39¢ a dress?

6. In the garment trade the busy seasons cover a period of 44 weeks. How much does a cutter earn who averages $125.00 a week during the busy season? What is his average weekly wage for the year? (Assume an 8-week lay-off.)

7. An operator earned $75.00 weekly and her sister, $66\frac{2}{3}$% as much. They gave 60% of their earnings toward the family support. How much had each left for her own use?

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Lesson Plans

Practical Nurse Education

MENTAL NURSING

VT 02934

TENNESSEE STATE BOARD FOR VOCATIONAL EDUCATION
Trade and Industrial Education Service
NASHVILLE

In Cooperation With The
DEPARTMENT OF INDUSTRIAL EDUCATION–COLLEGE OF EDUCATION
THE UNIVERSITY OF TENNESSEE

LESSON PLANS

MENTAL NURSING

Prepared by

PRACTICAL NURSING INSTRUCTORS

Following

JOINT CONFERENCE

Held at

THE UNIVERSITY OF TENNESSEE

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PREFACE

During the first Joint Conference of Vocational Education arrangements were completed for the development of lesson plans for the Practical Nursing curriculum. The coordinators and instructors prepared these lesson plans.

It is hoped that the prepared lesson plans will serve as an instructional aide for the practical nursing teacher. They should be used as a guide for the teacher as she makes daily lesson plans. The lessons include objectives, references, materials, instructional aids, outline of pertinent material to be presented, application, test and summary.

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INSTRUCTOR'S LESSON PLAN Lesson 1

MENTAL NURSING

NAME OF LESSON: Introduction to Psychiatric Nursing

AIM OF LESSON: To help the student to accept the need for integrating mental health concepts into every phase of the patient-nurse relationship.

REFERENCES:
Mental Health, the Nurse and the Patient - Odlum
Practical Nursing - Rapier, et al
Simplified Nursing - Thompson and LeBaron
The Psychiatric Aide - Robinson

Step I. INTRODUCTION:

No one is wholly successful in everything they wish to accomplish or achieve. Everyone meets with some frustrations. Some people are able to compensate for disappointments more than others. Our healthy state of mind assist us to achieve the ability to compensate for tensions, disappointments and the stresses occurring in our daily life. Health has three faces, body, mind and emotions. They must be considered together. Mind is the reasoning part of the individual. It is difficult to separate emotional and mental health. Mind is also the part of us that makes decisions. Individuals unable to make decisions which help them carry on as independent beings and fit into the world are mentally ill.

Step II. PRESENTATION OF LESSON

(List Points of Information)	Key Points (Things to Remember to Do or Say)
A. Historical Points	
1. Attitudes	a. Biblical times Since beginning of human existence temples were built for car of the mentally ill.
	b. Greece in the Golden Age Physicians tried to separate those with mental illness from the physically ill. There was a tolerant attitude toward the mentally ill or retarded.
2. Attitudes Changed	a. During the latter part of the eighteenth century, at the time o

the downfall of the flourishing empires, the treatment underwent severe change from tolerance and care to mistreatment.

b. In Medieval times the mentally ill was looked upon as possessed by evil spirits.

3. Reform

a. Began at the end of 18th century
b. Phillipe Pinel was French physician who thought the responsibility of the mentally ill should fall on the mentally well
c. Dorthea Dix, school teacher, informed the public, especially the government of existing conditions
d. Clifford Beers wrote "A Mind That Found Itself", a story concerning his hospitalization in the early 20th Century. He was instrumental in founding the National Committee for Mental Hygiene.

4. National Association for Mental Health

a. Sponsors
   - Guidance clinics
   - Adjustment Centers
   - Vocational Guidance
   - Prison Psychiatry
b. Educates by
   - Radio
   - Television
   - Community panel discussions, includes lay and professional groups
   - Distributes printed material

B. Discussion of Terms

1. Mental Illness
   a. People with difficulties that affect the mind
   b. Patient is as sick as if it were a physical ailment
   c. Modern medicine recognizes difficulties people meet
   d. Many recover and return to normal way of life

2. Psychiatry
   a. Specialized field of medicine
   b. Constantly finding new and better ways of treating mental illness
   c. Mentally ill may be cared for in home or hospital
   d. Many kinds of mental illness
      Symptoms: Usually recognizable, personality changes
      Cause: May be due to shock, true cause often unknown. There may be a hereditary tendency. More often arises from inability to adjust to difficult environment

3. Psychology
   a. Definition
   b. Plays a very practical part in our everyday life in the hospital
   c. Why the nurse needs to know in daily work with people.
      To understand people it is necessary that we have some idea of the way in which the human mind works.
      Learn the manner in which the individual is likely to behave.

Step III. <u>APPLICATION:</u>

Write brief outline of "Changing Public Attitudes Toward Mental Illness".
Visit with instructor Mental Health Center

Step IV. <u>CHECK UP OR TEST</u>:

Write resume of field trip to Mental Health Center.

<u>SUMMARY:</u>

For many centuries mental illness was looked upon with dread. The mentally ill were condemned. Gradually ideas regarding behavior disorders changed with the advance of scientific medicine. Cases were explored and treatments studied and applied. Through the efforts of well known individuals as Dorthea Dix, Clifford Beers

and others dedicated to the improvement of care for the mentally ill, the mental hygiene movement came into being. Out of this beginning the National Association for Mental Health, Inc., developed and psychiatry began to play an important part in everyday activity.

No matter how unlikely the recovery of a patient may seem, no patient is neglected or regarded as hopeless. Many hospitalized patients return to their families and work in the community as better adjusted citizens.

INSTRUCTOR'S LESSON PLAN Lesson 2

MENTAL NURSING

NAME OF LESSON: The Mental Hospital

AIM OF LESSON: To inform the student of the types of hospitals available for the care of the mentally ill.

REFERENCES: Practical Nursing - Rapier
The Psychiatric Aide - Robinson

MATERIALS: Chalkboard, chalk, eraser

Step I. INTRODUCTION

Current authorities in the field of mental health believe there are some 17,600,000 persons suffering from some form of mental illness. Slightly more than one out of every two hospital beds in the U. S. are occupied by mental patients. The extent of mental illness is generally underestimated because many people still think of it only as "insanity" or "craziness". Actually mental illness is very common. It can be as serious as cancer or as mild as a cold. Severe disturbances of mental health necessitate hospital care for nearly a million persons in this country. There are about 496 hospitals for mental disease in the U. S. The average daily hospital census of mental patients in 1957 was 673,115.

Step II. Presentation of Lesson

(List Points of Information)	Key Points (Things to Remember to Do or Say)
A. Private Hospitals	
1. Basis for admission	
a. Ability to pay	a. Smaller than state owned hospitals
b. Facilities available	b. May or may not operate for profit
B. Public Hospitals	
1. Basis for admission	
a. Resident of state	a. Usually patients requiring longer period of treatment may be 1,000 to 10,000 patients.

2. Facilities
   a. Diagnosis
   b. Treatment
   c. Research
      Cause
      Treatment
   d. Educational programs

C. Veterans Administration
   1. Federal hospitals
      a. Basis for admission
         Patients connected with government,
         Veterans

D. Psychopathic Hospitals
   1. Observation and emergency treatment

E. Residential Treatment Center
   1. Children

F. Day Care

G. Methods of Admission
   1. Voluntary
   2. Temporary Care
   3. Court Commitment

Step III. <u>APPLICATION</u>

Read unit in textbook on care of the mentally ill.
Read "What is Mental Illness" U. S. Department of Health, Education, and Welfare.
Read "There is Something You Can Do about Mental Health" W. C. Menninger, M. D.

Step IV. <u>CHECK-UP OR TEST</u>

A. Outline briefly types of hospitals available for the mentally ill and basis for admission.

<u>SUMMARY</u>

Mental illness remains the nations number one health problem. Each year about 290,000 new patients are admitted to mental hospitals and psychiatric units of general hospitals. There are

more patients in hospitals for mental illness than all other diseases combined.

More mentally ill patients are recovering, more research is underway, more communities are providing facilities for early detection, treatment and rehabilitation than at any time in history.

There are three methods of admission to a mental hospital. Voluntary admission is the most desirable since it is acknowledged by the patient who has insight into his problem and requests care and treatment.

INSTRUCTOR'S LESSON PLAN

Lesson 3

MENTAL NURSING

NAME OF LESSON: Basic Concepts of a Therapeutic Environment

AIM OF LESSON: To teach the student the importance of a therapeutic environment.

REFERENCES: Preview of Practical Nursing - Mosby
Simplified Nursing - Thompson and LeBaron

MATERIALS: One copy of test for each student

Step I. INTRODUCTION

The importance of the correct approach to mentally ill patients cannot be stressed too frequently, the nurses success depends on her ability to evaluate her patients and adjust her own behavior accordingly.

Step II. PRESENTATION OF LESSON

(List Points of Information)	Key Points (Things to Remember to Do or Say)
A. Needs of the patient	1. His desires, wishes and opinions are as important to him as are those of the well person 2. Consistent, non-punitive attitudes are essential. 3. Allow patient to set own pace in working with his problem 4. Unconditional acceptance 5. Allow to express both positive and negative emotions 6. Permissiveness with consistant limitations 7. Basic needs common to all people, love, security, protection, elimination, food, clothing and shelter.

B. Essential attitudes for the nurse	1. Wholesome and constructive attitude 2. Love and esteem, matter of factness 3. Active friendliness, passive friendliness 4. Politeness, patience, truthfulness and poise 5. Tactfulness, skillful listening, confidence
C. Hygiene	Basic hygiene needs known to all persons
D. Factors preventing therapeutic environment	1. Factors which would hinder therapy in any of the above mentioned points

Step III. APPLICATION

A. Discuss the right attitudes and compare them with effects of wrong attitudes
B. Discuss false notions of mental illnesses that exist today
C. Compare needs of the mentally ill with those of the well person

Step IV. CHECK-UP OR TEST

1. Essential attitudes for the nurse, to establish comfortable and agreeable relationships with mental patients would include the following:

A. Even temper	1. All of these
B. Noncritical attitude	2. A, C, and D
C. Confidence in ourselves and others	3. B, D, and E
D. Intimate friendships with patient	4. A, B, and C
E. Hurried manner	5. All except E

2. Attitudes to avoid in caring for mental patients

A. Over-rating what patient says	1. None of these
B. Stimulating ideas of reference	2. A, and D only
C. Politeness and tactfullness	3. All except E
D. Superior attitudes	4. A, B, and C
E. Friendliness	5. A, B, and D

3. Basic needs of the mentally ill person include all of the following except one. Select the one item that does not apply.

A. Love	1. All except D and E
B. Food, clothing and shelter	2. All except D
C. Security and protection	3. B, C, and E only
D. Punitive measures to control behavior	4. D only
E. Permissiveness without limitations	5. E only

4. The practical nurse's approach to the patient is determined by:

A. The doctor's orders upon admission	1. C only
B. Diagnosis	2. B, C, and D
C. The patient's behavior	3. All except E
D. The patient's education	4. A, D, and E
E. Likes and dislikes	5. None of these

5. The following are general principles applying to mental nursing

A. Lack of orientation promotes comfort	1. B, C, and E
B. Mental patients need to feel accepted	2. All except A
C. Mental patients need to express emotions	3. All except E
D. Mental patients need to feel security	4. B, C, and D only
E. Reassurance by nurse's skill	5. All of these

Answer Key

1. 4
2. 5
3. 1
4. 1
5. 2

SUMMARY:

Mental patients need assistance from well-adjusted and mature persons who, by training, skill, and understanding, can provide healing and therapeutic environment.

The next assignment will cover guides for observing and recording.

INSTRUCTOR'S LESSON PLAN — Lesson 4

MENTAL NURSING

NAME OF LESSON: Observation and Recording

AIM OF LESSON: To teach basic approaches to psychiatric behavior patterns. Guides for admission observations and ward observations.

REFERENCES: Preview of Practical Nursing - Mosby
Simplified Nursing - Thompson and LeBaron

MATERIALS: A large picture of a group of people engaged in some activity

INSTRUCTIONAL AIDS: Chalk board and chalk

Step I. INTRODUCTION:

Today we will discuss basic approaches to psychiatric behavior patterns, what to look for in caring for the mentally ill and how to record your observations.

Step II. PRESENTATION OF LESSON

(List Points of Information)	Key Points (Things to Remember to Do or Say)
A. Admission observations	1. Physical condition is checked 2. Careful and detailed observations made about behavior, notes are taken if possible 3. Appearance as to dress and facial expression 4. Sociability, degree of 5. General behavior, cooperativeness; whether or not responsive 6. Emotional reactions 7. Speech-normal or defective 8. Conversation, whether it appears normal in amount and content. Complaints are noted in detail

B. Ward Observations

1. Purpose of ward ovservations
2. Patients condition from time to time .
3. Observe without patients knowledge.
4. Appearance, is patient neat, clean and tidy, or dirty and untidy?
5. Sociability, does the patient associate freely with other patients, or is he withdrawn?
6. Behavior, is patient orderly or disorderly?
7. Restless, quiet or noisy, friendly or indifferent
8. Interested or disinterested, destructive or violent
9. Emotional reactions, speech, complaints, sleep, appetite, and excretions.

Step III. APPLICATION:

Using these points as a guide, report your observations of someone you have been in contact with today. (Have three or four students report.) Group discussion of important points of observing, stressing points that may have been left out.

Step IV. CHECK-UP OR TEST

Show a picture to the group, preferrably a group picture, for a brief period, then have each student write as many observations about the picture as they can.

SUMMARY

If a person is not naturally observant, this trait can be cultivated. One must be alert with all senses. Observe and report in detail, taking great care to be accurate. Do not draw own conclusions. Choose words carefully in writing notes. Accurate observing and recording is of the utmost importance while no report is better than a misleading one.

The next topic for discussion will be the new admission.

MENTAL NURSING

NAME OF LESSON: The New Admission

AIM OF LESSON: To teach the student guides to follow in the admission of a patient to a mental hospital.

REFERENCES: Preview of Practical Nursing - Mosby
Simplified Nursing - Thompson and LeBaron

MATERIALS: One copy of true or false test questions for each student.

Step I. INTRODUCTION:

It is important that a nurse know basic guide rules for admitting mentally ill patients. The patients initial contact with the hospital is very important, the saying "First impressions are lasting impressions" proves to be true quite frequently.

Step II. PRESENTATION OF LESSON

(List Points of Information)	Key Points (Things to Remember to Do or Say)
A. Guides to admission of patient to a mental hospital	1. Put patient at ease, thus increasing feelings of security 2. Admission of hospital routines in relationship to the patients person and belongings. 3. No patient left alone during admission because of possible escape or suicidal tendencies. 4. Orient patient to hospital environment. 5. Introduce patient to others on the ward, at his level of acceptance. 6. Be prepared to give acutely ill patient immediate and skillful care. 7. Friendly and gracious with patient's family. 8. Observe patient and report accurately.

9. Give verbal reports away from patient's hearing.
10. Keep written reports away from patient's seeing.
11. Do not ask leading questions.
12. All new admissions are watched closely until it is determined if there are escape, suicidal, or combative tendencies present.

Step III. APPLICATION

Group discussion of how guides for admission of a patient to a mental hospital varies with the guides for admission to a general hospital. Discuss why there is a need for these variations.

Step IV. CHECK-UP OR TEST

The following statements are either true or false regarding a patient who is a new admission to a mental hospital. Select either true or false and write the word that applies in front of the statement.

1. True Any behavior which might suggest self-injury or injury to others should be reported at once.
2. False It is acceptable to leave a new admission alone if no escape tendencies are noted.
3. False A new admission patient should be introduced to all the other patients on the ward, and all the nursing personnel, even though he may act as if he would rather be alone.
4. False It is not important to spend time with the patient's family because you owe all of your time to the patient.
5. True A psychiatric nurse must be prepared to give acutely ill patients immediate and skillful care.
6. True To put a mentally ill person at ease increases his feelings of security.
7. False It usually is not necessary to acquaint the mentally ill patient with hospital routines because he already has enough to be concerned about.
8. True Nursing care should center on the patient as a person and not on control of symptoms.

9. True While admitting a new patient you remember that behavior differs in degree rather than kind.

10. True Human behavior is motivated and can be understood and interpreted.

SUMMARY

Today we have discussed basic guides to use when admitting a patient to a mental hospital, how these guides vary with the usual admission routine and the importance of having such a guide in order for the best possible care to be given to the patient. By applying these guides we are also of value in securing the cooperation of the patient, his family, as well as having an opportunity to establish a good nurse-patient relationship.

The next assignment will be: The Withdrawn Patient, the Underactive Patient.

INSTRUCTOR'S LESSON PLAN

Lesson 6

MENTAL NURSING

NAME OF LESSON: The Withdrawn Patient, the Underactive Patient

AIM OF LESSON: To teach the student guides to nursing withdrawn and underactive patients according to behavior shown

REFERENCES: Preview of Practical Nursing - Mosby
Simplified Nursing - Thompson and LeBaron

Step I. INTRODUCTION:

Nursing success of mentally ill patients depends on the nurse's ability to evaluate various behavior patterns and adjust her nursing practices accordingly. Today we will discuss basic approaches to the withdrawn patient and the underactive patient.

Step II. PRESENTATION OF LESSON:
(List Points of Information)

Key Points
(Things to Remember to Do or Say)

A. The withdrawn patient

1. Show interest by warm friendly approaches
2. Use simple direct approach
3. Listen without indicating acceptance, dispute, or ridicule if hallucinations present
4. Try to not do or say things that might create suspicion
5. Anticipate changes in behavior so as to be ready to cope with it
6. Plan well for personal hygiene, the patient may forget or neglect to care for himself
7. Exercise must be planned for if patient stays in one position

B. The underactive patient

1. Show sincere interest by attitude
2. Try to keep patient's life simple and free from confusion
3. Patient slower in the morning new activities should be used in afternoon

4. Accept refusals to cooperate calmly
5. Do not attempt to reason away ideas of guilt, but allow to do menial tasks if not tiring
6. Provide security from suicide.
7. Be alert for signs of fatigue, and neglect of personal hygiene.
8. Be alert for physical illness, and malnutrition. Insomnia is common.

Step III. APPLICATION

Have each student plan the care for one day for each type of patient, pointing out the plans necessary to meet the patients basic needs, such as personal hygiene, exercise and nutrition.

Step IV. CHECK-UP OR TEST

Role playing: Students acting part of the patient and the nurse. Every student need not play either a patient or nurse but each one being free to offer helpful suggestions. The instructor should check to make the important points of approach to these two types of patients brought out clearly.

SUMMARY:

Today we have learned the approach to two types of mentally ill patients, these are basic guides. Each patient is an individual and their behavior patterns will change. Remember always that the successful nurse changes her nursing approach as the patient changes his behavior. It is impossible to predict all possible behavior that the patient may show at some time or other, however, with these guides, you can be sure of attending to the patients needs.

Tomorrows lesson will be "The Suspicious Patient" and "The Worrying Patient."

INSTRUCTOR'S LESSON PLAN Lesson 7

MENTAL NURSING

NAME OF LESSON: The Suspicious Patient, The Worrying Patient

AIM OF LESSON: To teach the student guides to nursing the suspicious patient and the worrying patient according to behavior shown.

REFERENCES:
Mental Health, the Nurse and the Patient - Odlum
Practical Nursing - Rapier, et al
Simplified Nursing - Thompson and LeBaron
The Psychiatric Aide - Robinson

SUPPLIES: One copy of test for each student

Step I. INTRODUCTION:

We have studied the approach to use for the withdrawn and the underactive patient, now we will discuss the approach to use for the suspicious and the worrying type patients.

Step II. PRESENTATION OF LESSON:

(List Points of Information)	Key Points (Things to Remember to Do or Say)
A. The Suspicious Patient	1. Reduce threat by interest, tolerant attitude, and approval for work well done. 2. Accept aloofness with matter-of-fact attitude 3. Recognize conceit, sarcasm, and conceited attitudes as a part of his illness 4. Try to learn and avoid patients points of sensitivity so that he won't be offended 5. Listen without showing acceptance or arguments if false suspicions exist 6. Tactful indirect methods of feeding patient if he feels he is being poisoned

7. Be alert for suicide tendencies or feelings of persecution
8. Provide contacts that offer no personal threat.

B. The Worrying Patient (psychoneurotic)

1. Accept complaints as part of illness, but plan work and play for patients comfort.
2. Matter-of-fact acceptance of patient.
3. Attend to physical problems tactfully and without undue concern
4. Observe for stealing, return stolen item with quiet unconcern.
5. Be alerted for unbearable anxiety, use tactful precautions for suicide.
6. Complaints may make him unacceptable to others in a group, support him tactfully.
7. Provide simple health program

Step III. <u>APPLICATION</u>:

Group discussion of items that may make an already suspicious patient even more suspicious. Discuss ways that the nurse can help to avoid bringing suspicion upon the nurses as they go about their daily activities. Using the guides that have been given, discuss ways of helping the worrying patient cope with his anxieties.

Step IV. <u>CHECK-UP OR TEST:</u>

Situation Questions; Please select the most nearly correct answer from the following: You have as one of your patients, a young mother of three children, she does not appear too upset, but you notice that she watches everyone about her, including you, very closely and presents other symptoms of being suspicious of her surroundings.

1. Your patient refuses to enter into ward activities because she feels that she cannot do as well as some of the other patients. You could best help by:

A. Insisting that she join the group.	1. C and D
B. Show disapproval because she does not cooperate.	2. B only
	3. A and D
	4. C only

C. Be tolerant and show friendly interest in simple activities that she can do

D. Accept the fact that she feels superior and tell her that she will have to join the group if she hopes to get well enough to go home.

2. One morning when you carry the breakfast tray to your patient she says, "Take it away, I am not going to eat anymore of that poison." You would:

A. Quietly remove the tray and offer food later in the morning.

B. Tell her that she must eat to keep her strength.

C. Discuss the disadvantages of tube feedings.

D. Tell her that the food is not poisoned and prove it by eating the food yourself.

1. D only
2. B and C
3. A only
4. B and D

3. A new patient is admitted to your unit and soon you discover that he seems to worry constantly about small items that normally do not bother most other patients. He has a lot of complaints and complains that the other patients avoid him because he is not good enough to associate with them. You should

A. Tell him to stay away from the group.

B. Accept his complaint, but assure him that he is probably better than they are.

C. Accept his complaint matter-of-factly and avoid comment on the patients worth.

D. Tell him to quit worrying and join the group anyhow.

1. C only
2. A and B
3. D only
4. B and D

Answer Key:

1. 4, 2. 3, 3. 1.

SUMMARY:

Today we have discussed the suspicious patient and the worrying type patient. Possibly the key note in caring for these types of patients is to remember that the patient responds to a situation in relation to whatever or whoever is in it with him, illusory or real. Permissiveness with broad, consistent limitations is essential for the patient to be better able to cope with and work out his problems.

The next lesson will be on: Security Measures in a Psychiatric Hospital.

INSTRUCTOR'S LESSON PLAN

Lesson 8

MENTAL NURSING

NAME OF LESSON: Security Measures in a Psychiatric Hospital

AIM OF LESSON: To teach the student measures that must be employed in mental nursing to offer the fullest protection to the patient, the hospital, and to the personnel.

REFERENCES:
Mental Health, the Nurse and the Patient - Odlum
Practical Nursing -Rapier, et al
Simplified Nursing - Thompson and LeBaron
The Psychiatric Aide - Robinson

Step I. INTRODUCTION:

By the nature of mental illness, in which emotions become greatly disturbed, the patient needs protection in different ways. The tendency to harm self or others may be strong. Ideas of unworthiness or hostility may be uncontrollable at times, poor judgment and impulsive behavior is common. Security measures are a MUST in psychiatric hospitals.

Step II. PRESENTATION OF LESSON

(List Points of Information)	Key Points (Things to Remember to Do or Say)
A. Security in relation to keys	1. Principles in proper handling of keys. 2. Locked areas for the protection of the patient in his environment.
B. Potentially dangerous articles	1. Sharps and silverware precautions and routines. 2. Necessary and unnecessary hazards in environment. 3. Nurse's duties and routines when hazardous articles are lost.
C. Precautions for the prevention of fire	1. Well informed and constantly alert personnel.

	2. Fire prevention routines, use and care of equipment. 3. Practice "fire drills."
D. Group Management	1. Preparation of group before leaving ward. 2. Management of group off ward.
E. Precautions regarding elopement.	1. Common methods used and reasons for patient elopement. 2. Nurse's responsibility in preventing routines when elopement occurs.
F. Preventing injury to self and others	1. Common reasons for attempting suicide. 2. Methods of suicide, means for precautions. 3. Types of patients likely to injure themselves or others.
G. Restraints	1. Principles of manual, mechanical and chemical restraints.

Step III. APPLICATION

Student group point out both necessary and unnecessary environmental hazards in the immediate environment. Review of fire precautions for the home, hospital, or school. Demonstration of as many types of restraints as possible.

Step IV. CHECK-UP OR TEST

Return demonstration for correct use of manual and mechanical restraints. Have each student give location and procedure for using the fire equipment in the area in which he is spending the greater part of the day.

SUMMARIZATION:

Symptoms of mental illness may cause a patient to disregard his own safety and the safety of others to the degree that security measures must be observed constantly by well informed, alert personnel.

During our next meeting we will discuss: Types of Mental Diseases

MENTAL NURSING

NAME OF LESSON: Types of Mental Diseases

AIM OF LESSON: To acquaint the student with the different classifications of mental diseases

REFERENCES:
Mental Health, the Nurse and the Patient - Odlum
Practical Nursing - Rapier, et al
Simplified Nursing - Thompson and LeBaron
The Psychiatric Aide - Robinson

Step I. INTRODUCTION:

There are many types of mental illnesses. Many types will lend themselves to a definite classification, other mental illnesses present symptoms of two or more of these different types.

Step II. PRESENTATION:

(List Points of Information)	Key Points (Things to remember to do and say)
A. Organic diseases	1. Acute Brain Disorders a. Associated with brain or bodily infection b. Drug or poison intoxication c. Alcohol intoxication d. Head injury (1) Brain surgery e. Circulatory disturbances (1) High blood pressure a. "Stroke" f. Brain tumors 2. Chronic Brain Disorders a. Birth injury, illness, or defect b. Chronic forms of the acute brain disorders that have passed the acute stage c. Disorders of unknown or uncertain causes 1. Multiple schlerosis 2. Huntington's chorea

B. Psychotic Disorders

1. Involutional psychotic reaction
   a. Depression occurring at middle age
      (1) "Change of life"
         a. Men
         b. Women

2. Manic depressive reactions
   a. Manic, overactivity
      (1) Motor
      (2) Verbal
   b. Depressed, underactivity
      (1) Motor
      (2) Verbal
   c. Other
      (1) Mixed overactivity and underactivity

3. Psychotic depressive reaction

4. Schizophrenic reactions
   a. Simple type
   b. Hebephrenic type
   c. Catatonic type
   d. Paranoid type

5. Schizophrenic reactions, acute and chronic

6. Paranoid reactions
   a. Paranoia
   b. Paranoid state

7. Psychophysiologic Autonomic and Visceral Disorders. (Psychosomatic Disorders)
   a. Skin reaction
   b. Musculoskeletal reaction
   c. Respiratory reaction
   d. Cardiovascular reaction
   e. Gastro-intestinal reaction
   f. Genito-urinary reaction
   g. Endocrine (glandular) reaction
   h. Nervous system reaction

C. Mental Deficiency

1. Defect in intelligence existing since birth, without demonstrated organic brain disease, or known cause before birth

2. Degrees of intelligence defect:
   a. Mild-vocational impairment
   b. Moderate. Requires special training and guidance
   c. Severe. Requires custodial or complete protective care

D. Psychoneurotic disorders

1. Anxiety reactions

2. Obsessive reaction

3. Dissociative reactions

4. Conversion reaction

5. Depressive reaction

6. Phobic reaction

E. Personality Disorders

1. Define the following disorders
   a. Inadequate personality
   b. Schizoid personality
   c. Cyclothymic personality
   d. Paranoid personality
   e. Emotionally unstable
   f. Passive-aggressive personality
   g. Compulsive personality
   h. Antisocial reaction
   i. Dissocial reaction
   j. Sexual deviation

F. Transient Situational Personality Disorders

1. Different types of transient disorders
   a. Gross stress reaction
      (1) Combat, fire, tornado, etc.
   b. Adult situational reaction
      (1) Difficult situations
      (2) New experiences
   c. Adjustment reaction of infancy and childhood
   d. Adjustment reaction of adolescence and late life

Step III. APPLICATION:

Classroom discussion of the types of mental diseases

Step IV. CHECK-UP OR TEST:

Matching: Classifications of Mental Illness are listed below. Select the major heading or classification and place the number in the space provided in front of the type of illness that fits the classification.

EXAMPLE: __1__ Brain tumor.
Number may be used more than once

__2__ Brain infection
__5__ Schizophrenic reaction
__7__ Respiratory reaction
__1__ Gross stress reaction
__8__ Antisocial reaction
__3__ Associated with syphilis
__6__ Phobic reaction
__5__ Paranoid reaction
__7__ Nervous system reaction
__8__ Sexual deviation
__1__ Adjustment reaction of late life
__8__ Compulsive personality
__2__ Associated with head injury
__8__ Inadequate personality
__1__ Adult situation reaction
__5__ Manic depressive reaction
__7__ Skin reaction
__2__ Associated with alcoholic intoxication
__7__ Gastro-intestinal reaction
__6__ Conversion reaction

1. Acute brain disorder
2. Mental deficiency

1. Transient Situational Personality Disorder
2. Acute Brain Disorders
3. Chronic Brain Disorders
4. Mental Deficiency
5. Psychotic Disorders
6. Psychoneurotic Disorder
7. Psychophysiologic Autonomic and Visceral Disorder
8. Personality Disorder

SUMMARY:

Mental illness is being recognized as an illness, not a disgrace. The patient will require special nursing techniques to meet his needs according to the reaction pattern that he presents. It is not the nurse's responsibility to classify the type of mental illness that the patient has, but it is helpful to know these classifications in order to be better equipped to predict a patients possible reactions in given situations.

Tomorrow's lesson will be: Types of Therapy

MENTAL NURSING

NAME OF LESSON: Types of Therapy

AIM OF LESSON: To teach the student the types of therapy used to treat the mentally ill patient, their basic principles and their value to the patient.

REFERENCES:
Mental Health the Nurse and the Patient - Odlum
Practical Nursing - Rapier, et al
Simplified Nursing - Thompson and LeBaron
The Psychiatric Aide - Robinson

Step I. INTRODUCTION:

Special therapies are used at different periods of a patient's illness. Today we will discuss the different types of therapy used and the principles involved as well as the benefits the patient receives from them.

Step II. PRESENTATION: (List Points of Information	Key Points (Things to remember to do or say)
A. Occupational Therapy	1. Mental or physical activity prescribed by the physician. 2. Occupational therapist specially trained. 3. Scope and principles of occupational therapy.
B. Recreational Therapy	1. Help patient relax. 2. Learn to adjust to groups again.
C. Hydro-therapy	1. Treatment of disease by water in any of its forms. 2. Sedative type most commonly used. a. Wet sheet pack. b. Continuous tub bath. c. Ice caps and packs.
D. Group Therapy	1. Patients with similar problems grouped.

2. Psychiatrist leads discussion.
3. Helpful to patient because others have same or similar problems.
4. Psychodrama used.

E. Shock Therapy

1. Insulin shock therapy.
   a. Therapeutic coma due to insulin.
2. Electroshock therapy.
   a. Most common of shock therapies.
   b. Convulsive reactions.

F. Fever Therapy

1. Therapeutic high fever.
   a. Sterile malaria germs.
   b. Kettering Hypertherm, fever apparatus.

G. Chemotherapy

1. Common standard drugs for hypnosis and tranquilizers

Step III. APPLICATION:

Classroom discussion of benefits of group discussion of mutual problems. Question and answer session regarding nursing care of patients in insulin shock and convulsions, also nursing care of a patient with a high fever.

Step IV. CHECK-UP OR TEST:

Oral quiz on effects of tranquilizing drugs, sedatives and hypnotic drugs. Oral quiz on bodily reactions to effects of heat and cold in relation to hydro-therapy.

SUMMARY:

Today we have discussed the special therapies used to treat the mentally ill and the expected results of these treatments. At some time during the patient's illness any one or all of these treatments may be employed. It is essential that you as the nurse who will be caring for the patients receiving these treatments understand the basic principles involved and the value of them to your patient.

Our final lesson in mental nursing will be on Rehabilitation.

INSTRUCTOR'S LESSON PLAN Lesson 11

MENTAL NURSING

NAME OF LESSON: Rehabilitation of the Mentally Ill Patient

AIM OF LESSON: To teach the student her role in the rehabilitation of the mentally ill and to familiarize her with some of the facilities available to help the mentally ill.

REFERENCES:
Mental Health the Nurse and the Patient - Odlum
Practical Nursing - Rapier, et al
Simplified Nursing - Thompson and LeBaron
The Psychiatric Aide - Robinson

MATERIALS: Copy of final test for each student.

Step I. INTRODUCTION:

Medically used the word rehabilitation means to offer to the person who is ill an opportunity to recover from his illness as well as to become again a member of the community at the best level of which he is capable. Today we shall discuss the basic steps of rehabilitation.

Step II. PRESENTATION:

(List Points of Information)	Key Points (Things to remember to do or say)
A. Rehabilitation Team	1. Many people involved, psychiatrist, social worker, psychologist, occupational and recreational therapists and nurses.
	2. Access to all facilities for all patients. a. Levels of convalescense or return to normal. Participation in simple activities on ward. Participation in activities in occupational therapy department. Participation in recreational activities with supervision.

Extended privileges,
ground, home.
Ground parole.
Outside parole.
Discharge from hospital.

3. Counseling for discharged patient

4. Family responsibilities to the patient

5. Community responsibilities

6. Role of the nurse in rehabilitation of the mentally ill

Step III. APPLICATION:

Comparison study of the physically ill patient and mentally ill patient and the factors involved in the rehabilitation of each type of patient, using the seven steps listed in key point 2. This can be handled in the form of a classroom question and answer period. A field trip through a psychiatric hospital.

Step IV. CHECK-UP OR TEST:

Matching Test: Taken from "Simplified Nursing" Thompson and LeBaron

E 1.	Minor disorder which does not completely incapacitate the patient	A. Mental illness
G 2.	Marked deviation from normal behavior with irregular conduct	B. Doctor
H 3.	Functional disorder	C. "Talking down"
I 4.	Toxic psychoses	D. Suicide attempt
J 5.	System of well organized delusions or false beliefs	E. Chemotherapy
K 6.	Illness borderline of psychiatry, often involved with the law	F. Psychoneuroses
A 7.	Medical term for mental illness	G. Psychosis
M 8.	Legal term for the psychotic	H. Schizophrenia
B 9.	The person who reviews the patient's outgoing mail	I. Drug addiction
		J. Paranoia
		K. Psychopathic personality
		L. Mental patient requiring "specials"
		M. Insane
		N. Manic retarded

__C__ 10. Aggravates feelings of inferiority
__D__ 11. Should be reported immediately
__E__ 12. Type of restraint used most often now
__L__ 13. Never leave this type patient alone for one second
__R__ 14. Chronic brain disorder
__Q__ 15. Acute brain disorder
__S__ 16. Psychotic disorder
__P__ 17. Psychosomatic disorder
__V__ 18. Fantasy
__U__ 19. Sexual deviation
__T__ 20. Transient situational personality disorder

O. Hypochondriac
P. Pruritus
Q. Brain Tumor
R. Huntington's chorea
S. Involuntional reaction
T. Adjustment reaction of infancy
U. Sadism
V. Daydreaming
W. Electric shock therapy
X. Lobotomy
Y. Insulin shock therapy

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ED013339

Script for the Slide Series

WHAT IS HORTICULTURE?

James Utzinger
Teacher of Vocational Agriculture
Pleasant View High School

Slide 1 - Horticulture is closely associated with the history and progress of mankind. The word horticulture is actually derived from two Latin words: hortus, meaning "garden," and colere, meaning "to cultivate." Literally then, horticulture means to cultivate or care for a garden. More broadly, horticulture can be thought of as a branch of agriculture dealing with intensively cultured plants which are used by man for food, medicines or beautification.

Slide 2 - The horticultural industry is usually divided into various specialized areas based onthe crop or plant use. One of themost beautiful and interesting areas of horticulture is that of the culture and use of flowers, known technically as floriculture. Flowers are used by people to express their emotions on various occasions such as birthdays and anniversaries, and they serve as a source of beauty both indoors and outdoors.

Slide 3 - Customers demand flowers the year around. Thus, greenhouse facilities such as seen here are found in many communities. These greenhouses represent thousands of dollars of investment. Thus, the owner, the operator or the manager of the greenhouse must be well educated. The manager is called upon to make many important decisions concerning the crops to be grown, harvested and marketed. Instruction in horticulture can help prepare one to become a greenhouse operator or plant grower.

Slide 4 - Flowers may be grown in the greenhouse for use as cut flowers. Pictured is a large planting of chrysanthemums growing in raised benches. This is a common sight in many floriculture greenhouses. It takes considerable horticultural and business knowledge to get results such as these.

Slide 5 - Students in high school horticulture classes learn by doing. Forcing bulbs during the winter months is one possible activity. Many flowers are grown in pots to be used as pot plants rather than as cut flowers. Pot plant production of such plants as geraniums, chrysanthemums, Easter lilies and poinsettias represent an important phase of the floriculture industry.

Slide 6 - Much of the floral production is marketed in attractive retail florist shops. The retail florist is a businessman as well as an artist. To be successful in this area one needs skills and abilities in floral design and business management.

VT002995

M E M O R A N D U M

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TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) Harlan E. Ridenour (Agency) Agricultural Education Curriculum Material Service

(Address) Room 201, 2120 Fyffe Road, Columbus, Ohio, 43210

DATE: 24 June 1967

RE: (Author, Title, Publisher, Date) James Utzinger, What is Horticulture, 40 color slides and script, Agricultural Education, Curriculum Material Service, 1966

Supplementary Information on Instructional Material

Provide information below which is not included in the publication. Mark N/A in each blank for which information is not available or not applicable. Mark P when information is included in the publication. See reverse side for further instructions.

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Address Room 201, 2120 Fyffe Road, Columbus, Ohio 43210
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(2) Means Used to Develop Material:
Development Group Teachers of Vocational Agriculture
Level of Group State
Method of Design, Testing, and Trial Conference with horticultural specialists, industry, and teachers. Tried with students.

(3) Utilization of Material:
Appropriate School Setting Comprehensive High School or Area Voc. School
Type of Program Introduction to Horticultural program
Occupational Focus Horticulture
Geographic Adaptability Midwest
Uses of Material Audio-Visual
Users of Material Teacher or students

(4) Requirements for Using Material:
Teacher Competency Teacher of Vocational Horticulture
Student Selection Criteria Beginning Students in Horticulture
Time Allotment 2 hours

Supplemental Media --
Necessary N. A. (Check Which)
Desirable

Describe

Source (agency)
(address)

Slide 7 - No wedding would be complete without flowers. The artistic arrangements carried by the wedding party represent a considerable amount of time in the growing, handling and arranging of flowers. Floral designing represents a vocational opportunity for those with a flair for creative design. The work is regular and the working conditions are quite pleasant.

Slide 8 - These girls are gaining valuable experience in floral arranging at school. Experience may also be obtained in the shop of a local retail florist who has agreed to work with the school in providing actual occupational experience for the students interested in preparing for careers in floriculture. The school quite often provides release time for the students to obtain very valuable and desirable occupational experience.

Slide 9 - Vegetable production is another of the very important and interesting areas of horticulture. It is known technically as olericulture. Vegetables are extremely important to the human diet. Those engaged in the production of vegetables are rendering a service to mankind by helping feed the people of the world.

Slide 10 - Many vegetables such as cabbage are grown under field conditions during the growing season. The crop may be sold as a fresh vegetable or processed in a plant and marketed as canned goods.

Slide 11 - Other vegetables, tomatoes for example, are produced under greenhouse conditions during the months when it is impossible to grow vegetables out of doors. Like the operator of the floral greenhouse, the vegetable greenhouse operator has a tremendous investment in facilities, equipment, fuel and labor. It takes considerable horticultural and business knowledge to be successful.

Slide 12 - The roadside market is still popular in many communities. Here the customer can find fresh vegetables of high quality produced by the skilled vegetable grower.

Slide 13 - Corn on the cob makes a wonderful summer eating treat. We can thank the horticulturist specializing in vegetable production for high quality food such as represented by this corn.

Slide 14 - The student may have a crop growing project at school where condsiderable learning may take place.

Slide 15 - By working with the teacher in conducting a supervised summer project garden at home, the student can gain valuable experience which is not possible to obtain in the classroom.

Slide 16 - Interest in horticulture developed in the classroom at school may lead to worthwhile hobbies which enable the student to use leisure time to his advantage.

Slide 17 - Certainly an appealing and appetizing area of horticulture for the consumer is that of fruit. Wouldn't we all like to have a fruit tree such as we see here in our backyard?

Slide 18 - Fruit production includes both small fruit and tree fruit production. The field of strawberries illustrates an important characteristic of horticulture - it is possible to obtain a high value crop from a small area of land.

Slide 19 - Another valuable small fruit crop produced by the horticulturist is the grape, harvested from vineyeards such as this one. Other small fruits include the blackberry, raspberry and cranberry.

Slide 20 - Tree fruits such as apples are grown in larger commercial orchards. Other deciduous tree fruits include the pear, peach, plum and cherry. Due to the mobility of the labor force today, it is quite possible that one receiving instruction in tree fruit production could obtain employment in an area far removed from the original training site.

Slide 21 - Students are actively involved in learning the subject matter of horticulture. Courses are laboratory oriented so as to enable the students to work with the tools and equipment of the industry. Often times local equipment dealers cooperate with the schools in making equipment available.

Slide 22 - The school orchard serves as a learning laboratory where valuable experience in fruit production is obtained.

Slide 23 - Quality as exhibited here requires good management practices. Basic horticulture instruction received at the school and university can prepare workers to assume important jobs in the fruit industry. By scheduling the proper elective courses, the high school horticulture student can prepare for college and learn a vocation at the same time.

Slide 24 - Turf or lawn care and maintenance is an important aspect of landscape horticulture.

Slide 25 - The golf course represents a business offering occupational opportunity at all levels of training. The student may want to take a degree program in college and become the greens superintendent, or irrigation specialist, while other students may take the high school course and become a service worker on the course by caring for the greens and fairways.

Slide 26 - Many lawns are established by using sod rather than seed.

Slide 27 - The turf on athletic fields requires constant care. This means that many jobs are available in the area of lawn and turf care.

Slide 28 - In conjunction with their school work in horticulture, students work with experienced supervisors in the industry. Here a student is receiving instruction from a golf course greens superintendent on how to patch turf which has been damaged by disease.

Slide 29 - The lawn is a source of considerable satisfaction to the home owner. The course in high school horticulture should help the student to have a lawn like this at his own home some day.

Slide 30 - Landscaping, along with floriculture, is the area of horticulture concerned with the beautification of our homes and communities. The use of plants for beauty is a characteristic unique to horticulture and helps to distinguish it from other agricultural activities. The appeal of this area of horticulture is universal.

Slide 31 - Many of the woody ornamental plants used in the landscape have their beginnings as cuttings which are rooted in propagating benches. The techniques and skills required to propagate plants is an area of instruction in the high school horticulture program.

Slide 32 - A field is being prepared to receive rooted nursery stock which has been growing in a semi-sheltered environment for a period of time. The worker in landscape horticulture is often called upon to operate power equipment such as the tractor. At the school, instruction is provided in safe operation, care and maintenance of power equipment common to the landscape horticulture industry.

Slide 33 - The woody ornamental has been in the nursery field for sufficient time and is in the process of being balled and burlapped.

Slide 34 - Meeting and selling products to customers is an important part of garden center work. Many high school horticulture students obtain jobs at garden centers and find the horticultural instruction obtained at the school to be a valuable asset in their work of selling and getting along with others.

Slide 35 - The well landscaped home is a result of a well-designed and executed planting plan.

Slide 36 - Landscaping offers many possibilities for vocational choice. Students may choose to become landscape architects, landscape consultants, landscape gardeners, maintenance foreman or groundskeepers.

Slide 37 - Horticulture classes may install an indoor landscape in the school hall. This adds a touch of beauty to the school during the winter months. Such displays are much enjoyed by the student body and staff.

Slide 38 - Plants are living things and as such require constant care. In the school landscape students are afforded an opportunity to learn to prune, water, fertilize and otherwise care for plants. This is valuable knowledge for the students to have, and it will have possible application for years after graduation.

Slide 39 - What is horticulture? It is a specialized area of agriculture including such subject matter areas as flowers, fruits, vegetables, lawns or turf and landscaping.

Slide 40 - What is horticulture? It is food for a hungry world. It is beauty to the eye. It is a vocation for many people throughout the world. Can horticulture be for you or for your school?

ED013339

1963

BUSINESS TRAINING COURSE JOB No. 1

Louisiana Vocational Curriculum Development and Research Center, Natchitoches.

Reference: TEN-KEY ADDING-LISTING MACHINE AND PRINTING CALCULATOR COURSE, Third Edition, Agnew and Pasewark, South-Western Publishing Company, Cincinnati 27, Ohio.

JOB TITLE: Touch Addition

INTRODUCTION:

The Ten-Key Adding-Listing Machine is a very common office machine because of its efficiency and low cost. Its efficiency, however, is dependent on the operator. The operator should have absolute touch control and a high degree of accuracy coupled with speed.

This first job introduces the keyboard and simple addition. Here your foundation begins; build it well.

PROCEDURES:

1. Read the instructions on pages 1 to 4.

2. Study illustrations for your machine on pages v to ix.

3. You will note that step 8 on page 4 instructs you to write the answers in the book and to tear out the sheets to turn in. You will not do this. On the reverse side of each job sheet there have been provided numbered blanks for you to enter the answers to each problem. There are also special blanks for speed drills and timed drills. At the completion of the job, hand in the job sheet with your answers and timings. This procedure applies to all jobs in this course.

4. Complete problems 1 to 20, pages 2 to 4, entering your answers on the reverse side of this job sheet. Use the following procedure:

   a. Work problem and note the answer.
   b. Re-work problem.
   c. If the answer is the same as in step "a" go to the next problem. If not, rework problem and record answer which proves to be correct.

5. Fill in your name, the date, and the time required to do this job.

VT003003

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10-Key Adding Machine Job 1

NAME_____ DATE_____ TIME REQUIRED_____

1.	_____	_____	11.	_____	_____
2.	_____	_____	12.	_____	_____
3.	_____	_____	13.	_____	_____
4.	_____	_____	14.	_____	_____
5.	_____	_____	15.	_____	_____
6.	_____	_____	16.	_____	_____
7.	_____	_____	17.	_____	_____
8.	_____	_____	18.	_____	_____
9.	_____	_____	19.	_____	_____
10.	_____	_____	20.	_____	_____

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TO: The ERIC Clearinghouse on Vocational and Technical Education
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FROM: (Person) LLOYD PONDER (Agency) VOCATIONAL CURRICULUM DEVELOPMENT & Research Center

(Address) PO. BOX 657 NATCHITOCHES, LA. 71457

DATE: JULY 29, 1967

RE: (Author, Title, Publisher, Date) Research Center, "Ten Key-Adding Listing Machine." Research Center, 1963

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(2) *Means Used to Develop Material:*
Development Group Committee of Teachers
Level of Group STATE
Method of Design, Testing, and Trial From experience of Committee; Field Testing done incident within framework of Committee member's Teaching Duties.

(3) Utilization of Material:
Appropriate School Setting TRADE SCHOOLS
Type of Program Post Secondary - Preparatory
Occupational Focus OFFICE OCCUPATIONS
Geographic Adaptability NO RESTRICTIONS
Uses of Material CLASS ROOM INSTRUCTION
Users of Material STUDENTS

(4) Requirements for Using Material:
Teacher Competency Qualified Teacher - Office Occupations
Student Selection Criteria Post Secondary, Either Sex, No Pre-Requisites, STUDENTS SEEKING EMPLOYMENT.
Time Allotment N/A

Supplemental Media --
Necessary ____ } (Check Which)
Desirable ____ }

Describe ____

Source (agency)
(address)

BUSINESS TRAINING COURSE

JOB No. 2

Reference: TEN-KEY ADDING-LISTING MACHINE AND PRINTING CALCULATOR COURSE, Third Edition, Agnew and Pasewark, South-Western Publishing Company, Cincinnati 27, Ohio

JOB TITLE: Touch Addition

INTRODUCTION: This job is a continuation of Job 1. You will learn the "zero" to "3" keys and the non-add key.

PROCEDURES:

1. Read and complete the steps outlined on pages 5 and 7.
2. Complete problems 1 to 20, pages 5 to 7, using the following procedure:
   a. Work problem and note answer on the reverse side of this job sheet.
   b. Re-work problem.
   c. If the answer is the same as in step "a" go to the next problem. If not, rework problem and record the answer which proves to be correct.
3. Complete timed drill on page 8, using instructions 1 to 3 on page 8.
4. Fill in your name, the date, and time required to do this assignment.

QUESTIONS:

1. What symbol must appear at the beginning of each problem?
2. Do you use your finger or an instrument to guide your eyes down the column?
3. What is stressed first, speed or accuracy?

10-Key Adding Machine Job 2

NAME_____ DATE_____ TIME REQUIRED_____

1.	_____	_____	11.	_____	_____
2.	_____	_____	12.	_____	_____
3.	_____	_____	13.	_____	_____
4.	_____	_____	14.	_____	_____
5.	_____	_____	15.	_____	_____
6.	_____	_____	16.	_____	_____
7.	_____	_____	17.	_____	_____
8.	_____	_____	18.	_____	_____
9.	_____	_____	19.	_____	_____
10.	_____	_____	20.	_____	_____

TIMED DRILL

1.	_____	_____
2.	_____	_____
3.	_____	_____
4.	_____	_____
5.	_____	_____
6.	_____	_____
7.	_____	_____
8.	_____	_____

Number of problems worked in 5 minutes_____

BUSINESS TRAINING COURSE

JOB No. 3

Reference: TEN-KEY ADDING-LISTING MACHINE AND PRINTING CALCULATOR COURSE, Third Edition, Agnew and Pasewark, South-Western Publishing Company, Cincinnati 27, Ohio.

JOB TITLE: Addition of Numbers Containing Repeated Digits and Varied Number of Digits.

INTRODUCTION:

This job is a continuation of touch addition. The numbers will now contain from one to several digits.

PROCEDURES:

1. Work Warm-up Drill "A" on page 9. Time yourself for five minutes and work the problems as many times as possible in the time allotted Compute the number of strokes and keep a record similiar to the one on page 115 of the textbook.

2. Complete problems 1 to 18, pages 9 to 11.

3. Complete Timed Drill on page 12 following instructions on page 8.

QUESTIONS:

1. Are you using the touch system?

2. Are you introducing rhythm in your stroking?

3. Are you asking the instructor for help when you need it?

10-Key Adding Machine Job 3

NAME_____ DATE_____ TIME REQUIRED_____

PROBLEMS

1.	_____	_____	10.	_____	_____
2.	_____	_____	11.	_____	_____
3.	_____	_____	12.	_____	_____
4.	_____	_____	13.	_____	_____
5.	_____	_____	14.	_____	_____
6.	_____	_____	15.	_____	_____
7.	_____	_____	16.	_____	_____
8.	_____	_____	17.	_____	_____
9.	_____	_____	18.	_____	_____

WARM UP DRILL

1.	_____	_____	_____
2.	_____	_____	_____
3.	_____	_____	_____
4.	_____	_____	_____
5.	_____	_____	_____
6.	_____	_____	_____

TIMED DRILL

1.	_____	_____
2.	_____	_____
3.	_____	_____
4.	_____	_____
5.	_____	_____
6.	_____	_____
7.	_____	_____
8.	_____	_____

BUSINESS TRAINING COURSE

JOB No. 4

Reference: TEN-KEY ADDING-LISTING MACHINE AND PRINTING CALCULATOR COURSE, Third Edition, Agnew and Pasewark, South-Western Publishing Company, Cincinnati 27, Ohio.

JOB TITLE: Substraction and Correction of Errors.

INTRODUCTION:

This assignment introduces the use of the MINUS key. Figures entered with this key will substract from the total.

PROCEDURES:

1. Complete warm-up drill "A", page 10, following instructions on page 9.
2. Complete problems 1 to 39, pages 13 to 15.
3. Complete TIMED DRILL on page 16 in the usual manner.

QUESTIONS:

1. Are you using this machine in your accounting?
2. Is your accuracy improving?

10-Key Adding Machine Job 4

NAME_____ DATE_____ TIME REQUIRED_____

1. _____	2. _____	3. _____	4. _____
5. _____	6. _____	7. _____	8. _____
9. _____	10. _____	11. _____	12. _____
13. _____	14. _____	15. _____	16. _____
17. _____	18. _____	19. _____	20. _____
21. _____	22. _____	23. _____	24. _____
25. _____	26. _____	27. _____	28. _____
29. _____	30. _____	31. _____	32. _____
33. _____	34. _____	35. _____	36. _____
37. _____	38. _____	39. _____	

WARM UP DRILL

1.	_____	_____	_____
2.	_____	_____	_____
3.	_____	_____	_____
4.	_____	_____	_____
5.	_____	_____	_____
6.	_____	_____	_____

TIMED DRILL

1.	_____	_____
2.	_____	_____
3.	_____	_____
4.	_____	_____
5.	_____	_____
6.	_____	_____
7.	_____	_____
8.	_____	_____
9.	_____	_____
10.	_____	_____
11.	_____	_____
12.	_____	_____

BUSINESS TRAINING COURSE

JOB No. 5

Reference: TEN-KEY ADDING-LISTING MACHINE AND PRINTING CALCULATOR COURSE, Third Edition, Agnew and Pasewark, South-Western Publishing Company, Cincinnati 27, Ohio.

JOB TITLE: Speed Drill--Addition

INTRODUCTION:

This job is designed to aid you in increasing your speed and accuracy.

PROCEDURES:

1. Complete each problem once, writing your answer in the first blank. Check the time before you start and again when you complete the 28 problems. Indicate the time required in the space provided.

2. Work the problems again, checking the first answer. If the answer disagrees, write the second answer in the second blank. Record your time.

3. Repeat the drill if the second timing is more than 20 minutes.

4. Do the Three-Minute Checkup. Start with problem No. 1 and complete as many as possible in three minutes. Record the number of problems worked.

10-Key Adding Machine Job 5

NAME_____ DATE_____ TIME REQUIRED_____

1. _____ _____
2. _____ _____
3. _____ _____
4. _____ _____
5. _____ _____
6. _____ _____
7. _____ _____
8. _____ _____
9. _____ _____
10. _____ _____
11. _____ _____
12. _____ _____
13. _____ _____
14. _____ _____
15. _____ _____
16. _____ _____
17. _____ _____
18. _____ _____
19. _____ _____
20. _____ _____
21. _____ _____
22. _____ _____
23. _____ _____
24. _____ _____
25. _____ _____
26. _____ _____
27. _____ _____
28. _____ _____

1st timing____minutes____seconds

2nd timing____minutes____seconds

3rd timing____minutes____seconds

Number of problems in three minutes_____

Gross strokes a minute: _____

Net strokes a minute: _____

BUSINESS TRAINING COURSE

JOB No. 6

Reference: TEN-KEY ADDING-LISTING MACHINE AND PRINTING CALCULATOR COURSE, Third Edition, Agnew and Pasewark, South-Western Publishing Company, Cincinnati 27, Ohio.

JOB TITLE: Sub-Total Key

INTRODUCTION:

This job introduces the use of the Sub-Total Key.

PROCEDURES:

1. Complete Warm-up Drill "A", page 10.
2. Read instructions in paragraphs 1 - 5, pages 21 to 23.
3. Complete problems 1 to 13, pages 21 to 23.
4. Complete the timed drill, page 24, in the usual manner.

ANSWERS FOR WARM-UP DRILL "A"

1. _____ _____ _____
2. _____ _____ _____
3. _____ _____ _____
4. _____ _____ _____
5. _____ _____ _____
6. _____ _____ _____

10-Key Adding Machine Job 6

NAME_____ DATE_____ TIME REQUIRED_____

S). _____
1). _____
S). _____
2). _____
S). _____
3). _____
S). _____
4). _____
S). _____
S). _____
5). _____
S). _____
S). _____
6). _____
S). _____
S). _____
7). _____
S). _____
S). _____
8). _____
S). _____
S). _____
9). _____
S). _____
S). _____
10). _____

S). _____
S). _____
11). _____
S). _____
S). _____
12). _____
13). _____
_____
_____
_____
_____
_____
_____
_____
_____
_____

TIMED DRILL

1. S) _____ T) _____
2. S) _____ T) _____
3. S) _____ T) _____
4. S) _____ T) _____
5. S) _____ T) _____
6. S) _____ T) _____
7. S) _____ T) _____
8. S) _____ T) _____

BUSINESS TRAINING COURSE JOB No. 7

Reference: TEN-KEY ADDING-LISTING MACHINE AND PRINTING CALCULATOR COURSE, Third Edition, Agnew and Pasewark, South-Western Publishing Company, Cincinnati 27, Ohio.

JOB TITLE: Repeat Addition

INTRODUCTION:

When several successive numbers in a column are the same, time can be saved by the use of the Repeat Key.

PROCEDURES:

1. Complete Warm-up Drill "B" on page 27, in usual manner.
2. Read the instructions on pages 25 and 26.
3. Ask the instructor for a demonstration.
4. Work problems 1 to 20.
5. Complete the Timed Drill on page 28.

10-Key Adding Machine Job 7

NAME _____ DATE _____ TIME REQUIRED _____

1.	_____	_____	11.	_____	_____
2.	_____	_____	12.	_____	_____
3.	_____	_____	13.	_____	_____
4.	_____	_____	14.	_____	_____
5.	_____	_____	15.	_____	_____
6.	_____	_____	16.	_____	_____
7.	_____	_____	17.	_____	_____
8.	_____	_____	18.	_____	_____
9.	_____	_____	19.	_____	_____
10.	_____	_____	20.	_____	_____

WARM UP DRILL "B"

1.	_____	2.	_____	3.	_____
4.	_____	5.	_____	6.	_____
7.	_____	8.	_____	9.	_____
10.	_____	11.	_____	12.	_____
13.	_____	14.	_____	15.	_____

TIMED DRILL

1.	_____	_____
2.	_____	_____
3.	_____	_____
4.	_____	_____
5.	_____	_____
6.	_____	_____
7.	_____	_____
8.	_____	_____

BUSINESS TRAINING COURSE JOB No. 8

Reference: TEN-KEY ADDING-LISTING MACHINE AND PRINTING CALCULATOR COURSE, Third Edition, Agnew and Pasewark, South-Western Publishing Company, Cincinnati 27, Ohio.

JOB TITLE: Multiplication

INTRODUCTION:

This machine was not primarily designed for multiplication, and it is therefore not so efficient as calculators in this application. However, since multiplication is a short cut method of addition, it can be performed on this type of machine.

PROCEDURES:

1. Complete Warm-up Drill "B", page 27.
2. Read instructions pertaining to your machine on pages 29 to 32.
3. Work problems 1 to 30, pages 29 to 32.
4. Complete Timed Drill on page 32.

ANSWERS

WARM-UP DRILL "B"

1. _____	2. _____	3. _____
4. _____	5. _____	6. _____
7. _____	8. _____	9. _____
10. _____	11. _____	12. _____
13. _____	14. _____	15. _____

10-Key Adding Machine Job 8

NAME_____ DATE_____ TIME REQUIRED_____

1.	_____	_____
2.	_____	_____
3.	_____	_____
4.	_____	_____
5.	_____	_____
6.	_____	_____
7.	_____	_____
8.	_____	_____
9.	_____	_____
10.	_____	_____
11.	_____	_____
12.	_____	_____
13.	_____	_____
14.	_____	_____
15.	_____	_____
16.	_____	_____
17.	_____	_____
18.	_____	_____
19.	_____	_____
20.	_____	_____
21.	_____	_____
22.	_____	_____
23.	_____	_____
24.	_____	_____
25.	_____	_____
26.	_____	_____
27.	_____	_____
28.	_____	_____
29.	_____	_____
30.	_____	_____

TIMED DRILL

1.	_____	_____
2.	_____	_____
3.	_____	_____
4.	_____	_____
5.	_____	_____
6.	_____	_____
7.	_____	_____
8.	_____	_____
9.	_____	_____
10.	_____	_____

BUSINESS TRAINING COURSE

JOB No. 9

Reference: TEN-KEY ADDING-LISTING MACHINE AND PRINTING CALCULATOR COURSE, Third Edition, Agnew and Pasewark, South-Western Publishing Company, Cincinnati 27, Ohio.

JOB TITLE: Speed Drill--Addition

INTRODUCTION:

This job is designed to aid you in increasing your speed and accuracy.

PROCEDURES:

1. Complete each problem once, writing your answer in the first blank. Check the time before you start and again when you complete the 16 problems. Indicate the time required in the space provided.

2. Work the problems again, checking the first answer. If the answer disagrees, write the second answer in the second blank. Record your time.

3. Repeat the drill if the second timing is more than 20 minutes.

4. Do the Three-Minute Checkup. Start with problem No. 1, and complete as many as possible in three minutes. Record the number of problems worked.

10-Key Adding Machine Job 9

NAME_____ DATE_____ TIME REQUIRED_____

1. _____ _____
2. _____ _____
3. _____ _____
4. _____ _____
5. _____ _____
6. _____ _____
7. _____ _____
8. _____ _____
9. _____ _____
10. _____ _____
11. _____ _____
12. _____ _____
13. _____ _____
14. _____ _____
15. _____ _____
16. _____ _____

1st Timing_____Minutes_____Seconds

2nd Timing_____Minutes_____Seconds

3rd Timing_____Minutes_____Seconds

Number of Problems worked in three minutes_____.

Gross Strokes per Minute_____.

Net Strokes per Minute_____.

BUSINESS TRAINING COURSE JOB No. 10

Reference: TEN-KEY ADDING-LISTING MACHINE AND PRINTING CALCULATOR COURSE, Third Edition, Agnew and Pasewark, South-Western Publishing Company, Cincinnati 27, Ohio.

JOB TITLE: Test No. 1

INTRODUCTION:

This test requires the application of the operating principles learned in the first nine jobs.

PROCEDURES:

1. Obtain the test from the instructor. The instructor will be with you during the test.

2. Complete the problems, placing your answers in the blanks provided on the reverse side of this job sheet. DO NOT WRITE ON THE TEST PAPER.

10-Key Adding Machine Job 10

TEST NO. 1

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____
S). _____
S). _____
S). _____
16. _____
S). _____
S). _____
S). _____
17. _____
S). _____
S). _____
S). _____
18. _____
S). _____
S). _____
S). _____
19. _____
S). _____
S). _____
20. _____
21. _____
22. _____
23. _____
24. _____
25. _____
26. _____
27. _____
28. _____
29. _____
30. _____
31. _____
32. _____
33. _____
34. _____
35. _____
36. _____
37. _____
38. _____
39. _____
40. _____

BUSINESS TRAINING COURSE

JOB No. 11

Reference: TEN-KEY ADDING-LISTING MACHINE AND PRINTING CALCULATOR COURSE, Third Edition, Agnew and Pasewark, South-Western Publishing Company, Cincinnati 27, Ohio.

JOB TITLE: Short-Cut Multiplication--Zeros in the Multiplier

INTRODUCTION:

Multiplication by the Short-Cut method combines repeated addition and repeated subtraction. It is used to reduce the number of machine operations in completing multiplication problems when the digits 7, 8, or 9 appear in the multiplier.

PROCEDURES:

1. Complete Warm-up Drill "A", page 10, in the usual manner.
2. Read instructions on pages 37 and 38 on Short-Cut Multiplication.
3. Work problems 1 to 15, pages 37 and 38.
4. Read instructions, page 39, for zeros in multiplier. Ask instructor for demonstration.
5. Work problems 26 to 35 on page 39.
6. Work Timed Drill, problems 1 to 20. Time yourself and be sure to use short-cut methods whenever applicable.
7. Turn in your work.

ANSWERS

WARM-UP DRILL "A", PAGE 10

1. _____ _____
2. _____ _____
3. _____ _____
4. _____ _____
5. _____ _____
6. _____ _____

10-Key Adding Machine Job 11

NAME_____ DATE_____ TIME REQUIRED_____

1.	_____	21.	_____		TIMED DRILL
2.	_____	22.	_____	1.	_____
3.	_____	23.	_____	2.	_____
4.	_____	24.	_____	3.	_____
5.	_____	25.	_____	4.	_____
6.	_____	26.	_____	5.	_____
7.	_____	27.	_____	6.	_____
8.	_____	28.	_____	7.	_____
9.	_____	29.	_____	8.	_____
10.	_____	30.	_____	9.	_____
11.	_____	31.	_____	10.	_____
12.	_____	32.	_____	11.	_____
13.	_____	33.	_____	12.	_____
14.	_____	34.	_____	13.	_____
15.	_____	35.	_____	14.	_____
16.	_____			15.	_____
17.	_____			16.	_____
18.	_____			17.	_____
19.	_____			18.	_____
20.	_____			19.	_____
				20.	_____

BUSINESS TRAINING COURSE

JOB No. 12

Reference: TEN-KEY ADDING-LISTING MACHINE AND PRINTING CALCULATOR COURSE, Third Edition, Agnew and Pasewark, South-Western Publishing Company, Cincinnati 27, Ohio.

JOB TITLE: Decimals, Fractions, and Percentages

INTRODUCTION:

In this job you will learn how to convert common fractions and percentages to decimal fractions. Multiplication of decimal fractions is the same as multiplication of whole numbers, therefore, all you really have to learn is how to point off in the product.

PROCEDURES:

1. Complete Warm-up Drill "B", page 27 in the usual manner.
2. Read and understand text material on pages 41, 42, and 43.
3. Work problems 1 to 42, pages 41 to 43. Be sure to use short-cut methods whenever applicable.
4. Complete Time Drill on page 44.

ANSWERS

WARM-UP DRILL "B", PAGE 27

1.	_____	9.	_____
2.	_____	10.	_____
3.	_____	11.	_____
4.	_____	12.	_____
5.	_____	13.	_____
6.	_____	14.	_____
7.	_____	15.	_____
8.	_____		

10-Key Adding Machine Job 12

NAME_____ DATE_____ TIME REQUIRED_____

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____
16. _____
17. _____
18. _____
19. _____
20. _____
21. _____
22. _____
23. _____
24. _____
25. _____
26. _____
27. _____
28. _____
29. _____
30. _____
31. _____
32. _____
33. _____
34. _____
35. _____
36. _____
37. _____
38. _____
39. _____
40. _____
41. _____
42. _____

TIMED DRILL

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____
16. _____
17. _____
18. _____
19. _____
20. _____
21. _____
22. _____
23. _____
24. _____
25. _____

BUSINESS TRAINING COURSE JOB No. 13

Reference: TEN-KEY ADDING-LISTING MACHINE AND PRINTING CALCULATOR COURSE, Third Edition, Agnew and Pasewark, South-Western Publishing Company, Cincinnati 27, Ohio.

JOB TITLE: Fixed Decimal Point

INTRODUCTION:

The Fixed Decimal Point is a useful device for solving any arithmetic problem on any type of machine. Its use does not eliminate the need for a knowledge of the rules of pointing off, but is an aid in working problems accurately and rapidly.

PROCEDURES:

1. Work Warm-up Drill "C", page 47.
2. Read and Study text material on page 45 and 46. Careful study of the example problems will help the principles involved.
3. Work problems 1 to 30, pages 45 to 47.
4. Complete Timed Drill, page 48.

QUESTION:

1. Are you using short-cut multiplication when the digits 7, 8, or 9 appear in the multiplier?

WARM-UP DRILL "C", PAGE 47

1. _____ _____ _____
2. _____ _____ _____
3. _____ _____ _____
4. _____ _____ _____
5. _____ _____ _____
6. _____ _____ _____

10-Key Adding Machine Job 13

NAME_____ DATE_____ TIME REQURED_____

1.	_____	16.	_____		TIMED DRILL
2.	_____	17.	_____	1.	_____
3.	_____	18.	_____	2.	_____
4.	_____	19.	_____	3.	_____
5.	_____	20.	_____	4.	_____
6.	_____	21.	_____	5.	_____
7.	_____	22.	_____	6.	_____
8.	_____	23.	_____	7.	_____
9.	_____	24.	_____	8.	_____
10.	_____	25.	_____	9.	_____
11.	_____	26.	_____	10.	_____
12.	_____	27.	_____	11.	_____
13.	_____	28.	_____	12.	_____
14.	_____	29.	_____		
15.	_____	30.	_____		

BUSINESS TRAINING COURSE

JOB No. 14

Reference: TEN-KEY ADDING-LISTING MACHINE AND PRINTING CALCULATOR COURSE, Third Edition, Agnew and Pasewark, South-Western Publishing Company, Cincinnati 27, Ohio.

JOB TITLE: Discount and Net Amount

INTRODUCTION:

The use of discounts to adjust list prices and to give an incentive for the prompt payment of invoices has a wide application in modern business. Working the problems in this assignment on the machine does not involve learning any new machine techniques. You should already know how to multiply decimals, fractions, and percentages.

PROCEDURES:

1. Complete Warm-up Drill "C" on page 47.
2. Study text material on pages 49 to 51. Learn the definitions of the following terms: trade discounts, cash discounts, gross amount, discount rate, discount, net amount, and net amount percentage.
3. Work problems 1 to 24, pages 49 to 51.
4. Complete Timed Drill on page 52.

QUESTION:

1. Are you using short-cut multiplication in solving discount problems, whenever applicable.

ANSWERS

WARM-UP DRILL "C", PAGE 47

1. _____ _____
2. _____ _____
3. _____ _____
4. _____ _____
5. _____ _____
6. _____ _____

10-Key Adding Machine Job 14

NAME_____ DATE_____ TIME REQUIRED_____

1.	_____	13a.	_____		TIMED DRILL
2.	_____	b.	_____	1.	_____
3.	_____	14a.	_____	2.	_____
4.	_____	b.	_____	3.	_____
5.	_____	15a.	_____	4.	_____
6.	_____	b.	_____	5.	_____
7.	_____	16.	_____	6.	_____
8.	_____	17.	_____	7.	_____
9.	_____	18.	_____	8.	_____
10.	_____	19.	_____	9.	_____
11a.	_____	20.	_____	10.	_____
b.	_____	21.	_____	11a.	_____
12a.	_____	22.	_____	b.	_____
b.	_____	23.	_____	12a.	_____
		24.	_____	b.	_____
				13a.	_____
				b.	_____
				14a.	_____
				b.	_____
				15a.	_____
				b.	_____

BUSINESS TRAINING COURSE

JOB No. 15

Reference: TEN-KEY ADDING-LISTING MACHINE AND PRINTING CALCULATOR COURSE, Third Edition, Agnew and Pasewark, South-Western Publishing Company, Cincinnati 27, Ohio.

JOB TITLE: Speed Drill--Addition

INTRODUCTION:

This job is designed to aid you in increasing your speed and accuracy.

PROCEDURES:

1. Complete each problem once, writing your answer in the first blank. Check the time before you start and again when you complete the 16 problems. Indicate the time required in the space provided.

2. Work the problems again, checking the first answer. If the answer disagrees, write the second answer in the second blank. Record your time.

3. Repeat the drill if the second timing is more than 20 minutes.

4. Do the Three-minute Checkup. Start with problem No. 1, and complete as many as possible in three minutes. Record the number of problems worked.

10-Key Adding Machine Job 15

NAME_____ DATE_____ TIME REQUIRED_____

1. _____ _____
2. _____ _____
3. _____ _____
4. _____ _____
5. _____ _____
6. _____ _____
7. _____ _____
8. _____ _____
9. _____ _____
10. _____ _____
11. _____ _____
12. _____ _____
13. _____ _____
14. _____ _____
15. _____ _____
16. _____ _____

1st Timing_____Minutes_____Seconds

2nd Timing_____Minutes_____Seconds

3rd Timing_____Minutes_____Seconds

Number of problems worked in three minutes_____.

Gross Strokes per minute_____.

Net Strokes per minute_____.

BUSINESS TRAINING COURSE JOB No. 16

Reference: TEN-KEY ADDING-LISTING MACHINE AND PRINTING CALCULATOR COURSE, Third Edition, Agnew and Pasewark, South-Western Publishing Company, Cincinnati 27, Ohio.

JOB TITLE: Chain Discounts

INTRODUCTION:

A series of two or more trade discounts from the gross amount is called a CHAIN DISCOUNT. You will learn how to arrive at the net amount by the use of a table, and also with the use of the table.

PROCEDURES:

1. Complete Warm-up Drill "D", page 59.
2. Read and work examples as you read textbook material on pages 57 and 58.
3. Work problems 1 to 35 and record answers on the reverse side of this sheet.
4. Read material on page 60 and complete Timed Drill, problems 1 to 11, in the usual manner.

ANSWERS

WARM-UP DRILL "D", PAGE 59

1. _____ _____
2. _____ _____
3. _____ _____
4. _____ _____
5. _____ _____
6. _____ _____
7. _____ _____
8. _____ _____
9. _____ _____

10-Key Adding Machine Job 16

NAME_____ DATE_____ TIME REQUIRED_____

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____
16. _____
17. _____
18. _____
19. _____
20. _____
21. _____
22. _____
23. _____
24. _____
25. _____
26. _____
27. _____
28. _____
29. _____
30. _____
31. _____
32. _____
33. _____
34. _____
35. _____

TIMED DRILL

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____

BUSINESS TRAINING COURSE JOB No. 17

Reference: TEN-KEY ADDING-LISTING MACHINE AND PRINTING CALCULATOR COURSE, Third Edition, Agnew and Pasewark, South-Western Publishing Company, Cincinnati 27, Ohio.

JOB TITLE: Constant Multiplication

INTRODUCTION:

On standard 10-key adding machines these problems are completed in the customary manner. You will benefit from the new techniques in this assignment only if you are using a Printing Calculator.

PROCEDURES:

1. Complete Warm-up Drill "D", page 59.

2. Read textbook material on pages 61 to 64, studying the instructions pertaining to the machine you are using. (If you are using a standard 10-key adding machine, omit this step as the problems are worked by ordinary multiplication.)

3. Work problems 1 to 35 on pages 61 to 64, and record the answers on the reverse side of this sheet.

4. Complete Timed Drill on page 64.

QUESTION:

1. If you are using a standard 10-key adding machine, are you using short-cut method for multiplication in all assignments?

ANSWERS

WARM-UP DRILL "D", PAGE 59

1.	_____	_____	2.	_____	_____	3.	_____	_____
4.	_____	_____	5.	_____	_____	6.	_____	_____
7.	_____	_____	8.	_____	_____	9.	_____	_____

10-Key Adding Machine Job 17

NAME _____ DATE _____ TIME REQUIRED _____

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____
16. _____
17. _____
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24. _____
25. _____
26. _____
27. _____
28. _____
29. _____
30. _____
31. _____
32. _____
33. _____
34. _____
35. _____

TIMED DRILL

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

BUSINESS TRAINING COURSE

JOB No. 18

Reference: TEN-KEY ADDING-LISTING MACHINE AND PRINTING CALCULATOR COURSE, Third Edition, Agnew and Pasewark, South-Western Publishing Company, Cincinnati 27, Ohio.

JOB TITLE: Division

INTRODUCTION:

Division can be done on the standard 10-Key Adding Machine only by multiplying the dividend by the reciprocal of the divisor. The reciprocal of a number is the answer you get when you divide that number into 1. A table of reciprocals is provided on pages 112 - 113.

PROCEDURES:

1. Complete Warm-up Drill "C" on page 47.
2. If you are using a standard 10-key adding machine, read textbook material on pages 65 and 66. If you are using a Printing Calculator, read the material pertaining to your machine on pages 66 and 67.
3. Complete problems 1 to 20 following instructions for the machine you are using. Write the answers on the reverse side of this sheet.
4. Complete Time Drill on page 68. Be sure to read the text material on page 68.

ANSWERS

WARM-UP DRILL "C", PAGE 47

1. _____ _____ _____
2. _____ _____ _____
3. _____ _____ _____
4. _____ _____ _____
5. _____ _____ _____
6. _____ _____ _____

10-Key Adding Machine Job 18

NAME_____ DATE_____ TIME REQUIRED_____

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____
16. _____R_____
17. _____R_____
18. _____R_____
19. _____R_____
20. _____R_____

TIMED DRILL

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____R_____
7. _____R_____
8. _____R_____
9. _____R_____
10. _____R_____

BUSINESS TRAINING COURSE

JOB No. 19

Reference: TEN-KEY ADDING-LISTING MACHINE AND PRINTING CALCULATOR COURSE, Third Edition, Agnew and Pasewark, South-Western Publishing Company, Cincinnati 27, Ohio.

JOB TITLE: Speed Drill-Addition

INTRODUCTION:

This assignment introduces the use of hand written numbers. The speed drill is designed to increase your speed and accuracy. Since addition is about 90% of the arithmetic work done in ordinary offices, the speed drills are a very important part of your training on this machine.

PROCEDURES:

1. Complete each problem once, writing your answer in the first blank. Check the time before you start and again when you complete the 28 problems. Indicate the time required in the space provided.

2. Work the problems again, checking the first answer. If the answer disagrees, write the second answer in the second blank. Record your time.

3. Repeat the drill if time permits.

4. Do the Three-minute Checkup. Start with problem No. 1, and complete as many as possible in three minutes. Record the number of problems worked.

10-Key Adding Machine Job 19

NAME_____ DATE_____ TIME REQUIRED_____

1.	_____	_____	15.	_____	_____
2.	_____	_____	16.	_____	_____
3.	_____	_____	17.	_____	_____
4.	_____	_____	18.	_____	_____
5.	_____	_____	19.	_____	_____
6.	_____	_____	20.	_____	_____
7.	_____	_____	21.	_____	_____
8.	_____	_____	22.	_____	_____
9.	_____	_____	23.	_____	_____
10.	_____	_____	24.	_____	_____
11.	_____	_____	25.	_____	_____
12.	_____	_____	26.	_____	_____
13.	_____	_____	27.	_____	_____
14.	_____	_____	28.	_____	_____

1st Timing_____Minutes_____Seconds

2nd Timing_____Minutes_____Seconds

3rd Timing_____Minutes_____Seconds

Number of Problems worked in 3 minutes_____

Gross Strokes per minute_____

Net Strokes per minute_____

BUSINESS TRAINING COURSE JOB No. 20

Reference: TEN-KEY ADDING-LISTING MACHINE AND PRINTING CALCULATOR COURSE, Third Edition, Agnew and Pasewark, South-Western Publishing Company, Cincinnati 27, Ohio.

JOB TITLE: Test No. 2

INTRODUCTION:

This test requires the application of the operating principles learned in assignments 11 thru 19.

PROCEDURES:

1. Obtain the test from the instructor. The instructor will be with you during the test.

2. Complete the problems, placing your answers in the blanks provided on the reverse side of this job sheet. DO NOT WRITE ON THE TEST PAPER.

10-Key Adding Machine Job 20

TEST NO. 2

NAME_____ DATE_____ TIME REQUIRED_____

1.	_____	26.	_____
2.	_____	27.	_____
3.	_____	28.	_____
4.	_____	29.	_____
5.	_____	30.	_____
6.	_____	31.	_____
7.	_____	B).	_____
8.	_____	32.	_____
9.	_____	B).	_____
10.	_____	33.	_____
11.	_____	B).	_____
12.	_____	34.	_____
13.	_____	B).	_____
14.	_____	35.	_____
15.	_____	B).	_____
16.	_____	36.	_____
17.	_____	37.	_____
18.	_____	38.	_____
19.	_____	39.	_____
20.	_____	40.	_____
21.	_____	41.	_____
22.	_____	42.	_____
23.	_____	43.	_____
24.	_____	44.	_____
25.	_____	45.	_____

BUSINESS TRAINING COURSE

JOB No. 21

Reference: TEN-KEY ADDING-LISTING MACHINE AND PRINTING CALCULATOR COURSE, Third Edition, Agnew and Pasewark, South-Western Publishing Company, Cincinnati 27, Ohio.

JOB TITLE: Division (Remainder in Quotient)
(Decimals in Quotient)
(Decimals in Dividend and Divisor)

INTRODUCTION:

You will learn valuable rules of arithmetic in the problems in this job. If the machines are available, you should work the problems on the standard machine and also on the printing calculator. For instance, working half the problems on each machine would be ideal.

PROCEDURES:

1. Complete Warm-up Drill "D" on page 59.

2. Study textbook material on pages 73 to 76. Ask your instructor to explain and demonstrate any parts that you may not understand.

3. Work problems 1 to 20 following the instructions for the machine you are using.

4. Complete Timed Drill on page 76 in the usual manner.

ANSWERS

WARM-UP DRILL "D", PAGE 59

1.	_____	_____	2.	_____	_____	3.	_____	_____
4.	_____	_____	5.	_____	_____	6.	_____	_____
7.	_____	_____	8.	_____	_____	9.	_____	_____

10-Key Adding Machine Job 21

NAME_____ DATE_____ TIME REQUIRED_____

		*
1.	_____	_____
2.	_____	_____
3.	_____	_____
4.	_____	_____
5.	_____	_____
6.	_____	
7.	_____	
8.	_____	
9.	_____	
10.	_____	
11.	_____	
12.	_____	
13.	_____	
14.	_____	
15.	_____	
16.	_____	
17.	_____	
18.	_____	
19.	_____	
20.	_____	

TIMED DRILL

1.	_____
2.	_____
3.	_____
4.	_____
5.	_____
6.	_____
7.	_____
8.	_____
9.	_____
10.	_____

*NOTE: Use second blank in problems 1 to 5 for remainders if you are using a printing calculator. On standard machines there will be no remainder.

BUSINESS TRAINING COURSE

JOB No. 22

Reference: TEN-KEY ADDING-LISTING MACHINE AND PRINTING CALCULATOR COURSE, Third Edition, Agnew and Pasewark, South-Western Publishing Company, Cincinnati 27, Ohio.

JOB TITLE: Credit Balances

INTRODUCTION:

Most modern office machines are equipped with automatic credit balances, however, it is important to learn how to convert a complementary total into a true credit balance should you ever have to operate a machine without the credit balance feature.

PROCEDURES:

1. Complete Warm-up Drill "C" on page 47.
2. Read textbook material, pages 77 to 79.
3. Work problems 1 to 18, pages 77 to 79.
4. Read text material, page 80 under "TIMED DRILL".
5. Complete Timed Drill, page 80, in the usual manner.

ANSWERS

WARM-UP DRILL "C", PAGE 47

1. _____ _____
2. _____ _____
3. _____ _____
4. _____ _____
5. _____ _____
6. _____ _____

10-Key Adding Machine Job 22

NAME_____ DATE_____ TIME REQUIRED_____

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____
16. _____
17. _____
18. _____

TIMED DRILL

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____

BUSINESS TRAINING COURSE

JOB No. 23

Reference: TEN-KEY ADDING-LISTING MACHINE AND PRINTING CALCULATOR COURSE, Third Edition, Agnew and Pasewark, South-Western Publishing Company, Cincinnati 27, Ohio.

JOB TITLE: Interest

INTRODUCTION:

The computation of interest is one of the most common applications of business machines. Of course, as in all machine applications, an understanding of the arithmetic involved is essential.

PROCEDURES:

1. Complete Warm-up Drill "E" on page 83.
2. Study textbook material on pages 81 and 82.
3. Work problems 1 to 14, pages 81 to 83.
4. Complete Timed Drill on page 84.

ANSWERS

WARM-UP DRILL "E", PAGE 83

1. _____ _____
2. _____ _____
3. _____ _____
4. _____ _____
5. _____ _____
6. _____ _____

10-Key Adding Machine Job 23

NAME _____ DATE _____ TIME REQUIRED _____

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____

TIMED DRILL

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

BUSINESS TRAINING COURSE

JOB No. 24

Reference: TEN-KEY ADDING-LISTING MACHINE AND PRINTING CALCULATOR COURSE, Third Edition, Agnew and Pasewark, South-Western Publishing Company, Cincinnati 27, Ohio.

JOB TITLE: Percentage of Increase and Decrease

INTRODUCTION:

It is easy to remember that to find the percentage of increase or decrease you simply divide the figure for the earlier date into the difference between the two figures.

PROCEDURES:

1. Complete Warm-up Drill "F", page 87.
2. Study text material on page 85.
3. Work problems 1 to 25, pages 85 to 87. You will have two answers for each problem.
4. Complete Timed Drill, page 88.

ANSWERS

WARM-UP DRILL "F", PAGE 87

1.	_____	_____	2.	_____	_____	3.	_____	_____
4.	_____	_____	5.	_____	_____	6.	_____	_____
7.	_____	_____	8.	_____	_____	9.	_____	_____

10-Key Adding Machine Job 24

NAME_____ DATE_____ TIME REQUIED_____

	AMT.	%		AMT.	%
1.	_____	_____	19.	_____	_____
2.	_____	_____	20.	_____	_____
3.	_____	_____	21.	_____	_____
4.	_____	_____	22.	_____	_____
5.	_____	_____	23.	_____	_____
6.	_____	_____	24.	_____	_____
7.	_____	_____	25.	_____	_____
8.	_____	_____		TIMED DRILL	
9.	_____	_____	1.	_____	_____
10.	_____	_____	2.	_____	_____
11.	_____	_____	3.	_____	_____
12.	_____	_____	4.	_____	_____
13.	_____	_____	5.	_____	_____
14.	_____	_____	6.	_____	_____
15.	_____	_____	7.	_____	_____
16.	_____	_____	8.	_____	_____
17.	_____	_____	9.	_____	_____
18.	_____	_____	10.	_____	_____

NOTE: Use first blank to write in AMOUNT OF INCREASE and second blank for PERCENTAGE OF INCREASE OR DECREASE.

BUSINESS TRAINING COURSE

JOB No. 25

Reference: TEN-KEY ADDING-LISTING MACHINE AND PRINTING CALCULATOR COURSE, Third Edition, Agnew and Pasewark, South-Western Publishing Company, Cincinnati 27, Ohio.

JOB TITLE: Speed Drill-Addition

INTRODUCTION:

This assignment is designed to increase your speed and accuracy. Since addition is the most used of the arithmetic processes in business, it follows that the ability to add rapidly and accurately is the most important phase of your training on this machine.

PROCEDURES:

1. Complete each problem once, writing your answer in the first blank. Check the time before you start and again when you complete the 28 problems. Indicate the time required in the space provided.

2. Work the problems again, checking the first answer. If the answer disagrees, write the second answer in the second blank. Record your time.

3. Repeat the drill if time permits.

4. Do the Three-minute Checkup. Start with problem No. 1, and complete as many problems as possible in three minutes. Record the number of problems worked.

BUSINESS TRAINING COURSE

JOB No. 26

Reference: TEN-KEY ADDING-LISTING MACHINE AND PRINTING CALCULATOR COURSE, Third Edition, Agnew and Pasewark, South-Western Publishing Company, Cincinnati 27, Ohio.

JOB TITLE: Prorating

INTRODUCTION:

In prorating problems it is important to remember that the sum of the prorated parts must equal to the total to be prorated. Adjust small differences to the largest amount.

PROCEDURES:

1. Complete Warm-up Drill "E", page 83.
2. Study textbook material on pages 93 and 94.
3. Work problems 1 to 35, pages 93 to 95.
4. Do Timed Drill, problems 1 to 11, in the usual manner.

ANSWERS

WARM-UP DRILL "E", PAGE 83

1. _____ _____
2. _____ _____
3. _____ _____
4. _____ _____
5. _____ _____
6. _____ _____

10-Key Adding Machine Job 26

NAME_____ DATE_____ TIME REQUIRED_____

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____

13. _____ _____
14. _____ _____
15. _____ _____
16. _____ _____
17. _____ _____
18. _____ _____
19. _____ _____
20. _____ _____
21. _____ _____
22. _____ _____
23. _____ _____

24. _____ _____
25. _____ _____
26. _____ _____
27. _____ _____
28. _____ _____
29. _____ _____
30. _____ _____
31. _____ _____
32. _____ _____
33. _____ _____
34. _____ _____
35. _____ _____

TOTALS. $_____ _____%

TIMED DRILL

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

_____ TOTAL

7. _____ _____
8. _____ _____
9. _____ _____
10. _____ _____
11. _____ _____

BUSINESS TRAINING COURSE

JOB No. 27

Reference: TEN-KEY ADDING-LISTING MACHINE AND PRINTING CALCULATOR COURSE, Third Edition, Agnew and Pasewark, South-Western Publishing Company, Cincinnati 27, Ohio.

JOB TITLE: Payrolls

INTRODUCTION:

All businesses are concerned with payrolls. If you have not already learned how to compute gross earnings, deductions, etc., this is your opportunity to learn this important phase of your training as well as the machine applications. You will have further training on payrolls in your Business Mathematics and Accounting courses.

PROCEDURES:

1. Complete Warm-up Drill "F", page 87.

2. Read text material, page 97, and work problems 1 to 10 on page 97. Record your answers on the reverse side of this job sheet.

3. Rule a plain sheet of paper similiar to the problem on page 97, and copy the figures that are given. Complete the worksheet showing all the answers, and following the textbook instructions on page 98.

4. Rule a plain sheet of paper similiar to the problem on page 99, and copy the figures that are given. Complete the worksheet showing all answers, and following the textbook instructions on page 99.

5. TIMED DRILL: Rule a sheet of plain paper similiar to the one on page 100. Copy the information that is given before beginning your timing. Complete the weekly payroll, showing all answers.

10-Key Adding Machine Job 27

NAME_____ DATE_____ TIME REQUIRED_____

WARM-UP DRILL "F"

1. _____ _____	2. _____ _____	3. _____ _____
4. _____ _____	5. _____ _____	6. _____ _____
7. _____ _____	8. _____ _____	9. _____ _____

PROBLEMS 1 TO 10

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

BUSINESS TRAINING COURSE

JOB No. 28

Reference: TEN-KEY ADDING-LISTING MACHINE AND PRINTING CALCULATOR COURSE, Third Edition, Agnew and Pasewark, South-Western Publishing Company, Cincinnati 27, Ohio.

JOB TITLE: Reconciliation of Bank Statements

INTRODUCTION:

Reconciling the bank statement means that you must account for the difference between the bank statement and the checkbook balance. The form shown on page 101 is a good one to follow.

PROCEDURES:

1. Complete Warm-up Drill "D", page 83.
2. Read textbook material on page 101 and work problems 1 to 5 on page 101 to 103.
3. Complete Timed Drill, problems 1 and 2, in the usual manner.

10-Key Adding Machine Job 28

NAME_____ DATE_____ TIME REQUIRED_____

WARM-UP DRILL "D"

1. _____ _____

2. _____ _____

3. _____ _____

4. _____ _____

5. _____ _____

6. _____ _____

JOB 28 ANSWERS

1. _____

2. _____

3. _____

4. _____

5. _____

TIMED DRILL ANSWERS

1. _____

2. _____

BUSINESS TRAINING COURSE

JOB No. 29

Reference: TEN-KEY ADDING-LISTING MACHINE AND PRINTING CALCULATOR COURSE, Third Edition, Agnew and Pasewark, South-Western Publishing Company, Cincinnati 27, Ohio.

JOB TITLE: Speed Drill-Addition

INTRODUCTION:

This assignment is designed to increase your speed and accuracy. In completing this drill you should strive constantly to improve both speed and accuracy.

PROCEDURES:

1. Complete each problem once, writing your answer in the first blank. Check the time before you start and again when you complete the 16 problems. Indicate the time required in the space provided.

2. Work the problems again, checking the first answer. If the answer disagrees, write the second answer in the second blank. Record your time.

3. Repeat the drill if time permits.

4. Do the Three-minute Checkup. Start with problem No. 1, and complete as many as possible in three minutes. Record the number of problems worked.

10-Key Adding Machine Job 29

NAME_____ DATE_____ TIME REQUIRED_____

1.	_____	_____	9.	_____	_____
2.	_____	_____	10.	_____	_____
3.	_____	_____	11.	_____	_____
4.	_____	_____	12.	_____	_____
5.	_____	_____	13.	_____	_____
6.	_____	_____	14.	_____	_____
7.	_____	_____	15.	_____	_____
8.	_____	_____	16.	_____	_____

1st Timing_____ Minutes_____ Seconds

2nd Timing_____ Minutes_____ Seconds

3rd Timing_____ Minutes_____ Seconds

Number of Problems worked in 3 minutes_____

Gross Strokes per minute_____

Net Strokes per minute_____

BUSINESS TRAINING COURSE JOB No. 30

Reference: TEN-KEY ADDING-LISTING MACHINE AND PRINTING CALCULATOR COURSE, Third Edition, Agnew and Pasewark, South-Western Publishing Company, Cincinnati 27, Ohio.

JOB TITLE: Test No. 3

INTRODUCTION:

This test requires the application of the operating principles learned in assignments 21 to 29.

PROCEDURES:

1. Obtain the test from the instructor. The instructor will be with you during the test.

2. Complete the problems, placing your answers in the blanks provided on the reverse side of this job sheet. DO NOT WRITE ON THE TEST PAPER.

10-Key Adding Machine Job 30

TEST NO. 3

1.	_____	16.	_____
2.	_____	17.	_____
3.	_____	18.	_____
4.	_____	19.	_____
5.	_____	20.	_____
6.	_____	21.	_____
7.	_____	22.	_____
8.	_____	23.	_____
9.	_____	24.	_____
10.	_____	25.	_____
11.	_____	26.	_____
12.	_____	27.	_____
13.	_____	28.	_____
14.	_____	29.	_____
15.	_____	30.	_____

	PERCENTAGE	AMT. CHARGED EACH DEPT.
31.	_____	_____
32.	_____	_____
33.	_____	_____
34.	_____	_____
35.	_____	_____

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

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ED013339

COURT REPORTING

INTRODUCTION

Purpose of Curriculum

In North Carolina there has been an ever increasing need for trained men and women for positions as court reporter and/or conference-convention reporter. The purpose of the Court Reporting Curriculum is to outline a training program that will provide specialized training in the accepted procedures required by the profession, and to enable persons to become proficient soon after accepting employment.

The curriculum is designed to offer the students the necessary skills in typing, Stenograph shorthand, dictation, transcription, and terminology for employment as a court reporter and/or conference reporter.

Job Description

The graduate of the Court Reporter Curriculum should find opportunity for immediate employment, rapid advancement, and a good income. The duties of a court reporter may consist of: recording examination, testimony, judicial opinions, judge's charge to jury, judgment or sentence of court, and other proceedings in a court of law.

The duties of a conference-convention reporter may consist of: recording proceeding of conferences, conventions, board meetings, and informal business or committee meetings. The graduate may be employed by a reporting firm, or be employed on a free-lance basis.

VT003014

ACKNOWLEDGMENTS

The Curriculum Laboratory of the Department of Community Colleges recognizes the valuable contributions of the following persons who served as members of the curriculum committee.

Mr. Bert M. Montague	Assistant Administrator of the Office of the Courts
Mr. William H. Stephenson	Secretary of the North Carolina Industrial Commission
Mrs. Wilda Hauer	Court Reporter - Federal
Mrs. Alma Wilkes	Court Reporter - Instructor
Mr. Royace Pipkin	Chief Court Reporter - Wake County

MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) Roger G. Worthington (Agency) Department of Community Colleges

(Address) Education Building, Raleigh, North Carolina

DATE: August 4, 1967

RE: (Author, Title, Publisher, Date) Curriculum Laboratory. "Court Reporting Business Technology" North Carolina Department of Community Colleges; May 1, 1966.

Supplementary Information on Instructional Material

Provide information below which is not included in the publication. Mark N/A in each blank for which information is not available or not applicable. Mark P when information is included in the publication. See reverse side for further instructions.

(1) Source of Available Copies:
Agency ERIC only, except North Carolina Institutions
Address
Limitation on Available Copies **Price/Unit**
(quantity prices)

(2) Means Used to Develop Material:
Development Group Curriculum committee on Court Reporting
Level of Group State and Instructors
Method of Design, Testing, and Trial Tentative guide evaluated by committee and instructors and developed more fully to incorporate teacher suggestions.

(3) Utilization of Material:
Appropriate School Setting Technical Institutes and Community Colleges
Type of Program Pre-employment
Occupational Focus Court reporter and/or conference reporter
Geographic Adaptability N/A
Uses of Material Curriculum planning
Users of Material Administrators and Instructors

(4) Requirements for Using Material:
Teacher Competency Secretarial Science instructor/with stenotype experience
Student Selection Criteria Requirements of post-secondary education

Time Allotment P

Supplemental Media --
Necessary ____ **Desirable** ____ **(Check Which)** P

Describe

Source (agency)
(address)

BUSINESS TECHNOLOGY

COURT REPORTING

SUGGESTED CURRICULUM BY QUARTERS

(Old No.)	Course Title		Hours Per Week Class	Hours Per Week Lab.	Quarter Hours Credit
	FIRST QUARTER				
X	T-ENG 101	Grammar	3	0	3
BUS 302	T-BUS 102	Typewriting (or Elective)	2	3*	3
X	T-BUS 126	Machine Shorthand	5	6*	7
X	T-BUS 185	Vocabulary Building	3	0	3
X	T-BUS 114	Law	3	0	3
			16	9	19
	SECOND QUARTER				
X	T-ENG 102	Composition	3	0	3
BUS 303	T-BUS 103	Typewriting (or Elective)	2	3*	3
X	T-BUS 127	Machine Shorthand	5	6*	7
BUS 383L	T-BUS 183L	Terminology and Vocabulary (Legal)	3	0	3
X	T-BUS 251	Court Procedure	3	0	3
			16	9	19
	THIRD QUARTER				
ENG 306	T-ENG 206	Business Communication	3	0	3
BUS 304	T-BUS 104	Typewriting	2	3*	3
X	T-BUS 128	Machine Shorthand	5	6*	7
BUS 383M	T-BUS 183M	Terminology and Vocabulary (Medical)	3	0	3
X	T-BUS 252	Court Procedure	3	0	3
			16	9	19

*"Manipulative laboratory" involves development of skills and job proficiency. Credit of one quarter hour for each three hours of laboratory.

(Old No.)		Course Title	Hours Per Week Class	Lab.	Quarter Hours Credit
	FOURTH QUARTER				
ENG 307	T-ENG 204	Oral Communication	3	0	3
X	T-BUS 201	Machine Shorthand	5	6*	7
X	T-BUS 202	Dictation and Transcription	3	2	4
BUS 350	T-BUS 205	Advanced Typewriting	2	3*	3
BUS 384M	T-BUS 284M	Terminology and Vocabulary (Medical)	3	0	3
			16	11	20
	FIFTH QUARTER				
X	T-BUS 203	Dictation and Transcription	3	2	4
		Social Science Elective	3	0	3
		Elective	9	0	9
			15	2	16
	SIXTH QUARTER				
		Social Science Elective	3	0	3
X	T-BUS 204	Dictation and Transcription	3	2	4
X	T-BUS 253	Court Reporting	0	10	5
		Elective	3	0	3
			9	12	15

Total Quarter Hours in Courses	96
Electives (Min.)	12
Total	108

BUSINESS TECHNOLOGY

COURT REPORTING

COURSE DESCRIPTIONS BY QUARTERS

(Old No.)	FIRST QUARTER	Hours Per Week Class	Hours Per Week Lab.	Quarter Hours Credit
X	T-ENG 101 Grammar	3	0	3

Designed to aid the student in the improvement of self-expression in grammar. The approach is functional with emphasis on grammar, diction, sentence structure, punctuation, and spelling. Intended to stimulate students in applying the basic principles of English grammar in their day-to-day situations in industry and social life.
Prerequisite: None.

BUS 302	T-BUS 102 Typewriting	2	3*	3

Introduction to the touch typewriting system with emphasis on correct techniques, mastery of the keyboard, simple business correspondence, tabulation, and manuscripts.
Prerequisite: None.

X	T-BUS 126 Machine Shorthand	5	6*	7

This course presents the basic principles and theory of Stenograph machine shorthand.
Prerequisite: None.

X	T-BUS 185 Vocabulary Building	3	0	3

A study of specialized vocabulary which is necessary in successful performance in court and conference reporting. Emphasis on business, engineering and technical terms.
Prerequisite: None.

X	T-BUS 114 Law	3	0	3

An introduction to law covering topics or contracts, torts, negligence, agency, and laws in general.
Prerequisite: None.

SECOND QUARTER

X	T-ENG 102 Composition	3	0	3

Designed to aid the student in the improvement of self-expression in business and technical composition. Emphasis is on the sentence, paragraph and whole composition.
Prerequisite: T-ENG 101.

BUS 303	T-BUS 103 Typewriting	2	3*	3

Instruction emphasizes the development of speed and accuracy with further mastery of correct typewriting techniques. These skills and techniques are applied in tabulation, manuscript, correspondence, and business forms.
Prerequisite: T-BUS 102 or the equivalent. Speed requirement, 30 words per minute for five minutes.

X	T-BUS 127 Machine Shorthand	5	6*	7

A continuation of T-BUS 126 with emphasis on machine operation. The development of the ability to take dictation on the Stenograph machine at the rate of 80 words per minute.
Prerequisite: T-BUS 126.

BUS 383L	T-BUS 183L Terminology and Vocabulary (Legal)	3	0	3

To develop an understanding of the terminology and vocabulary appropriate to the course of study, as it is used in business, technical, and professional offices.
Prerequisite: None.

X	T-BUS 251 Court Procedure	3	0	3

Designed to give the student a general knowledge of courtroom procedures and practices. Emphasis on structure of the judicial system, types of courts, jurisdictions, and court room ethics.
Prerequisite: None

THIRD QUARTER

ENG 306	T-ENG 206 Business Communication	3	0	3

Develops skills in techniques in writing business communications. Emphasis is placed on writing action--getting sales letters and prospectuses. Business reports, summaries of business conferences, letters involving credit, collections, adjustments, complaints, orders, acknowledgments, remittances, and inquiry.
Prerequisite: T-ENG 102.

BUS	304	T-BUS 104 Typewriting	2	3*	3

Emphasis on production typing problems and speed building. Attention to the development of the student's ability to function as an expert typist, producing mailable copies. The production units are tabulation, manuscript, correspondence, and business forms.
Prerequisite: T-BUS 103 or the equivalent. Speed requirement, 40 words per minute for five minutes.

	X	T-BUS 128 Machine Shorthand	5	6*	7

A continuation of T-BUS 127. The development of the ability to take dictation on the Stenograph machine at the rate of 100 words per minute on straight new matter.
Prerequisite: T-BUS 127.

BUS	383M	T-BUS 183M Terminology and Vocabulary (Medical)	3	0	3

To develop an understanding of the terminology and vocabulary appropriate to the course of study, as it is used in business, technical, and professional offices.
Prerequisite: None.

	X	T-BUS 252 Court Procedure	3	0	3

Continuation of court procedures with emphasis on trial procedures, appellate procedures, legal documents, deposition forms, and criminal and civil procedures.
Prerequisite: T-BUS 251.

FOURTH QUARTER

ENG	307	T-ENG 204 Oral Communication	3	0	3

A study of basic concepts and principles of oral communications to enable the student to communicate with others. Emphasis is placed on the speaker's attitude, improving diction, voice, and the application of particular techniques of theory to correct speaking habits and to produce effective oral presentation. Particular attention given to conducting meetings, conferences, and interviews.
Prerequisite: T-ENG 101.

	X	T-BUS 201 Machine Shorthand	5	6*	7

A continuation of T-BUS 128. The development of the ability to take dictation on the Stenograph machine at a minimum of 120 words per minute on straight new matter.
Prerequisite: T-BUS 128.

X	T-BUS 202 Dictation and Transcription	3	2	4

An introduction to the transcription of machine shorthand on the typewriter. The development of the ability to take dictation on straight new matter at a rate of 120-140 words per minute and to transcribe this dictation in an acceptable manner.
Prerequisite: T-BUS 201.

BUS 350	T-BUS 205 Advanced Typewriting	2	3*	3

Emphasis is placed on the development of individual production rates. The student learns the techniques needed in planning and in typing projects that closely approximate the work appropriate to the field of study. These projects include review of letter forms, methods of duplication, statistical tabulation, and the typing of reports, manuscripts and legal documents.
Prerequisite: T-BUS 104. Speed requirement, 50 words per minute for five minutes.

BUS 384M	T-BUS 284M Terminology and Vocabulary (Medical)	3	0	3

Greater emphasis on an understanding of the terminology and vocabulary appropriate to the course of study, as it is used in business, technical, and professional offices.
Prerequisite: T-BUS 183M.

FIFTH QUARTER

X	T-BUS 203 Dictation and Transcription	3	2	4

A continuation of T-BUS 202. Development of ability to take dictation of straight new matter at the rate of 140-160 words per minute and to transcribe at the rate of 25 words per minute.
Prerequisite: T-BUS 202.

SIXTH QUARTER

X	T-BUS 204 Dictation and Transcription	3	2	4

A continuation of T-BUS 203. The development of ability to take dictation of straight new matter at the rate of 180-200 words per minute and transcribe at the rate of 30 words per minute.
Prerequisite: T-BUS 203.

X	T-BUS 253 Court Reporting	0	10	5

A course of actual court and/or conference reporting practice. Student will spend time in various courtroom situations, and/or conferences or convention reporting situations.

Prerequisite: Ability to take dictation of straight new matter at the rate of 175 words per minute.

ELECTIVES

An appropriate list of electives for this curriculum is shown from which the institution may select courses to complete the program of study. The institution has the prerogative to develop new courses for the electives or to modify courses from the suggested list to fulfill the local objectives. It is suggested, however, that technical courses be appropriate to the major area of study; that they not change or alter the major objectives of the program nor create a false impression of proficiency in an area either related or foreign to the major.

Elective courses must be selected from an associate degree course or new courses should be developed at a comparable level. The institution may elect to require certain courses or may let the student select an appropriate course.

COURT REPORTING

MA	310	T-MAT 110 Business Mathematics	5	0	5

This course stresses the fundamental operations and their application to business problems. Topics covered include payrolls, price marking, interest and discount, commission, taxes, and pertinent uses of mathematics in the field of business.
Prerequisite: None.

SOC	312	T-PSY 112 Personality Development	3	0	3

Designed to help the student recognize the importance of the physical, intellectual, social, and emotional dimensions of personality. Emphasis is placed on grooming and methods of personality improvement.
Prerequisite: None.

SOC	302	T-ECO 102 Economics	3	0	3

The fundamental principles of economics including the institutions and practices by which people gain a livelihood. Included is a study of the laws of supply and demand and the principles bearing upon production, exchange, distribution, and consumption both in relation to the individual enterprise and to society at large.
Prerequisite: None.

X		T-ECO 108 Consumer Economics	3	0	3

Designed to help the student use his resources of time, energy and money to get the most out of life. It gives the student an opportunity to build useful skills in buying, managing his finances, increasing his resources, and to understand better the economy in which he lives.
Prerequisite: None.

X	T-BUS 213 Office Practice	3	0	3

Designed to introduce the student to general office practices such as indexing, filing of notes, billing and rudimentary bookkeeping, use of dictating equipment, and other office functions.
Prerequisite: None.

SOCIAL SCIENCE

X	T-SSC 201 Social Science	3	0	3

An integrated course in the social sciences, drawing from the fields of anthropology, psychology, history, and sociology.
Prerequisite: None.

X	T-SSC 202 Social Science	3	0	3

A further study of social sciences with emphasis on economics, political science, and social problems as they relate to the individual.
Prerequisite: T-SSC 201.

SOC 310	T-PSY 206 Applied Psychology	3	0	3

A study of the principles of psychology that will be of assistance in the understanding of inter-personal relations on the job. Motivation, feelings, and emotions are considered with particular reference to on-the-job problems. Other topics investigated are: employee selection, supervision, job satisfaction, and industrial conflicts. Attention is also given to personal and group dynamics so that the student may learn to apply the principles of mental hygiene to his adjustment problems as a worker and a member of the general community.
Prerequisite: None.

X	T-SSC 205 American Institutions	3	0	3

A study of the effect of American social, economic, and political institutions upon the individual as a citizen and as a worker. The course dwells upon current local, national, and global problems viewed in the light of our political and economic heritage.
Prerequisite: None.

X	T-POL 201 United States Government	3	0	3

A study of government with emphasis on basic concepts, structure, powers, procedures and problems.
Prerequisite: None.

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ED013339

DEN 1008

COURSE OUTLINE

DEN 1008 DENTAL OFFICE MANAGEMENT

August 1966

Edited by

Mary Elizabeth Milliken
Curriculum Consultant for Health Occupations
Division of Vocational-Technical Education

Developed by:

Joyce Sigmon — Central Piedmont Community College
Mildred Lynch — Technical Institute of Alamance

CURRICULUM LABORATORY
DEPARTMENT OF COMMUNITY COLLEGES
STATE BOARD OF EDUCATION
RALEIGH, NORTH CAROLINA

VT003017

MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) Roger G. Worthington (Agency) Dept. of Community Colleges

(Address) Education Building, Raleigh, North Carolina

DATE: August 2, 1967

RE: (Author, Title, Publisher, Date) Milliken, Mary Elizabeth (Editor), Course Outline for Dental Assisting: Dental Office Management, Curriculum Laboratory, Dept. of Community Colleges, August 1966.

Supplementary Information on Instructional Material

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(2) Means Used to Develop Material:
Development Group Staff writer and committee of teachers
Level of Group State and local
Method of Design, Testing, and Trial Sharing of locally developed outlines and committee evaluation of each. Synthesis and reorganization by staff curriculum specialist for health occupations.

(3) Utilization of Material:
Appropriate School Setting Post-high school
Type of Program Pre-employment
Occupational Focus Dental assisting
Geographic Adaptability N/A
Uses of Material Basis for lesson plans
Users of Material Teacher

(4) Requirements for Using Material:
Teacher Competency Certified dental assistant with work experience and /aptitude for teaching
Student Selection Criteria To be determined locally
Time Allotment One calendar year

Supplemental Media --
Necessary X
Desirable ____ (Check Which)

Describe P

Source (agency)
(Address)

Course Description

DEN 1008 DENTAL OFFICE MANAGEMENT

Principles and procedures related to management of the dental office, including maintenance of inventories, ordering of supplies, charting, maintaining patient and financial records, making appointments and establishing favorable patient relations.

COURSE OUTLINE

DEN 1008 DENTAL OFFICE MANAGEMENT

OBJECTIVES: To provide opportunities for students to learn about various aspects of dental office menagement and to develop further understanding of effective patient relations.

COURSE HOURS PER WEEK: Class, 4; Laboratory, 3.

QUARTER HOURS CREDIT: 5.

PREREQUISITE: DEN 1005.

OUTLINE OF INSTRUCTION:

I. Introduction

II. Office administration

A. Records

1. Legal purpose

2. Identification methods

3. Types

B. Keeping records

1. Appointment book

2. Patient charts

a. Case history

b. Examinations

(1) Vitality tests and transillumination

(2) X-ray records

(3) Study models

(4) Examination findings

c. Fee determination

d. Contracts for payment

3. Recall systems

C. Credit

1. Ratings

2. Classification of patients

3. Plans for payment

a. Cash

b. Credit

c. Bank loan

d. Insurance

D. Office financial records

1. Patient service and account record

2. Summaries

a. Daily

b. Monthly

c. Annual

3. Disbursements

a. Types

b. Records

4. Salary computation

5. Petty cash

6. Banking procedures

7. Tax records

E. Statements and collections

1. Statements

a. Preparation

b. Mailing

2. Collections

a. Office procedures

b. Telephone procedures

c. Collection letters

d. Collection agencies

e. Court procedures

F. Filing systems

1. Types

a. Alphabetical

b. Color-coding

c. Quick glance

d. Numerical

2. Filing and indexing rules

3. Classification of accounts

a. Active

b. Inactive

c. Closed

III. Supplies

A. Types

1. Dental

a. Expendable

b. Nonexpendable

2. Office

3. Miscellaneous

B. Management responsibilities

1. Inventory records

2. Ordering

a. Sources

b. Procedures

3. Receiving

a. Checking orders

b. Returns

c. Back orders

4. Accounts payable

C. Storage and care of supplies

1. Organization

2. General rules

3. Special handling

a. Gold

b. Narcotics

c. Film

d. Acids

e. Other

4. Inventory control

IV. Patient management

A. Understanding behavior

1. Influences on behavior

a. Age level

b. Environment

c. Past experiences

d. Mental and emotional state

e. Physical condition

f. Attitudes of office personnel

g. Appearance of dental office

2. Coping with behavior problems

a. Children

b. Adults

B. Motivating patients

1. Developing awareness of patients' needs

2. Promoting desire for services

V. Effective office management

A. Work habits

B. Personal qualities

C. Interpersonal relations

1. Awareness of influences

2. Skills

3. Personal goals for improvement

SUGGESTED TEXT:

Brauer, J. C. and Richardson, R. E. The Dental Assistant; Third Edition. New York: McGraw-Hill Book Company, Inc., 1964.

SUGGESTED REFERENCES:

Barton, R. E. (Editor). Dental Assisting: Secretarial Procedures. Chapel Hill: University of North Carolina, 1964.

Bregstein, S. J. Handbook for Dental Assistants, Hygienists and Secretaries. Englewood Cliffs: Prentice-Hall, Inc., 1961.

Bregstein, S. J. The Successful Practice of Dentistry. Englewood Cliffs: Prentice-Hall, Inc., 1953.

Cinotti, W. R. et al. Applied Psychology in Dentistry. St. Louis: C. V. Mosby Company, 1964.

Levy, I. R. A Textbook for Dental Assistants; Fourth Edition. Philadelphia: Lea & Febiger, 1955.

Peterson, Shailer. The Dentist and His Assistant. St. Louis: C. V. Mosby Company, 1961.

Rutledge, C. E. and Winsor, E. H. The Dental Business Office. Philadelphia: Lea & Febiger, 1956.

Stinoff, R. K. Dental Practice Administration; Second Edition. St. Louis: C. V. Mosby Company, 1964.

ED013339

STATE VOCATIONAL-TECHNICAL & TRADE SCHOOLS
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ECONOMICS

FOR INDUSTRIAL SUPERVISORS

VT003022

ECONOMICS

FOR INDUSTRIAL SUPERVISORS

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) Loyd Ponder (Agency) VOCATIONAL CURRICULUM DEVELOPMENT & RESEARCH CENTER

(Address) PO. BOX 657 NATCHITOCHES, LA. 71457

DATE: JULY 29, 1967

RE: (Author, Title, Publisher, Date) Research Center, "ECONOMICS FOR INDUSTRIAL SUPERVISORS" Research Center 1964

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Geographic Adaptability NO RESTRICTION
Uses of Material LESSON PLANNING
Users of Material Teacher

(4) Requirements for Using Material:
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Student Selection Criteria mature Adults scheduled for Promotion OR Those who have been Promoted
Time Allotment N/A
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PREFACE

The primary purpose of this material is to provide conference leaders with supplemental information on the principles and workings of our Free Enterprise System so they may help people acquire sufficient understanding--a layman's understanding--of these economic principles that affect their opportunities to earn a living and that regulate and govern the management of their personal business affairs.

Key Generalizations of Each Session

Session I Introduction to Free Competitive Enterprise

1. Our high standard of living in the United States is a result of the large amount of freedom which the individual enjoys in the United States.
2. Socialism and communism implicitly argue that the end justifies the mean; competitive private enterprise has high regard for the individual and seeks to accomplish its ends by means which involve only minimum interference with the individual's freedom.
3. Competition produces more abundant goods and is far more effective than centralized government planning.

Session II What Makes Our Economy Grow

1. The United States economy needs increasingly large amounts of capital to provide a rising standard of living.

2. High taxes can seriously impede the accumulation of needed capital.
3. Any increase in productivity affects the standard of living of the entire nation and not just the management and employees of the plant involved.
4. Productivity is important because of what it has brought us up to now; it also is the key to our economic future.
5. Mobility of the work force, the "economic climate," the willingness of people to save and invest their money, natural factors, competition--all influence productivity.

Session III The Role of Competition

1. Everybody in the economy benefits from competition.
2. Competition makes for freedom of opportunity to enter a business.
3. The existence of competition provides flexibility in the nation's production and distribution system so that, as time goes on, what the consumer wants is produced efficiently and at reasonable prices.

Session IV The Role of Marketing

1. Our high standard of living is due to our ability to produce in quantity and quality as well as our ability in developing the processes of distribution.
2. A major marketing problem of any firm is to determine exactly what its prospective customers will buy.

3. Marketing starts with product planning and, in many cases, follows the product into the consumer's home or office in the form of a service.
4. Modern marketing procedures allow people in other departments of a business to give consideration to customer needs and wants before making decisions.

Session V Incentives and Their Results

1. The volume of production and the level of employment are determined by the quantity of goods and services which buyers are willing and able to take at prices which yield a profit to their producers.
2. In determining the price of a product, wages paid to employees are among a company's biggest costs.
3. The price system provides a mechanism for the reallocation of resources.
4. Although the total dollar amount of profit reported by an American industry is large, the rate of profits tends to average about 3% on sales after taxes.
5. Some of the new investment for expansion purposes comes out of profit.
6. The normal operation of a competitive market is an excellent regulator of the "fairness" of profits in relation to risk.

Session VI The Role of Organization in Our Economy

1. The hope for profit stimulates the organization of resources for production; the skills of managers and employees translate the hope into achievement.
2. Freedom for the working man should mean freedom to work at any job for which he has the capability.
3. As the economy grows, the rewards of improved productivity are shared by all segments of society.
4. Proper exercise of the responsibilities which labor and management have to each other affects our national prosperity.

Session VII Governments Role in Our Economy

1. American businesses have always been, to some degree, subject to some form of regulation.
2. The government's impact on our economy takes not only the form of regulation, it also makes considerable efforts to be of assistance to the enterpriser.

INTRODUCTION

Our economic system has many different names: "Free Enterprise," "Private Enterprise, " "Capitalism," "A Competitive Economy," and so on. But the name isn't important. What is important is how the system works and what it means to the individual, in this case you and the people who work for you.

Almost every adult starts with some knowledge in terms of his own personal experience of how economic principles work. Nor is this hard to understand when you stop to think that we are all a part of our economic system; whether we want to be or not. This is where our jobs and pay come from. This is where our standard of living and our old age security came from. This is where our bright hopes for the future, or the sad disappointments originate.

Every time you receive your salary, or pay your rent, or buy a pair of shoes, or repair your roof, you are taking part in some phase of the enormously complex system which governs our existence from birth to death. You're as intimately involved in economics as you are with the food you eat, the clothes you wear, or the house you live in.

In spite of the deep influence which economics has on our lives, we are often confused about how it works. This is probably in part because people who work with economics all the time have developed a sort of shorthand language of their own. It's like the family doctor putting his prescription in Latin.

You could "Say" the same things these prescriptions do in everyday language, but it would take a lot of words to do it.

Fortunately, though, in economic study it is relatively easy to get away from most of the special words and phrases of the experts. You can cover the same problems in terms of your company and yourself and your jobs.

You would be thinking of economic problems if you asked yourself questions like these:

Why is my work "Worth" a certain number of dollars every month?

Why do people pay money to my company?

How has it been able to survive as a business organization?

Will my company survive in the future?

Answering questions like these properly means understanding Economics.

INFORMATION FOR THE CONFERENCE LEADER

Sessions I through VI are outlines of the following booklets:

Session I

Booklet Number 2, "A Comparison of Three Economic Systems."

Session II

Booklet Number 3, "Capital and Economic Growth."

Booklet Number 4, "Productivity and Production in Industry."

Session III

Booklet Number 7, "The Role of Competition."

Session IV

Booklet Number 10, "The Role of Marketing."

Session V

Booklet Number 8, "Wages and Prices in an Industrial Economy."

Booklet Number 5, "Industry's Profits."

Session VI

Booklet Number 9, "Industry: Organization and Employees."

The outlines of these booklets will be found in the right hand columns of this manual.

All information found in the left hand columns is directly related to the subject but is not found in these booklets. Session VII can be presented any way the leader thinks will best suit the needs of his group.

This National Association of Manufacturers' eleven booklet economic series, "Industry and the American Economy" will be made available to every conference leader. These booklets are available from the Education Department, National Association of Manufacturers, 2 East 48th Street, New York 17, New York.

While it is felt that the information included is complete, the leader should add or remove such material as he deems advisable.

To secure the best use of the information, care must be taken in planning and arranging the material to fit the needs of the specific groups that will receive such training. The information must be fitted to meet the needs of the group.

Very few graphs or charts were included in this material because they tend to become dated in such a short time. I suggest that the leader use as many charts and graphs as possible for illustration purposes. Many good charts and graphs are to be found in a series of conference board sheets entitled Road Maps of Industry.[1]

---

[1]National Industrial Conference Board Incorporated, 460 Park Avenue, New York 22, New York.

SESSION I

INTRODUCTION TO FREE COMPETITIVE ENTERPRISE

Objectives

I. To explain the purpose of these economic discussions.

II. To explain the major differences between our economic system and the collectivist economies of Socialism and Communism.

INDUSTRIAL ECONOMICS

Introduction to Free Competitive Enterprise

I. INTRODUCTION

A. An Explanation of the Conference Procedure

B. The Importance of an Objective Approach to Economics

Workers who blame capitalism for our "boom and bust" past, do not understand what a free enterprise economy is, nor "the profit system." "Economics" is one of those mysterious subjects, like psychology, which one reads or studies about and then forgets about as soon as possible. Yet, we live and work under some kind of economic system no matter where we are, and it is important that, without becoming entangled in theory, we understand the differences between the principal economic systems such as capitalism, socialism, and communism.

When an employee understands what is meant by "free" economy and a competitive enterprise system, he is not apt to believe all he hears about the virtues claimed for communism and related Marxian theories. More to the point, an employee who realizes what makes a competitive economy "tick" and how he benefits from profit making is usually a more understanding and stable worker.

(I, continued)

C. Introduce First Session

One way to understand how our system operates and the advantages of our system is to compare it with those in which other prople live and work. The purpose of this first session is to show the differences between our American economic system of competitive private enterprise and the economic methods that are a part of the collective systems of socialism and communism. In our democracy, the people own and control individual competitive enterprises, whereas under communism the government owns and controls all means of production. In a socialized state such as Sweden and England, all forms of production are socialized. Most forms of production are owned by individuals, but controlled by the government.

Page 5[1]

II. WHY WILL THIS BUSINESS BE STARTED?

A. Competitive Private Enterprise

1. Wants to be his own boss
2. He has an idea for new produce
3. People expect to make a profit.

B. Socialism and Communism

1. Because it fits into a government "plan"

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[1]National Association of Manufacturers, Industry and the American Economy, New York, N. Y., Fourth Printing 1962, Booklet 2, "A Comparison of Three Economic Systems," Page 5.

(II, continued)

IN SHORT:

Under competitive enterprise, manufacturers are free to produce something people want or need at a price they are willing to pay, the hope for a profit provides the incentive.

Under collectivism people may want or need the product but they get it only if some group of government planners approve.

Page 7[2]

III. WHO WILL OWN THE BUSINESS?

A. Competitive Private Enterprise

1. Private individuals
   a. invest voluntary savings
      1) buy stock

B. Socialism and Communism

1. Socialist economy
   a. may be privately owned but has a "silent partner"
      1) the "state"
         a) controls indirectly or directly savings
         b) approves investments
         c) control over credit

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[2]National Association of Manufacturers, op. cit., page 7.

(III, 1) continued)

d) controls foreign exchange
e) allocates labor and materials
(1) natural resources

There are approximately 275,000 industrial enterprises in the Soviet Union; 92 per cent of these are owned by the state outright, and all profits from them go to the state; the other 8 per cent are co-operatives. Factories, mines, farms, mills, workshops, apartment buildings, turn their revenues over to the state, and the state alone determines to what use these shall be put.

2. Communism
a. the state builds and owns all means of production

IN SHORT:

In our economy, private individuals own most of the means of production. What people want determines what is produced.

Under collectivism, the state controls owns the means of production and the planners decide what should be produced. Their decisions are often based on political, military or propaganda considerations.

Page 10[3]

IV. WHO TAKES THE RISK?

A. Competitive Private Enterprise

1. Investors

[3]National Association of Manufacturers, op. cit., page 10.

(IV, continued)

B. Socialism and Communism

1. "Risk is shared"
   a. everybody loses in the form of
      1) fewer goods
      2) higher prices
      3) higher taxes

For many years, citizens were encouraged to invest in state bonds; in the case of many, a proportion of their pay was deducted automatically, and put into state loan certificates. The certificates paid 4 per cent interest and could be cashed in after 20 years. When they were reaching maturity, the government postponed payments for 20 or 25 years and interest payments were frozen. The investor gets no return and cannot regain any of his capital until 1978, if then. The life savings of many citizens were wiped out.

IN SHORT:

In our economy, if one business fails, those who have taken the risk lost their investment. As individuals, they have the opportunity to try again. The successful risks more than offset the losses and the economy as a whole continues to expand.

"Sharing the risk" under collectivism eliminates the advantages to an economy of successful risk-taking by enterprising individuals.

Page 11[4]

V. HOW WILL THE FACTORY BE RUN?

A. Competitive Private Enterprise

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[4]National Association of Manufacturers, op. cit., page 11.

(V, A, continued)

1. By professional managers. Experts in such fields as:
   a. production
   b. labor relations
   c. purchasing
   d. research
   e. advertising
      marketing
2. Some functions of management are:
   a. anticipate customer wishes
   b. know availability of raw materials and the competitive advantages of these materials
   c. Know the labor market
      1) set attractive wage and salary scales
   d. make arrangements with retailers
   e. develop advertising and sales campaigns

B. Socialism and Communism

1. Socialist economy
   a. managers, chosen by the "plan" and controlled by the "plan"
      1) the "plan" is specific as to:
         a) quantity
         b) quality
         c) style
         d) amount of working capital
         e) selling price
         f) number of workers
            (1) their pay
         g) profit for the state

No Soviet plant has a public relations department or advertising department office for employer-employee relationships, or even a salesmanager and staff. Salesmanship does not exist in our senst at all.

A considerable number of executive officers, in a Russian industrial organization, even engineers, are women.

Failure for the plant manager--for whatever reason--is likely to mean more than losing that particular job. It may mean demotion to the rank of a worker or, even prison.

IN SHORT:

In our economy, factory managers must effectively meet the challenge of a competitive market. They have great leeway in deciding how to discharge their responsibilities to the owners, the employees, and the customers. In collectivist economies, the factory is managed to meet the demands of an arbitrary plan. Management has little leeway in how to discharge its responsibility to the state.

Page 145

VI. WHO WILL WORK IN THE FACTORY?

A. Competitive Private Enterprise

1. Individuals who are free to choose type of work and company

B. Socialism and Communism

1. Socialism
   a. "Planners" control the labor supply. They would determine who works where and when.
   b. communism
      1) workers are assigned to jobs, with little or no chance of changing

About 50 million men and women have jobs in Soviet industry. Many workers are

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[5]National Association of Manufacturers, op. cit., page 14.

not skilled and are employed wastefully. The average productivity per man is far less than for a comparable American man. Workers not only lack skill; they lack interest in their job.

A Russian's average wage is 300-350 rubles a month (75 to 90 United States dollars). Their work week was cut to 46 hours a week with two hours off on Saturday.

IN SHORT:

Under competitive private enterprise, businesses must compete for workers, since a worker is always free to seek another job if he thinks that by doing so he can better himself.

Under collectivism, regulations and restrictions limit the worker's freedom to choose--or to change--his job.

Page 16[6]

VII. WHO WILL BUY THE PRODUCT?

A. Competitive Private Enterprise

1. People needing or wanting this product
2. People attracted to this product because of:
   a. price
   b. better product
   c. advertising
   d. beauty

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[6]National Association of Manufacturers, op. cit., page 16.

(VII, continued)

The government sets prices with the deliberate intention of absorbing as much of the consumer's purchasing power as possible; the amount of goods released to the public depends not merely on production, but on the amount of money estimated to be in the hands of the public. High prices, set by the government, act as a form of rationing.

There is a waiting list of approximately 100,000 for the small Russian auto at a cost of $5,000 U.S. dollars.

In 1957 the United States had 3.1 persons per passenger car compared to 500.5 persons per car for the USSR.

IN SHORT:

In our economy, with many competing brands, people who want or need a radio would buy the one best suited to their requirements.

In socialist or communist economies, the product would be put on the market at a controlled price. People who want or need a radio would be faced by a "take it or leave it" situation.

2. Communism
   a. people who are fortunate enough to meet the "controlled price" and can find one
      1) There is not a "limited" choice but an actual shortage of many products.

Page 19[7]

VIII. WHY IS THE PRODUCT IMPROVED?

A. Competitive Private Enterprise

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[7]National Association of Manufacturers, op. cit., page 19.

(VIII, A, continued)

1. To meet competition

B. Socialism and Communism

1. Socialism
   a. theory - research and improvement for the benefit of the people
   b. practice - Management in a Socialist economy can ignore new ideas indefinitely.
      1) Competitive incentive is missing.
2. Communism
   a. no competition to force concern of improvement of consumer goods
      1) research is done on problems important to the state.
         a) heavy machinery
         b) armaments

IN SHORT:

In our economy, competition continually forces the use of science and technology to improve consumer goods, as well as for national defense.

Under collectivism, the lack of competitive incentive has limited the use of science and technology in improving the standard of living.

References

National Association of Manufacturers, Industry and the American Economy, Booklet Number 2, "A Comparison of Three Economic Systems," pp. 5-20.

Films

The Secret of American Production, 16mm, Sound, Black ans White, 13 minutes, by the National Education Program, 815 East Center Avenue, Searcy, Arkansas.

This film discusses the five freedoms of our American economy that make possible our high rate of production. These are:

1. Freedom to work
2. Freedom to dream
3. Freedom to compete
4. Freedom to advance
5. Freedom to invest.

SESSION II

WHAT MAKES AN ECONOMY GROW

Objectives

I. To study capital and discuss its relationship to the growth of our economy.

II. To analyze production and productivity for the purpose of studying its effects on our economy growth.

III. To visualize what lies ahead if our economy continues at its present rate of growth.

INDUSTRIAL ECONOMICS

What Makes An Economy Grow

The story of the growth of American industry is the story of improvement in the American standard of living. Both have come about because of saving and investing of capital combined with increased productivity.

Sometimes the capital needed to start a business may be only a few hundred dollars, or may even reach several millions of dollars. Whatever the need and the willingness and ability, of our people, to "lay it on the barrel head" is the keystone of our economic growth.

Page 4[1]

I. INTRODUCTION

II. CAPITAL

A. Definition

1. Money, goods, and equipment, used in producing more wealth

B. Function of:

1. Provides all the tools, machines and buildings now used in production.
2. Provides all the stocks of raw materials without which industry cannot operate.
3. Provides our transportation and utilities systems.

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[1]National Association of Manufacturers, Industry and the American Economy, New York, N. Y., Booklet Number 3, "Capital and Economic Growth," Third Printing, 1962.

(II, A, continued)

4. Means more jobs, higher pay, better and less costly products.

C. How Capital is Obtained

1. Form a corporation
   a. sell stock
2. By a sole proprietor forming a partnership
3. By going into debt
   a. short-term loan
   b. long-term loan

Equity capital: Personal savings used to purchase common stock is called.

"Equity capital." Those who put up equity capital take the biggest risk. They may not get dividends, if their company does not make a profit.

Not all of the capital needed by companies is necessarily raised through the sale of common stock.

<u>Debt Capital</u>:

Bonds which pay a fixed rate of interest are "debt capital," as are monies loaned by banks. Debt capital represents much less of a risk to the investor than equity capital.

If the interest on debt capital is not paid, or if the company goes out of business, those who put up this capital take over the ownership of any assets of the company. These fixed interest payments are usually far less than is earned by common stocks.

Companies, except in rare instances, need more equity than debt. Usually, the ratio is 3 to 1. Debt capital generally cannot be obtained unless there is

sufficient equity capital invested to provide bond holders and banks with adequate security.

New capital is needed to keep companies going, to make them expand and grow and prosper.

Capital is needed to replace worn out equipment or to buy new and better machines for doing old jobs. Some tools, machinery and entire manufacturing processes are rendered obsolete. Many millions of dollars are required to keep certain industries "up to date" with recent discovered advances in science and management.

When corporations net under $25,000 the tax rate is 22%.

D. New Capital for Old Companies

1. To replace facilities that are worn out or obsolete
2. To provide for new products and processes
3. To provide for expansion

E. What Limits Capital

1. Tax rates on
   a. corporations
      1) The top corporate rate today is 48 per cent.
   b. individuals
      1) Tax rates start at 14 per cent and go on up to a top of 70 per cent.
   c. double taxation
      1) First, the income is taxed when it is earned by the corporation.

         Second, it is taxed again when the individual pays his income tax on the dividends he gets from the corporation.

Page 4[2]

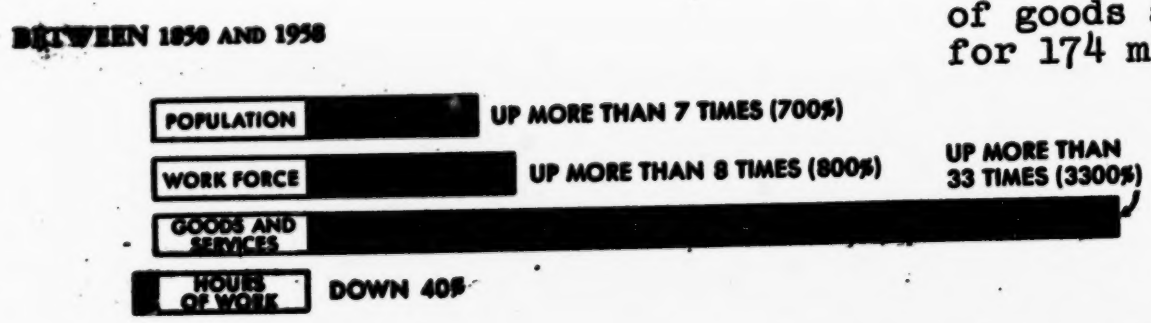
III. PRODUCTION AND PRODUCTIVITY

A. Definition

1. Production - our total "output"
2. Productivity - Efficiency of output is usually described in terms of units of human labor put into production and is called productivity.

B. Rate of Growth

1. In 1850
   Seven and one-half million Americans (about 1/3 of the population of slightly more than 23 million) worked an average of 72 hours a week. They produced goods and services that would have been worth about 12 billion dollars in 1955.
2. In 1955
   Sixty-four million people (about 37% of our population worked an average 40 hour week. They produced, in 1955 dollars, $400 billions of goods and services for 174 million people.



C. Factors Entering into Increased Productivity

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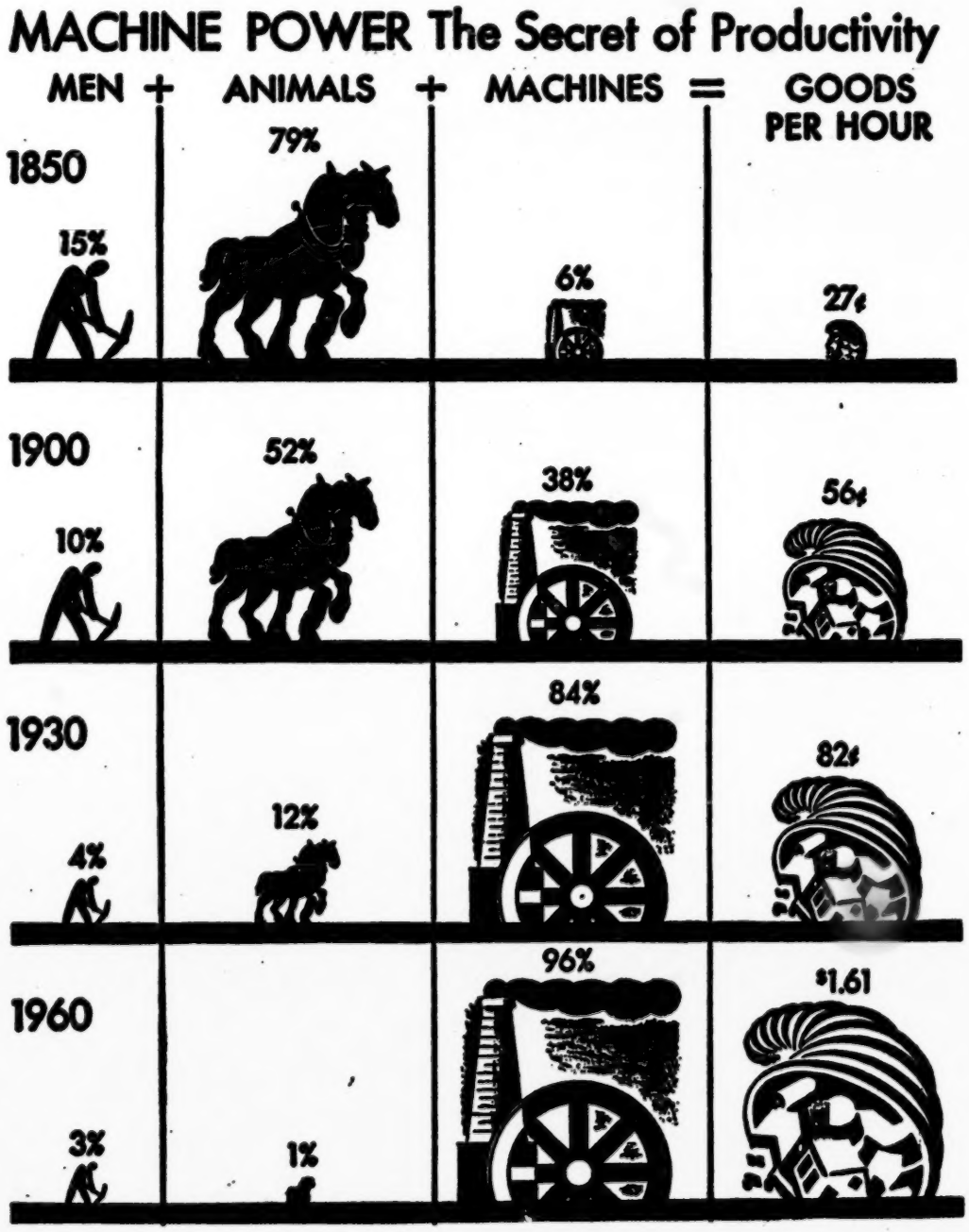
[2]National Association of Manufacturers, Industry and the American Economy, New York, N.Y., Booklet Number 4, "Productivity and Production in Industry," Second Printing 1961.

(III, C, continued)

Future progress lies in raising our output per man-hour though increasing use of machine power.

1. Machine power
   a. Back in 1850 men and animals supplied most of the energy for our work. By 1960 machine power supplied 96 per cent of the energy we used. This meant that we could turn out six times as much per man-hour of work.



2. Innovations that save labor
   a. new and improved machines

(III, C, continued)

b. the development of new procedures
   1) the development of the "line" method of production (assembly line)
   2) mechanical conveyors
c. new materials
   1) plastics
   2) aluminum
   3) etc.

3. Imagination
4. Money
   a. The United States spent approximately $120 billion on research and development in 1960.
   b. capital for putting these innovations into use

In 1850 there were about 110,000 inventions, but in 1960 the number of inventions registered in the U. S. Patent Office was approximately 3,000,000.

5. Work force
   a. human factors
      1) employee's experience
      2) attitude toward work
      3) his skill
      4) his morale
   b. mobility of the work force
6. Favorable economic climate
   a. efficient transportation systems
   b. willingness of people to save and invest their money in industry
   c. willingness of the customer to accept new products.
7. Nature
   a. abundance of oil
   b. abundance of coal

(III, C, continued)

8. Governmental Policies
   a. anti-trust policies
      1) protected competition

D. Looking Ahead

1. By 1975
   a. population of 220 million people as compared to 164 million in 1955
   b. 20 million more people working than in 1955
   c. We should produce about $700 billions of goods and services as compared to 392 billions in 1955.
   d. The average per capita income should be about half again as large as it was in 1955.

2. By 2050
   a. We should be able to support twice the population of 1950.
      1) Population in 1950 was 151.3 million.
   b. We should enjoy eight times the income of 1950
      1) Average per capita income in 1950 was $1,740.
   c. This would allow those next-century Americans counted together to spend:
      1) 8 times as much on food and nutrition.

In 1960 we had a population of 179.3 million.

From 1955 to 1960 we increased our employed work force by 4.5 million.

Our production of goods and services increased from 392 billions in 1955 to 504.4 billions in 1960.

Per capital personal income is found by division of total personal income by total population.

Our per capita income increased from $2,000 in 1955 to $2,223 in 1960.

(III, D, continued)

2) 16 times as much on shelter and home maintenance.
3) 20 times as much on clothing and personal care.
4) 30 times as much on health and education.
5) 33 times as much on clothing and travel.

References

National Association of Manufacturers, Industry and the American Economy, Booklet Number 3, "Capital and Economics Growth," pp. 3-13.

National Association of Manufacturers, Industry and the American Economy, Booklet Number 4, "Productivity and Production in Industry," pp. 3-13.

Films

1. The Basic Elements of Production, 16 mm, sound, Black and white, 14 minutes, by Encyclopedia Britannica Films, Inc., 1414 Dragon Street, Dallas 2, Texas.

This film defines and explains the factors necessary for the production of goods and services in the community.

Discusses the four essential elements of production and how they are handled.

1. Natural Resources
2. Labor
3. Capital
4. Management

2. The Story of Creative Capital, 16 mm, sound, Technicolor, 14 minutes, by Audio Visual Service Department, Chamber of Commerce of the United States, 1615 "H" Street, N.W., Washington 6, D. C., rental $5 for 3 days.

Films (Cont'd)

This film shows you the progress--through the years--of America's standard of living. What's been the key to this steady improvement in our way of life? The free enterprise system, fed by the invested dollars of millions of Americans.

Here's the vital story of risk capital in our business system--the drama of our profit-and-loss economy, and the part that all Americans play in keeping that system free to expand and improve our standard of living. You will learn how invested dollars create new products and new jobs.

SESSION III

THE ROLE OF COMPETITION

Objectives

I. To show the importance of competition to our American economy.

II. To explain the many ways that companies compete.

III. To discuss business size and competition.

IV. To take a look at foreign competition and its effects on our American economy

INDUSTRIAL ECONOMICS

The Role of Competition

I. INTRODUCTION

In the U.S. there are about four million individual separate business establishments outside of agriculture, and six million more in agriculture, producing some eight million different items. This provides ten million centers of initiative and enterprise, ten million places where experiments may be tried, usually without any outside authorization or control. Out of this vast, divergent effort, the more aggressive and enterprising are constantly stumbling upon, designing or inventing the new.

On the economic side it is difficult to imagine this great technical development and expanding output of goods of the last century or so without the presence of a high spirit of rivalry, of keen competition.

Page 3[1]

II. COMPETITION

A. Definition

1. The effort of two or more parties, acting independently, to secure business by offering the most favorable terms.

We also have some regulated monopolies; gas and electric companies; railroads, telephone companies; and occasionally price controls, which set the maximum prices allowed on various goods.

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[1]National Association of Manufacturers, Industry and the American Economy, New York, N.Y., Booklet Number 7, "The Role of Competition," Third Printing 1962.

(II, continued)

B. Importance of Competition

1. Competition is the basic regulator of our economy.
   a. The forces of competition direct valuable manpower and material resources (capital) to industries where they are used to the best advantage.
   b. Competition is also the means whereby the public is protected against unfair treatment by business.
2. Competition Protects Individuals
   a. In a competitive labor market the individual finds that, in effect, several employers are bidding for his services.
   b. The employer knows that he faces competition and needs the most competent help he can find to meet it.
   c. Competition also makes for freedom of opportunity to enter a business.
   d. The customer's interests are also safeguarded by competition.
      1) Costs and prices are held down
      2) wider choices and improved quality

C. How Companies Compete

1. Technical innovations

(II, C, continued)

a. new products
b. new processes
c. new uses for an existing material

2. Product differentiation
   a. Each producer tries to add some feature to his product that will make it different from competing products.
3. Marketing
   a. advertising is part of the economic function of marketing
   b. consulting services
      1) producers of paint render advisory service to the sellers of paints
      2) the manufacturers of agricultural machinery and chemicals help the farmer improve his practices
      3) the makers of production machinery help their customers to make decisions about automation

D. Local Service

1. Delivery service
2. Parking lots
3. Storage boxes
4. Price competition
   a. the traditional, and very often the most convincing, way to compete is by giving the customer a product for the same price

(II, continued)

Film number 1 may be shown here.

E. Business Size and Competition

1. Big business, small business and competition
2. Size or concentration

F. Foreign Competition

1. In recent years, foreign competition has caused major problems for important sections of the United States competition.
   a. foreign wages are lower
   b. Economic aid--including instructions in "industrial know-how"--has been one of our chief exports.
   c. Certain foreign countries have done a better job of controlling inflation than we have.
   d. "Exporting" capital by building plants in foreign countries.
2. What this means for the American economy
   a. prosperity of other parts of the world is a good thing
      1) means potential markets
      2) easing of the burden on the American taxpayer
   b. What action must be taken to keep foreign competition from becoming a major threat to our economy
      1) Industry must strive to maintain--or increase-- the technological advantages that make for increased productivity and lowered prices.

(II, F, continued)

2) Labor must show restraint to keep wage costs from mounting, although American wage rates will remain high.
3) Government can help by controlling inflation and by re-examining tax policies and tariffs.
4) need for negotiations that will increase the volume of exports by removing the barriers to American products in some countries

References

National Association of Manufacturers, Industry and the American Economy, Booklet Number 7, "The Role of Competition," pp. 3;14.

Films

1. Competition and Big Business, 16 mm, sound, color, 22 minutes, by Encyclopedia Britannica Films, Inc., 1414 Dragon Street, Dallas 2, Texas.

This film deals with the following major issues: Is Economic Competition Really Working? Is Industrial Concentration--Big Business--Compatible With a Free, Competitive Society? Do Competitive Practices Differ With Size and Type of Business?

2. Competition In Business, 16 mm, sound, color, 14 minutes, by Coronet Films, Coronet Building, Chicago 1, Illinois, 60601.

This film illuminates competition, first by introducing the vast variety and scope of competition, and then by dramatizing one firm's experience in creating, manufacturing, and marketing a competitive product.

One of the major points in the film is that the customer benefits most from competition.

SESSION IV

THE ROLE OF MARKETING

Objectives

I. To study marketing functions and their relationship to the consumer.

II. To look at the cost of distribution to see why the "tail is wagging the dog."

III. To examine laws that affect our marketing system.

IV. To summarize the importance of marketing for the present and the future.

INDUSTRIAL ECONOMICS

The Role of Marketing

I. INTRODUCTION

How would you, as a consumer, like to go to a farmer to get the wheat you need for your bread, invest your money in enough wheat to last you for a year, store the wheat in your basement, take the wheat to a mill as you need it made into flour, and then use the flour to make bread? If you contemplate these problems, you will realize the valuable functions performed by the marketing system. The marketing system is just one further evidence of the advantages of specialization.

Entirely too few people know anything more about the marketing system than they have learned through their experience in buying goods in retail stores. Since marketing affects every consumer directly, he should know what functions it performs and how it operates so that he may get the most benefits from the marketing system.

Page 3[1]

II. THE ROLE OF MARKETING

A. The Role of Marketing is to Get Goods and Services to us in the Right Form and Amount, at the Right Time and at the Right Price.

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[1]National Association of Manufacturers, Industry and the American Economy, New York, N.Y., Booklet Number 10, "The Role of Marketing," First Printing 1961.

III. MARKETING FUNCTIONS AND COSTS

A. Introduction

1. A major marketing problem of any firm is to determine what its prospective customer will buy.

B. What Customers Want

1. Market research
   a. The aim of market research is to collect, analyze and disseminate to the rest of the company facts concerning the market, customers needs, reactions to products and the outlook for the company's products.
      1) follows census bureau data on population shifts
      2) makes economic analyses
      3) interviews customers
      4) goes through the information transmitted by salesman
      5) measures the effectiveness of current and past programs
      6) estimates the sales outlook for the future
      7) it includes research on:
         a) costs
         b) economic trends
         c) market areas
         d) types of outlets for sales
         e) income distribution

(III, B, continued)

8) inquires into the reasons why people buy various things
9) studies who is likely to buy the firm's product:
   a) housewives?
   b) mechanics?
   c) children?
   d) professional people?
10) Are their customers city people, country people, suburbanites?
11) Helps determine the feasibility of introducing a new product.

2. Product planning
   a. management responsibility involving the evaluation and modification of all ideas for new products
      1) Those involved in marketing must consider for each product idea such matters as:
         a) function
         b) appearance
         c) promotional features
         d) cost
         e) selling price
         f) quality level
         g) service features
         h) standardization and special adaptations

In our form of economic system selling and advertising are necessary. They have helped to create a large demand.

3. Advertising and selling
   a. salesmanship and advertising help us to choose among competing products.

(III, B, continued)

There are two general methods of stimulating demand. The first method is to pass on to each member in the distributive system the responsibility of selling the product at a particular stage in production. Under this method the manufacturer may sell to the wholesaler, the wholesaler sells to the retailer, and the retailer sells to the consumer. The retailer has the final responsibility of selling the product to the customer.

The second method is to create consumer demand. Under this plan the manufacturer buys advertising space in newspapers, magazines, uses time on T.V., and employs various other means of mass advertising to tell customers about his goods, thus causing them to want his goods in preference to others. Under this method, the function of selling is partially reversed. The customer demands the product from the retailer; the retailer buys it from the wholesaler, who buys it from the manufacturer.

In actual practice, the two methods are almost always intermingled; the manufacturer advertises to the public, but he also has salesmen to call on wholesale dealers. The wholesaler or manufacturer, in turn, may advertise to the public; but he will also send salesmen to call on retailers.

b. It stimulates us to an awareness of the variety of things we want.

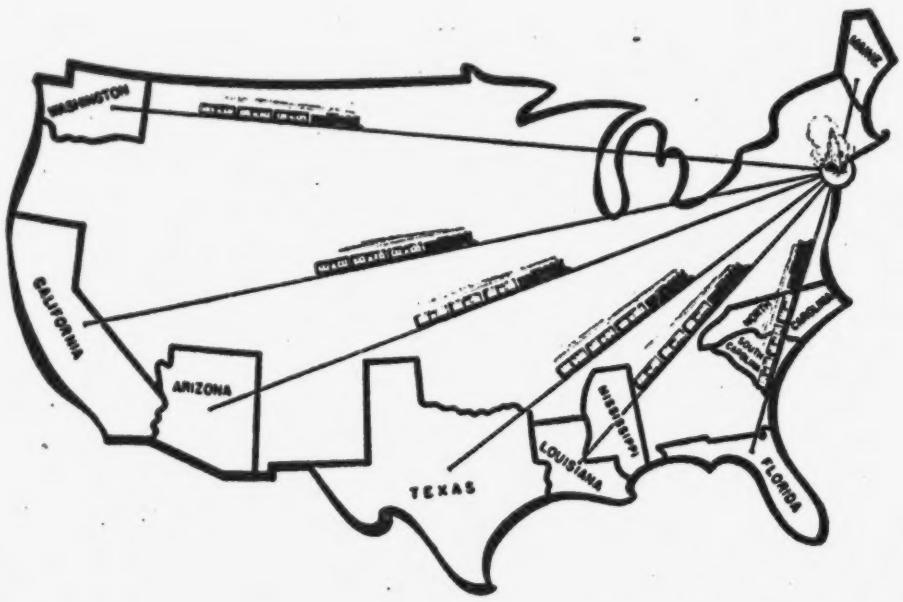
(Unit III, continued)

Great sums of money are expended annually for advertising.

New York City's sources of fresh fruits and vegetables during the winter and summer months

C. Other Marketing Functions

1. Transportation



The transportation costs take an average of 20 cents from each dollar that the customer spends for these foods.

Without storage many products could not be enjoyed. The fact is especially true of such products as meat, eggs and fresh vegetables. These foods are available as the result of cold storage. The introduction of quick-freezing methods of storage brings to our tables fresh fruits and vegetables in all seasons, preserved with their original flavors.

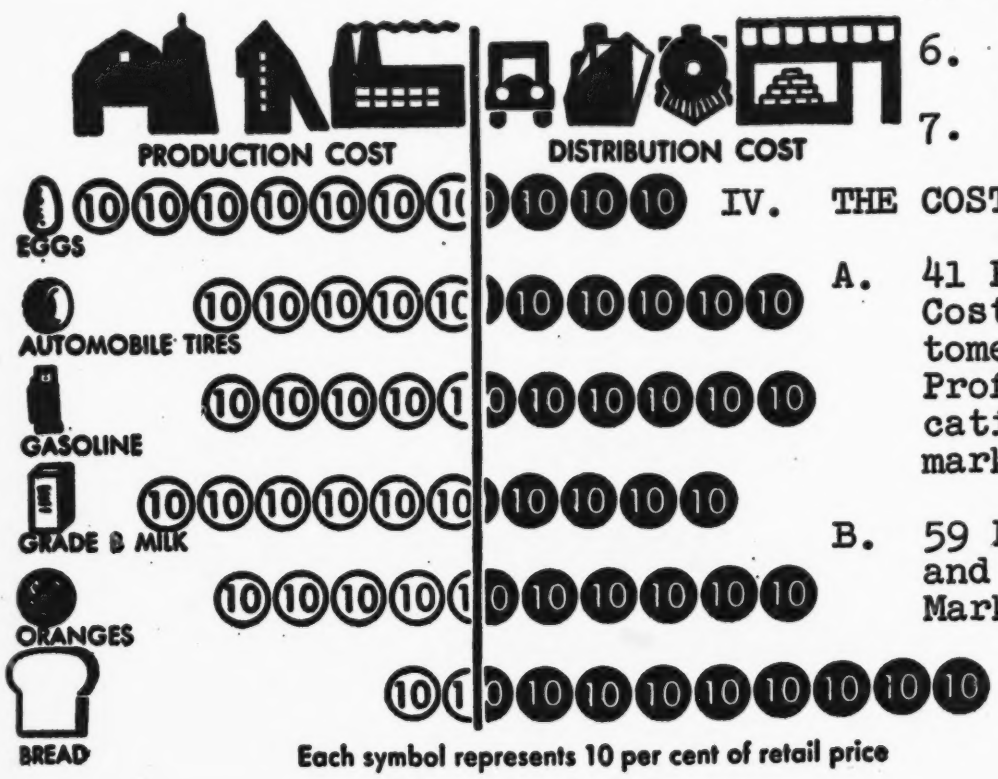
2. Storage

(III, C, continued)

3. Inventory

Many individuals and businesses must carry an inventory of goods. For example, manufacturers assemble raw materials for manufacture. Wholesalers assemble many types of manufactured goods from many different manufacturers located in many different places and make those available for the retailer. The retailer assembles a considerable variety of goods from different wholesalers and makes these goods available for the consumer.

4. Breakdown of bulk
5. Assembly of related products
6. Financing of goods in exchange
7. Servicing of products



IV. THE COSTS OF DISTRIBUTION

A. 41 Per Cent of the Total Costs of Products to Customers is the Cost and Profit Involved in Fabrication or Other Nonmarketing Operations.

B. 59 Per Cent was the Cost and Profit Involved in Marketing.

This will be covered more thoroughly in Session VII.

V. MARKETING, THE LAW AND GOVERNMENT

A. Federal Anti-Trust Laws

1. Sherman Act
2. Clayton Act
3. Federal Trade Commission Act
4. Robinson-Patman Act

B. Many Other Federal Laws Affect Sales and Distribution

1. One group of these includes the statutes designed to protect property rights in trade-marks, trade names, and copyrights.
2. The pure food and drug laws

C. Local and State Laws and Regulations Offer Remedies Against Deceit and Fraud.

VI. INDUSTRY'S POINT OF VIEW

A. Industry Supports Legislation Which is Designed to Curb Monopoly Power. However, Industry Opposes Legislation Which has the Effect of Unnecessarily Restricting Competition and, Therefore, Limiting its Good Effects on Our Whole Society.

B. Problems Arising Out of the Enforcement of Anti-Trust Laws

1. Differences of opinions in the interpretation of anti-trust laws
2. The change in the nature of competition over the past half-century
3. Identical pricing

VII. MARKETING AND OUR ECONOMIC FUTURE

A. Summary of The Importance of Marketing for the Present and Future

1. Marketing performs certain indispensable economic functions.
2. Marketing in the United States is organized within the framework of a free competitive system.
3. A large part--perhaps the largest part--of the cost of goods to their final purchasers is the cost involved in marketing them.
4. America's past economic growth was accomplished by a continuous increase in the importance of marketing effort related to the total economic effort.

References

National Association of Manufacturers, Industry and the American Economy, Booklet Number 10, "The Role of Marketing," pp. 3-14.

Films

1. It's Everybody's Business, 16mm, sound, technicolor, 22 minutes, by Chamber of Commerce of the United States, 1615 "H" Street, Washington 6, D.C., rental $5.00 for three days.

The opening of this film traces the career of an immigrant hat maker, from his arrival in colonial America to the time he becomes a successful individual businessman. In operating his own business--financed partly by his own capital, partly by investor--he learns that competition demands better products, advertising is necessary, and he learns that he must give a fair return to the people who invested their savings in his business.

Films (Continued)

The path of invested savings is traced through their roles in advertising, research and product development. Special note is made of the practice of "plowing back" part of the profits into the business for expansion, and the payment of dividends to those who have invested their savings in the business.

This film outlines the services provided by the taxes we pay, emphasizing the need to keep our economy free of unnecessary tax burdens.

2. Distributing America's Goods, 16 mm, sound, black and white, 11 minutes, by Business Education Films, 5113 16th Avenue, Brooklyn 4, New York, rentals $2.50.

This film shows distribution costs of producer, wholesaler, retailer, and ways distributors and consumers can cooperate to reduce these costs.

This film also discusses some of the marketing functions such as; advertising, transportation, storage, inventory, etc.

Much of the material covered in this film is also discussed in this session.

SESSION V

INCENTIVE AND ITS RESULTS

Objectives

I. To analyze wages and prices in an industrial economy--what they are, how they are related and what happens when they are out of balance.

II. To look at industrial profits--their importance and their size.

INDUSTRIAL ECONOMICS

Incentive and Its Results

Every person is affected by prices. Prices affect wages, profits, the buying of commodities, the making of investments and many other activities. This session will, for instance, show how a person may receive an increase in the prices of goods although he may not be able to buy as much with his new wages as he formerly was able to obtain.

I. INTRODUCTION

Page 2[1]

II. EARNING AND SPENDING

A. Introduction

1. Everyone--as a spender--wants lower (or, at least, stable) prices. Every one--as an earner--wants to be able to buy more of the goods and services he and everyone else produces. This part of this session is about wages and prices in an industrial economy--what they are, how they are related and what happens when they are out of balance.

B. Customers and Jobs

1. Introduction
   a. The volume of production and the level of employment are

[1]National Association of Manufacturers, Industry and the American Economy, New York, N.Y., Booklet Number 8, "Wages and Prices in an Industrial Economy," Third Printing February, 1962.

(II, B, Continued)

determined by the quantity of goods and services which buyers are willing and able to take at prices which yield a profit to their producers. More simply, when people buy a lot of things, a lot of people are kept at work making them.

2. Example of buying behavior with respect to a single product--a clock.
   a. If clock costs $20, he might buy one.
   b. If cost was only $5, he might buy two.
   c. If cost was only $1, he might buy one for every room in the house.

Let us generalize and trace through this situation in a hypothetical industry--say the manufacture of "Wambots."

3. Hypothetical industry
   a. customers
      1) The potential behavior of all consumers of Wambots might be summarized in the following way:

Price	Number of Wambots Sold per Year	Total Dollar Sales
$10	100,000	$ 1,000,000
5	10,000,000	$ 50,000,000
4	40,000,000	$160,000,000
3	60,000,000	$180,000,000
2	80,000,000	$160,000,000
1	100,000,000	$100,000,000

   b. jobs
      1) Facts concerning the number of jobs this Wambot industry can generate.

(II, B, continued)

a) The number of persons the Wambot industry can employ depends on the number of Wambots the industry can make and sell.

b) The price at which the Wambot industry can afford to sell its product depends--among other things--on the wages it must pay its employees.

C. "Raises" Are Not The Solution

1. General wage increases do not--and cannot--result in people having more money, much less more goods.

a. We do not create money by our activities in buying and selling goods, or in paying wages to each other.

III. THE ECONOMIC FUNCTIONS OF PRICES

A. In This Discussion We Are Primarily Interested in The Function of Prices in the Economy as a Whole. From That Point of View--

1. Prices are an expression of choice.

2. Prices reflect changes in preference and the need to reallocate resources.

(III, A, continued)

3. The price system is an efficient regulator of production and distribution.

B. Free Market Prices vs. "Just" or "Fair" Prices

1. Free market prices
   a. From the point of view of the effective functioning of the economy, the most desirable price is that which results from competition in the free market.
2. "Just" or "fair" prices
   a. prices regulated by government bodies such as public utility rates.
   b. risk of government intervention in a price system
      1) The control of the price of one commodity may require the control of the prices of others until a free market economy is displaced by a direct or controlled economy.
   c. example of this type system
      1) farm program

IV. WAGES AND EMPLOYMENT

A. As Has Already Been Indicated Wages are Among the Biggest Costs of Industry and Arbitrary Attempts to Raise Wages May Result in a Contraction of Business Activity.

(IV, A, continued)

1. Does this mean that we can have either high level employment or good wages--but not both?
2. Does it mean that any attempt to raise the standard of living of American employees must be paid for by unemployment?
3. Fortunately, this is not the case at all, the workable level of wages does not have to remain the same year after year.
   a. It can be, and has been in terms of "real wages."

B. Productivity

1. The reason why arbitrary increases in the general wage level do not benefit even those who receive them is that the price of goods is closely tied to the wages of the people who produce them.
   a. example
2. Productivity growth is the only way the general wage level--in terms of the standard of living wages buy--can be raised.

Film number 3, Why Play Leapfrog, can be shown at this point.

V. THE RELATIONSHIP BETWEEN WAGES AND PRICES

A. Prices and Wages Do Not, of Course, React Upon Each Other Independently of Other Economic Factors. Each of Them Affects, and is Affected by a Host of Other Economic Variables: Productivity, Competition, Profits, Money Supply, the Availability of Credit, the State of Confidence, Fears of Future Shortage, Foreign Competition, etc.

(V, A, continued)

1. One theory is that wage increases are automatically followed by roughly proportional price increases.
2. At the opposite extreme is the argument that there is room for substantial wage increases out of profits and, therefore such wage increases need not be followed by any price increase at all.

Have Charts II, "Trends in Unit Labor Cost," and Chart III, "Trends in Unit Profit," drawn up large for illustrations. (see charts below)

B. Wage Costs and Profits

1. The two charts (Charts II and III) show the trends in unit labor costs and in unit profits for the output of the private economy since 1939.
   a. Profits--whether before or after taxes--have had their ups and downs.
      1) The after tax trend has been downward since 1948.
   b. Labor costs leveled off during some periods but have not shown a downward trend since 1939
      1) Unit labor costs more than doubled between 1939 and 1959.
         a) These labor costs reflect increases in both wages and fringe benefits.
         b) The increase occurred in spite of substantial gains in productivity during that period.

CHART II
TRENDS IN UNIT LABOR COST

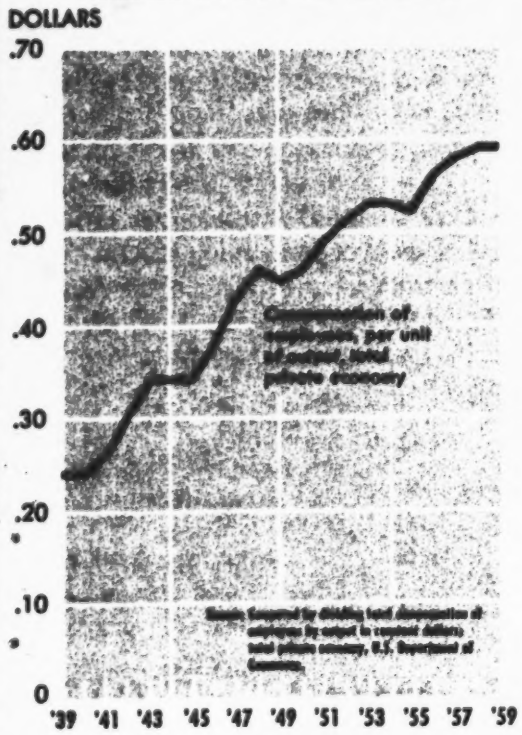
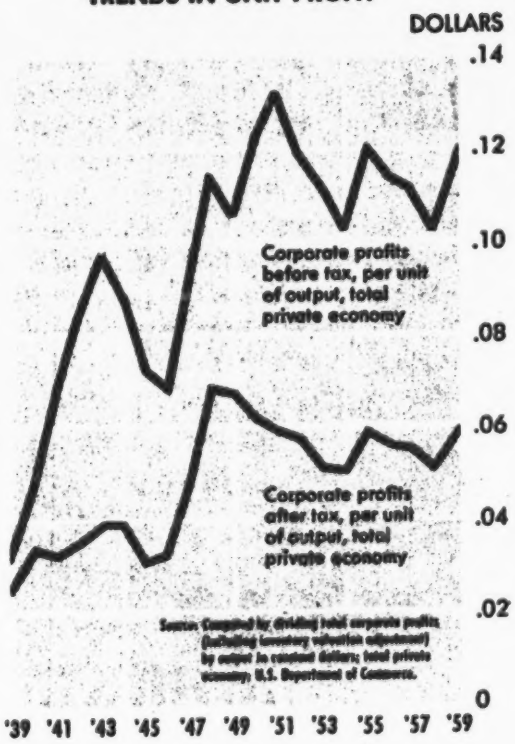


CHART III
TRENDS IN UNIT PROFIT



VI. INFLATION AND ECONOMIC GROWTH

A. The General and Continuing Increase in Prices Indicates that Our Economy is Faced by the Problems of Inflation. Our Dollars are Worth Less From Year to Year. Since the End of World War II we have Suffered From Two Different Types of Inflation.

1. "Demand pull"
   a. too much money chases too few goods
      1) wartime or postwar
2. "Cost push"
   a. when prices remain high, and the backlog of demand for consumer goods are pretty much satisfied and people begin to resist further rises
      1) 1951-1952

Film Number 1, Your Money Is What You Make It, can be shown here.

B. The Desire for Better Pay in Relationship to the Hope for a Higher Standard of Living Cannot be Satisfied by Inflationary Wage Increases Which are Matched by Equal Increases in the Cost of the Things the Wage Earner Buys.

Page 3[2]

VII. PROFITS AND OUR BUSINESS SYSTEM

A. Profits are Vital to Our Business System as a Whole and, Therefore, to Each and Every Individual--No matter How He Earns His Living. A Business is Started in Our Economy With the Expectation of a Profit.

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[2]National Association of Manufacturers, Industry and the American Economy, New York, N.Y., Booklet Number 5, "Industry's Profits," First printing September, 1959.

(VII, Continued)

B. Profit is the Return--After Cost--to the Enterpriser Who Takes the Responsibility and the Risk Involved in Organizing and Managing a Business.
   1. Individual
   2. Partnership
   3. Corporation
      a. stockholders

C. Once a Business Has Been Started, it Becomes Important to People Other Than Those Who First Thought of it.
   1. Employees
   2. Tax revenue for city, state, federal government
   3. Retailers and their customers
   4. People who have invested their money in the company
   5. Suppliers of machines and materials have a new customer

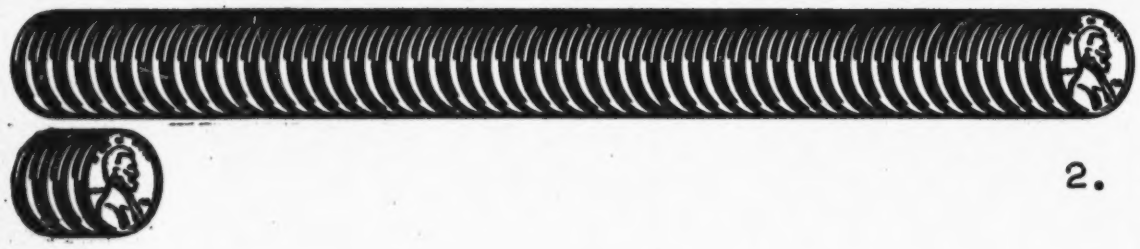
VIII. WHAT COMES BEFORE PROFITS

A. We can Only See Where Profits Come in When We Consider All the Costs. The Figures We Will Use are Typical of The Actual Business Costs of Manufacturing Companies in the United States.

B. If We Look at What Happens to Each Dollar the Company Gets for Selling its Product We Find That:

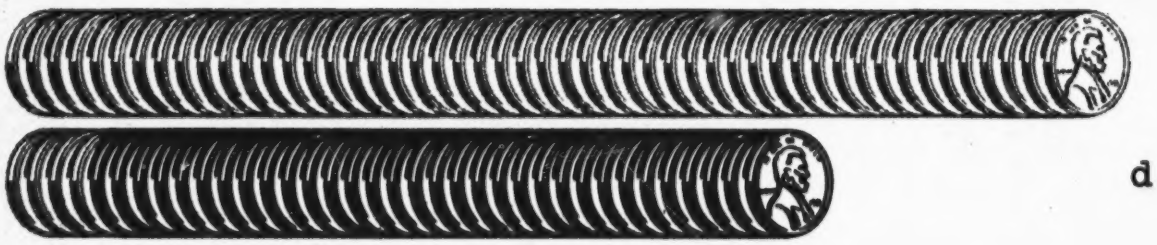
   1. 54 cents goes to other businesses for supplies
      a. raw materials

(VIII, B, continued)

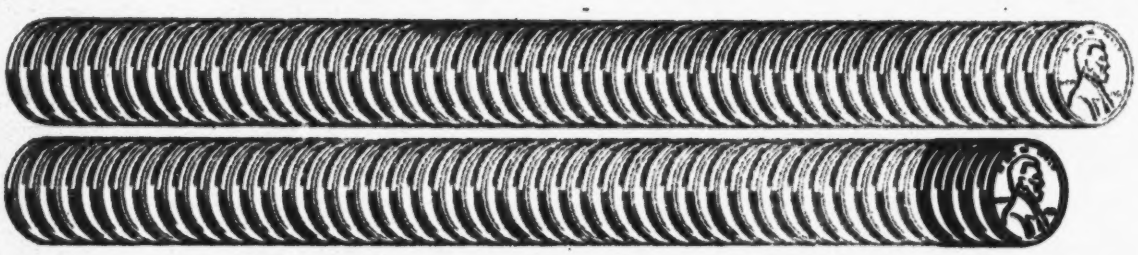


a. raw materials
b. fuel
c. electricity
d. boxes, crates
e. office supplies
f. telephones
g. many other products and services

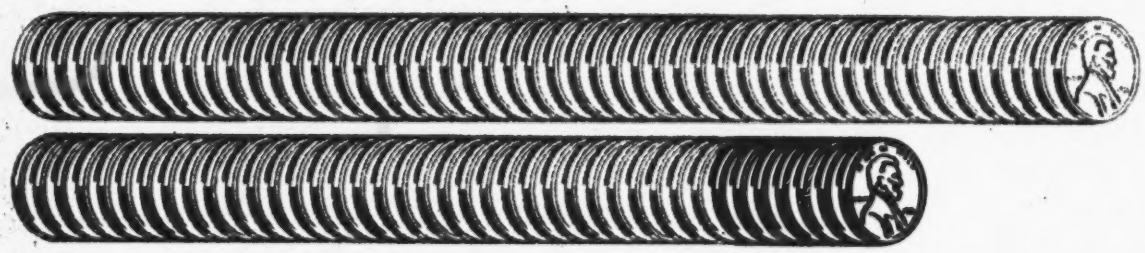
2. 32 cents go to employees
   a. wages
   b. matching each employee's payment for social security tax
   c. compulsory state programs
      1) workmen's compensation and unemployment insurance
   d. fringe benefits
      1) group life insurance
      2) pensions
      3) hospitalization
      4) paid vacations



3. 4 cents are put aside to replace machinery and equipment
   a. obsolete machinery
   b. worn out machinery and equipment

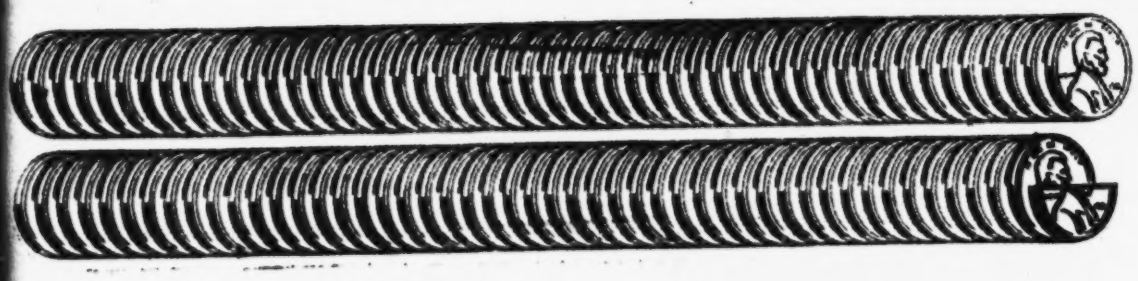


4. 7 cents goes for taxes
   a. local
      1) property taxes
   b. state
      1) state income tax
      2) various fees and taxes such as the charge for incorporation
   c. federal
      1) up to $25,000 net 22%
      2) over $25,000 net 48%

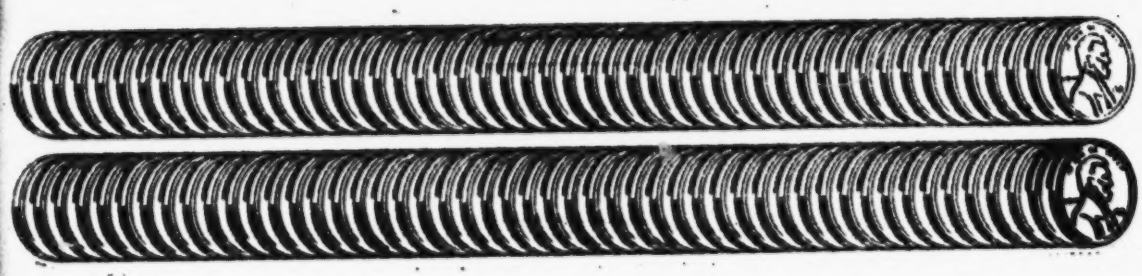


(VIII, B, continued)

5. 1½ cents as payment to the owners in the form of dividends



6. 1½ cents to grow on
   a. make more and better products
   b. expand operations
   c. create more and better jobs



C. Could the Last 3 Cents be "Saved?"

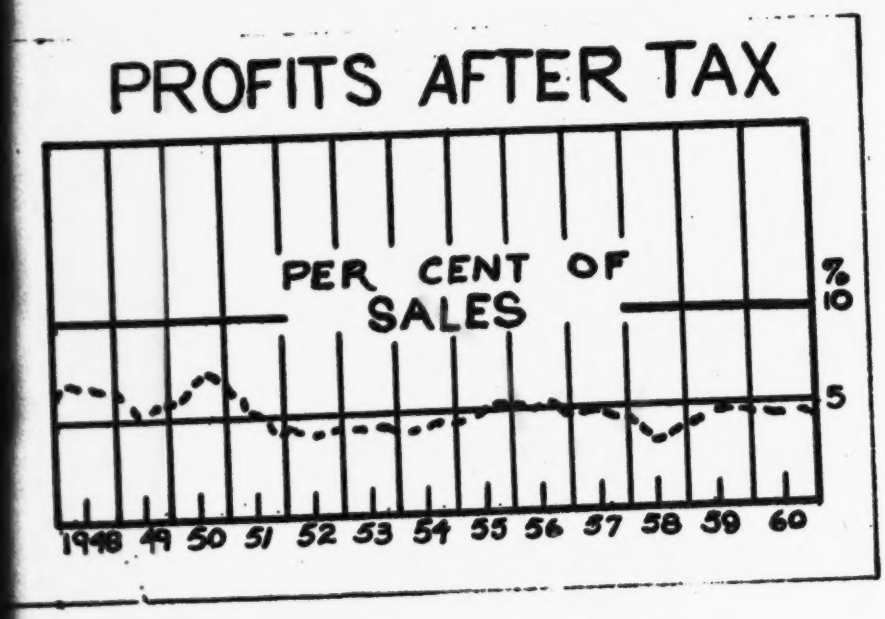
1. If this 3 cents were deducted from the price or paid out in wages would anyone benefit?
   a. A company's profits are necessary to expand the economy; to make new jobs; to raise living standards to attract and reward investors.

IX. DOES INCREASED OUTPUT NECESSARILY MEAN INCREASED PROFITS?

A. "No." On the Whole, the Period Since World War II Has Been One of Dynamic Growth in Manufacturing. But Corporate Profits in Manufacturing Industries Have Shown a Marked Decline During the 1948-1960 Period.

The total real private output per man hour, during the period 1948-1960, has increased at the rate of about 2.8 per cent per year.

(IX, A, continued)



1. Labor costs have gone up.
2. Amount put aside to replace machinery and equipment is usually insufficient because of continuing inflation.

B. In Spite of Increased Output, The Profit Margin in American Manufacturing Declined Between 1948 and 1960 because of increasing costs.

PROFITS PLUS

A. During This Session We Have Been Discussing Profits as They Related to the Operation of Business and Industry. But Profits Have Other Significance to Every One of Us.

1. Profits earned in one industry have been used to help start or expand others.
   a. increased job opportunities
   b. increased our standard of living
2. Profits make possible support of charitable and educational organizations and institutions.
3. The hope for profit has helped to develop our country.

B. The Profit System Has Brought and Will Continue to Bring us Better Jobs, More Leisure, Better Schooling, More and Better Goods and Services.

Film Number 2, Everybody Knows, can be shown at the end of session.

References

National Association of Manufacturers, Industry and the American Economy, Booklet Number 8, "Wages and Prices in an Industrial Economy," pp. 2-10.

National Association of Manufacturers, Industry and the American Economy, Booklet Number 5, "Industry's Profits," pp. 2-10.

Films

1. Your Money is What You Make It, 16 mm, sound, color, 20 minutes, by National Association of Manufacturers, Education Department, 2 East 48th Street, New York 17, N.Y., Rental $3.50.

This film demonstrates that when the quantity of money increases faster than the goods available for purchase, the value of money is reduced, while prices go up.

Also when production increases, without an increase in the quantity of money available to purchase goods, prices go down as more goods are made available.

Explains how our economy is thrown off balance during war time.

Also shows how the value of the dollar was cut almost in half between 1939 and 1950.

2. Everybody Knows, 16 mm, sound, live action, color, 15 minutes, by Audio-Visual Services Department, Chamber of Commerce of the United States, 1615 "H" Street, N. W., Washington 6, D.C., Rental $5.00.

In the town where Bill Richards works is a factory which has recently closed down--the business failed. This closed factory is an enigma to Bill, who had worked there until the final layoff and then had been forced to find another job. The unanswered question in Bill's mind is: "Why did this factory close?"

Bill seeks the answer to this question through conversations with five key individuals. First is the grocer who knows first-hand the problem of profit-and-loss, rising costs and consumer resistance to price rises. Second is the ex-president of the union local in the closed plant, who makes it clear to Bill that the union did exactly what the members wanted in going after larger and larger wage increases each year. Third is a stockholder, a widow who had relied on income from her stock-holdings as a principal source of income. Fourth is former

Films (Continued)

company salesman who can explain meaningfully the customers' reaction to cost and price rises. Finally, Bill discusses his question with the former president of the closed plant.

Everybody Knows spotlights vital facts about wages, prices, profits, the cost of living, productivity, and jobs.

3. Why Play Leapfrog?, 16 mm, color, 10 minutes, sound, by Business Education Films, 5113-16th Avenue, Brooklyn 4, N.Y., Rental $2.50.

This film shows through an animated cartoon how increases in wages result in increased prices, points out that wage prices based on increased productivity increase without corresponding increase in productivity, force prices higher so that the two can, and frequently do, "play leapfrog."

SESSION VI

THE ROLE OF ORGANIZATION IN OUR ECONOMY

Objectives

I. To study the functions of owners, managers, and non-managerial employees within an industrial organization.

II. To explain their responsibilities and relationships in achieving the economic goal--a successful business enterprise.

INDUSTRIAL ECONOMICS

The Role of Organization in Our Economy

The last step in promotion of a commercial venture, organization, is one of the most important considerations that must be faced. Every organization, no matter what its size, must be properly set up or it will not run efficiently.

This session deals with the responsibilities and relationships of people-owners, managers, and non-managerial employees in American industry.

Page 3[1]

I. INTRODUCTION

II. OWNERS, MANAGERS AND EMPLOYEES

A. Introduction

1. At the initial stage in the formation of an enterprise, a person or a group of people pool their savings and establish a company. They are the owners. If they decide to form a corporation, they get a charter from the state. They then hire people who represent them and who manage the company on a day-by-day basis. They are the managers. They are responsible to the owners who may discharge them if they are not satisfactory. Frequently the same people are owners and managers. This would be true in a

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[1]National Association of Manufacturers, Industry and the American Economy, New York, N.Y., Booklet Number 9, "Industry--Organization and Employees," Third Printing, February, 1962.

(II, A, continued)

small retail store or a small family service business. It is also true in larger enterprises where the president of the company is often a large stockholder. As a matter of fact, in many corporations, employees at all levels are shareholders.

When the decision on what business to enter has been made, it is the managers who guide the business in a competitive market, organize the physical resources and human skill, supervise employees, try to satisfy customers, meet the payroll and other costs, and earn a profit. Management organizes the activities and resources of the enterprise in order to satisfy all these objectives.

In a corporation, everyone below the Board of Directors--from the president to the newest man on the production line and the youngest file clerk in the accounting department--is an employee.

B. Owners

1. Some American companies have hundreds of owners, others are owned by a few people or only one person. Many companies are owned by individuals; A few have more than one million owners each. More than 12.5 million people own stock in American companies.

(II, B, continued)

These owners provide the money for the tools and other necessary capital for the production and distribution of goods and services. They do so in an attempt to make a profit; and to do so they take the risk of loss.

C. Managers

1. The major function of management is to organize resources so that the enterprise can function effectively. The type of managers needed vary with the objectives of the enterprise.

   In general usage, management is ordinarily considered to include those employees who have a responsibility for making decisions and supervising others, this would include, for example, the foreman in the factory.

D. Other Employees

1. In the United States, manufacturing provides employment for a wide variety of people, in addition to those traditionally thought of as "working in a factory."
   a. Between 1952 and 1957, the number of professional and technical workers rose by 45 per cent.

(II, D, continued)

b. In 1960, 44 per cent of the employed worked in the production industries, 56 per cent in the service industries.

c. In 1940, 54 per cent were employed in production industries; 46 per cent in service industries.

E. The Economic Goal

1. The responsibilities of owners, managers, and other employees are complementary. Each group has a function in achieving the economic goal--a successful business enterprise.

a. Production--the output of goods and services--is the purpose of the American economy and the hope for profit stimulates the organization of resources for production.

1) The skills of managers and employees translates the hope into achievement.

2. The joint achievements of the productive team are impressive. A recent study by the United States Department of Labor summarizes a 50-year change:

(II, E, continued)

a. With but 6% of the world's population and 7% of the land area, this nation produces more than one-third of the world's goods. The individual American worker's output today in a 40-hour week is 3 times that of his grandfather in a 70-hour work span.

3. Basic causes of this production record:
   a. high rate of power application
   b. development of tools and techniques
   c. a mobile and adaptable work force
   d. the experimental bent of the American busiman in a free enterprise economy, his surprising freedom from tradition and custom
   e. inventive genius in production methods and devices
   f. the vast stores of accessible raw materials (supplemented by synthetics).

III. MANAGEMENT AND THE INDIVIDUAL EMPLOYEE

A. Introduction

1. It is natural and right for each individual working in a company to be concerned about finding his place in the organization and developing his fullest

(III, A, continued)

potential. The employer is equally desirous of having each employee develop to the best of his ability.

These needs can only be met by management through sound personnel and human relations policies and practices.

In other words, good human relations--like good organization--help the enterprise to satisfy its economic objectives.

B. Classrooms in Industry

1. Education--including training in specific on-the-job skills is one area of employer concern that brings the employee the satisfaction of improving his competence and his earning potential and, at the same time, make him more valuable to the company. These training and education activities are very extensive and varied.
   a. apprentice training
   b. specialized training in new skills to keep up-to-date
   c. management training

C. The Safest Place To Be

1. There was a time when some manufacturing

(III, C, continued)

activities were considered hazardous. Today, employees in manufacturing industry are usually safer on the job than they are off the job.

2. Progress in safety has resulted from efficient machinery (good engineering and on-the-job safety education.)

D. A Pleasant Place to Work

1. Attractive working conditions increase the moral of the work force and contribute to maximum efficiency. These include:
   a. good physical working surroundings
      1) air-conditioning
      2) fluorescent lighting
      3) landscaped grounds
      4) background music
   b. good personal relationships
      1) Recreational and social activities are provided for families.
      2) information designed to give the families first hand experience with the company
         a) special letters
         b) plant tours
         c) booklets
   c. evaluation of personnel programs by the company
      1) by polls taken by the company

(III, continued)

E. The Universal Incentive

1. A universal incentive among employees is financial reward.
   a. Wages or salary is the basic financial reward.
   b. Fringe benefits are an important part of the economic reward of employees.
      1) paid vacations
      2) paid holidays
      3) profit-sharing payments
      4) health and medical protection
      5) bonuses
      6) pension plans
   c. Extra benefits, over and above wages or salary, constitute a substantial cost to the employer.
      1) It was estimated in 1959, fringe benefits cost the employer $1,132 per employee or 22.8% of total payroll.

F. The Employees Share

1. The increase in productivity resulting in this standard of living is essentially an achievement of owners and managers. The rewards of the increased productivity achieved have been fully shared by the employees.

IV. MANAGEMENT AND ORGANIZED LABOR

A. Introduction

1. Conditions of work are determined on an individual company basis or in negotiations with unions.
   a. Of 53 million non-agricultural wage and salary workers in the United States, 18,080,567 are members of Trade Unions.

B. "Unions and Labor's Share"

1. Employees have shared in the economic gains due to improved productivity.
   a. Unions are unable to obtain gains for employees for which there is no sound economic basis unless it does so at the expense of other people--including other wage earners.
2. Unions have grown in power and influence through special protection and exemptions provided for them in the law.

   Some legislation, such as the Taft-Hartley Act, has improved restrictions on unions.

TAFT-HARTLEY LAW

Industrial relations of firms engaged in the interstate commerce are thoroughly regulated by the Labor-Management Relations Act of 1947, more commonly known as the Taft-Hartley Law.

C. The Power of Unions

1. The power of unions is reflected in compulsory unionism in industry.

(IV, C, continued)

The Law covers four major subjects as follows:

1. Guarantees labor the right to organize and requires collective bargaining.

2. Prohibits interference with, or discrimination against, union activity.

3. Sets up a board to hear complaints of violations of the law and to provide for election and certification of unions as qualified representatives of employees.

4. Provides for governmental action in strikes that endanger national health or safety.

1. The power of unions is reflected in compulsory unionism in industry.
   a. The union shop, agency shop, maintenance of membership, and preferential hiring are forms of compulsory unionism.
   b. Unions have the power to exploit their members and limit the freedom of the working man.
   c. The power of unions can seriously affect the well-being of the economy by forcing it into inflation or unemployment.
      1) "Featherbedding" is an example of excessive union power that reduces productivity and economic growth through restricted work practices, the two essential characteristics of featherbedding are that they require the employer:
         a) pay for work not done in order
         b) to spread the available work or make more jobs.
      2) The railroad industry has seen some startling examples of these practices in recent years. Estimated costs of "featherbedding" runs about $500 million a year to the railroads.

V. SUMMARY

A. No Matter How Important Machines Become, People Are the Key to Our Progress.

B. As the Economy Grows, the Rewards of Improved Productivity are Shared by All Segments of Society.

C. Because of the Importance of People, Industry Makes Every Attempt to Provide a Good Place to Work and to Help the Individual to Develop His Abilities.

D. Unions are Accepted by Many as an Integral part of Our Economy Today. The Majority of People in Every Walk of Life Believed That Abuses of Power Should be Curbed.

E. Owners, Managers and Employees have One Vitally Important Goal in Common--a Satisfactory Profitable Business. Such Businesses are Necessary if Individuals--and the Nation as a Whole--are to Prosper.

Reference

National Association of Manufacturers, Industry and the American Economy, Booklet Number 9, "Industry - Organization and Employees," pp. 3-14.

SESSION VII

GOVERNMENT'S ROLE IN OUR ECONOMY

Objectives

I. To discuss government policies affecting the enterprise that is related to the conferees.

II. To look at and discuss some government agencies and laws that affect our industrial economy.

INDUSTRIAL ECONOMICS

Government's Role In Our Economy

This session may be handled by the leader in any fashion he or she thinks best. It can be lecture, discussion or a combination of both.

I recommend that the first part of this session be discussion.

You could find out from the group what regulations or restraints the government places on the enterprise they are associated with, Why these regulations or restraints are placed on this enterprise? Are they helpful to this enterprise? Why?

Make up your questions to fit your particular group.

I. INTRODUCTION

A. One of the basic principles of capitalism is that the individual should be allowed to pursue his own interests, free from government interferences, or restraint. Early economists believed so strongly in this economic liberty that they urged a policy called "laissez-faire," meaning that the government should "leave alone" businessmen completely and not watch or regulate them in any way. Our country has never applied the "laissez-faire" idea fully, for American business has always, to some degree, been subject to some form of regulation. Today even the strongest advocates of free and private enterprise generally concede that the economy must have at least some governmental control to operate efficiently.

B. Whether one believes strongly in absolute freedom from business regulation and controls, or leans equally far in the opposite direction toward a "planned economy," he is faced with the fact that the government plays an important role in the drama of American business. The businessman must take measures to see that his own enterprise operates within the boundaries of

(I, B, continued)

the Law, and He Also Takes Full Advantage of Government Services, For the Government's Impact on Our Economy Takes Not Only the Form of Regulation; it Also Makes Considerable Efforts To Be of Assistance to the Enterprise.

The following is a list of government agencies and laws that affect our industrial economy.

II. FEDERAL COMMUNICATIONS COMMISSION

A. Regulates the Field of Communications, Which Includes Telephone, Telegraph Cable, Radio, and Television

B. Supervises and Regulates The Competition, or the Government-granted Monopolies in This Field

III. FEDERAL POWER COMMISSION

A. Supervises the Electrical-power and the Natural-gas Industries.

B. Regulates the Competition, or the Government-granted Monopolies, in This Field

IV. FEDERAL TRADE COMMISSION

A. Is Charged With the Surveillance of Unethical Practices in Many Fields

B. The F. T. C. Act was the outgrowth of a demand for protection of competitors by the prevention of unfair methods of competition.

(IV, B, continued)

The Protection of the Consumer Was Not Originally the Expressed Purpose of the Act, Although the Consumer Did Benefit Indirectly. The Original Federal Trade Commission Act Provided Only "That Unfair Methods of Competition in Commerce are Hereby Declared Unlawful." Revision of the Law and Acts Pertaining to the F. T. C. Provide That "Unfair Methods of Competition in Commerce and Unfair or Deceptive Acts or Practices in Commerce are Hereby Declared Unlawful." Hence it is Not Necessary for Competition to be Involved in Order for an Act to be Unlawful.

C. Some of the Unethical Practices, Under the Surveillance of the Commission, Include False and Misleading Advertising, Exaggerated Medical Claims, or Fraudulent Claims of Official Approval in Advertising and Selling; Using False and Misleading Trade Names; Misbranding; False Statements About a Competition or His Products; or Unethical Tactics Used to Embarrass or Harass Competitors.

1. Sherman Antitrust Act and the Clayton Antitrust Act
   a. These acts declare that "combinations in restraint of trade" are illegal;

(IV, C, continued)

and the F. T. C. has been given the responsibility for enforcing these laws. The regulations did not set a standard of size above which a company could grow. Rather they prohibited business enterprises from combining together, or even cooperating with each other, if the effect of such combination is to make competition in the industry unduly difficult, or if the companies agree among themselves to stop the free movement of prices.

b. Public utility companies like those in the electrical-power, communication, and transportation fields, however, are permitted by the government to be monopolies. These public-utilities companies are, however, closely watched and regulated by the federal and state governments, so that they cannot take advantage of the public with reference to the services they render or the prices they charge for such service.

c. These antitrust laws are aimed not only at mergers, consolidations, holding companies, and other forms of business combinations. They also prohibit separate,

(IV, C, continued)

independent firms from making agreements among themselves to control prices or to throttle competition. Such informal contracts among competitors to cooperate and not fight each other for business are called "pools." When these agreements are on an international level, they are called "cartels."

V. FAIR-TRADE LAWS

A. Miller-Tydings Act

1. This is where state laws permit a manufacturer to set a retail price for his branded or trademarked goods. Giving him the protection of the law in enforcing the price and making all retailers charge only that price and no lower. These laws have been subject to considerable attack by consumer groups and retailers who wish to sell the manufacturer's goods at lower than the fair-trade price. Fair-trade laws have received many set-backs in the courts because of their doubtful constitutionality.

(V, continued)

B. Robinson-Patman Act

1. Under this act it is unlawful for a manufacturer, whosesaler or any other type of distributor to discriminate among his outlets as regards price, discount, or services. For instance, it is not lawful for a manufacturer to sell to one distributor at a lower price than he does to another, provided the conditions of the sale are the same.
2. Under this act the buyer and the seller are equally guilty if the seller discriminates.

VI. INTERSTATE COMMERCE COMMISSIONS

A. Regulates the Railroad and Overland Transportation Industries

B. This Commission Establishes rates for the Transportation of Products and Groups of Products Between Specified Points.

C. It is Evident That Railroads Have a Partial Monoply in That no New Roads can be Constructed Without Permission, but They Still Have to Compete on the Basis of Services and Conveniences.

VII. TAXATION

A. Through the Assessment of High Taxes, the Government Has Become, to all Intent and Purposes, a Partner in Every Enterprise. Businessmen Often Must Give Primary Consideration to the Influence of Taxation Upon The Net Profit They Produce From Their Enterprise. An Estimated Adequate Profit May be Decreased by Taxation to Such an Extent that a Particular Enterprise May Not be Worth the Risk Involved.

B. Whereas Other Expenses are Generally Encountered at Only One Stage of Business Operations or Need Only be Dealt With by One Particular Department, Taxes Pervade all Business Activities. Taxation, in One Way or Another, Affects Almost Every Move the Company Makes.

C. The Costs and Annoyances That Taxation Entail Have Many Secondary Effects on Business Enterprises. A Company, For Instance, Often Finds It Difficult to Obtain "Equity" Financing, That is, More People to Invest Money in That Firm. This Shortage of Investment Capital is Due to the Fact That the Company Must Pay High Corporate Taxes and, in Addition, the Stockholders are Taxed on The Dividends they Receive From the Corporation. The so-called "Double-Taxation" of Corporate Investors May at Times Discourage People From Buying Stock.

(VII, continued)

D. The Federal Government is Trying to Relieve This Shortage of Investment Capital by Passing a Tax Bill That Cut Corporate Taxes From 52% to 48% on Net Earnings Above $25,000. In 1963 Approximately 28¢ Out of Every Federal Tax Dollar Came From Taxes on Business Enterprises.

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STATE VOCATIONAL-TECHNICAL & TRADE SCHOOLS of LOUISIANA

INTRODUCTION TO MANAGEMENT

FOR INDUSTRIAL SUPERVISORS

VT003024

INTRODUCTION TO MANAGEMENT FOR INDUSTRIAL SUPERVISORS

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

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INTRODUCTION

This training course--"Introduction to Management for Industrial Supervisors"--strives to meet two important objectives: (1) to provide training in basic management fundamentals and concepts for those supervisory personnel who have had little or no previous supervisory training, and (2) to provide training for supervisory personnel who have had previous courses in supervisory training, but who may not have had a basic management course.

Both of these objectives have purpose. Every supervisor, whether he is a new member of management, or whether he has had experience but no training, must have knowledge of how management developed, its current status, and how he must use principles of management and leadership for doing an effective job of supervising. Many supervisors, who have had previous organized training courses, were no doubt in classes devoted to various segments of management skills. Actually, management fundamentals, such as this program, should have been the first course taken in the series of supervisory training courses.

The nature of the contents of such a course as this necessitated the preparation of a large quantity of material. The five sessions contained in "Introduction to Management" were planned so that each should take two hours for presentation, or a total of ten hours for the entire course. Because much of the material is of an informational nature, the lecture method will have to be employed; however, the contents include charting techniques, handout material, discussion techniques, and visual

aids. By no means should the sessions be conducted in a formal manner, as participants should be allowed much freedom in discussion and individual contributions.

It will be found that ample material is given in each session; this will allow the instructor to tailor the material to fit his individual desires. The outline form is predominantly used, but in Session IV the text form is used. In all cases, the arrangement of the material on the pages is such that will allow the instructor to insert notes or additional points in the left-hand margin or between the entries on the outline. A 10-minute recess should be given midway in each session to break the time interval of the two-hour session. Experience in pacing the material will allow for fitting it into two-hour sessions and arranging for a logical stopping place for the recess without difficulty.

It is extremely important that the entire course be read through for familiarization before attempting to conduct the training for the first time. Also, the Code presented on Page iv should be learned so that there will be no difficulty encountered in using the material as prepared.

The twenty handout sheets will serve well as supplements to the basic course material. There should be a set of these 20 handout sheets available for each trainee who takes the course. These are not to be given out all at once; only when the outline indicates that a handout is to be given out. The trainees should be told at the start that these handouts will serve as a good source of reference material which they can take with them at

the conclusion of the training. They can use a letter-size manila folder to retain these in. In addition, trainees should be encouraged to take notes of important material during the sessions, as these notes will provide additional reference material that they can take with them back to their jobs and use.

Sessions II, III, and V have recommendations for the use of visual aids. These visual aids will require the use of a 16 mm. film projector for Sessions II and III, and a 35 mm. sound filmstrip projector for Session V. It is very important that these films be previewed before they are shown at the sessions. The leader's guide, which accompanies each film, should be used for guidance in presenting the films and discussion which follows.

Session IV, "Organized Labor," has about twice as much material as the other sessions. This is because of the nature of the subject matter. Also, no visual aid is used for this session, and only two handout sheets supplement the outline and text material. In addition, if this training course is used in states other than Louisiana, the section which pertains to organized labor in Louisiana, will no doubt be omitted.

If additional readings are required for any of the subject material, sources may be obtained from the bibliography.

Although no tests have been prepared for purposes of evaluating each trainee's understanding and retention of the material presented, the course lends itself well to the preparation of tests without difficulty.

CODE

Plain type	. . . . .	Instructor says in own words
LARGE TYPE	. . . . .	Instructor says verbatim
Material Enclosed in Box	. . . . .	Instructor charts on board
(Material in Parentheses)	. . . . .	Instructions to instructor
Handout Sheet	. . . . .	Indicates handout material

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FOR INDUSTRIAL SUPERVISORS

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SESSION I

HISTORY OF MANAGEMENT

I. Introduction

A. (If possible, have management representative of the company open the session; this procedure will definitely have good results by a show of management's interest in the training program.

Make sure that the management representative has been given an outline of the course and has had an opportunity to review it before such introduction is made.)

B. Getting Acquainted

1. (Tell something about your own background, giving brief outline of your industrial or business experience. Indicate what your present position is; tell the trainees that you will serve as instructor for the sessions.)

2. (Have each member of the class identify themselves; ask them to tell something about the work they perform, department which they work in, number of persons they supervise, etc.)

3. (Name cards for each trainee may be prepared--this will allow for easier acquaintance and a change in seating arrangement for following sessions, if desired.)

C. (Give time, place, etc. where and when meetings will be conducted.)

D. (Stress that attendance at all sessions by all trainees is very important. Management may require a copy of your attendance records; therefore, be prepared to submit this upon request. In addition, management may institute its own attendance requirements at the sessions, in which case, these requirements should be discussed.)

E. (If certificates are to be awarded at the conclusion of the sessions, this should be mentioned. If attendance requirements or other standards must be met before certificates are awarded, this should be mentioned.)

F. (Discuss the techniques which will be used in conducting the sessions: lecture, discussion, visual aids, handout material.

Stress the importance of individual participation; how each person will get much more from the training sessions if he takes an active part in the discussion, asks questions, and maintains an interest in what is going on. Encourage each person to take notes.)

G. *** Handout 1 ***

1. (Give a copy of Handout 1 to each trainee. This is to be used to give an introduction to the course and what each session consists of.)

2. (Read through the material in Handout 1; answer any questions raised by trainees concerning the sessions or objectives of each.)

3. (Ask the trainees to retain this handout as it will provide a handy reference to each session's contents and will better prepare them for participation for forthcoming sessions.)

II. Objectives for Session 1

A. (These objectives may be charted before the first session begins for convenience and a saving of time.)

Objectives
1. To trace briefly the history of management
2. To relate the history of management to current management concepts
3. To study the work of Frederick W. Taylor, the areas of scientific management, and evolution of such
4. To examine current management practices and procedures

III. Management Concepts

A. It first must be understood that management prevails in all undertakings and endeavors; i.e., in the fields of business, industry, government, education, and other areas.

B. The term "management" should not be confused with the identification of one type of person or group, rather it should be thought of as an activity or function.

1. It must also be pointed out that persons in a business or industry who have "management" status are those who carry out the management function.

C. MANAGEMENT HAS MANY FACETS; IT IS EXTENSIVE; AND CERTAINLY DIFFICULT TO DEFINE BY USING A FEW WORDS. IN ANY ENTERPRISE, HOWEVER, THERE ARE SIX BASIC ELEMENTS WITH WHICH MANAGEMENT DEALS--THESE ARE FREQUENTLY REFERRED TO AS THE "SIX M'S":

1. Men	4. Markets
2. Machines	5. Methods
3. Money	6. Materials

(Discuss these six elements as they relate to the economics of any organization in its efforts to meet objectives set.)

D. BECAUSE MANAGEMENT IS AN ACTIVITY, SUCH ACTIVITY IS USUALLY DIVIDED INTO CERTAIN AREAS CALLED:

1. PLANNING
2. DIRECTING
3. CONTROLLING
4. CO-ORDINATING
5. ORGANIZING

(Discuss the foregoing only briefly, as they will be taken in more detail in Session III)

E. FROM THE PREVIOUS DISCUSSION, ONE DEFINITION OF MANAGEMENT MIGHT BE:

"MANAGEMENT IS AN ACTIVITY WHICH PLANS, DIRECTS, CONTROLS, CO-ORDINATES, AND ORGANIZES THE BASIC ELEMENTS OF AN ENTERPRISE TOWARD THE ACHIEVEMENT OF THE OBJECTIVES AS SET BY THE ENTERPRISE."

1. (After charting this definition on the board, give time to trainees to record this in their notes; answer any questions pertaining to this definition.)

F. PLEASE BEAR IN MIND, AND ESPECIALLY BASED ON THE DEFINITION DEVELOPED THAT IT IS NOT ONLY THE PRESIDENT, OR VICE-PRESIDENT, OR SUPERINTENDENT OF AN ORGANIZATION WHICH MUST BE CONSIDERED AS PERSONS WITH MANAGEMENT STATUS; BUT ANY ONE, THE SUPERVISORS, FOREMEN, OR OTHERS WHO PERFORM THE MANAGEMENT FUNCTIONS.

1. (Be sure that the above information is clearly understood by the trainees, as many times the word "management" is misunderstood to mean only persons in the top echelon.)

G. Management makes possible the following:

1. Management gives a degree of effectiveness to human activity

2. A degree of order is given to endeavors

3. Efforts are guided more directly toward stated objective

4. The determination of a proposed method of action is possible

5. Activities are so arranged so that they are carried out in a uniform manner

6. Determination is made of possible solutions to problems or objectives

H. Objectives of Management

1. As with any endeavor or undertaking, management also has certain objectives which it must meet.

2. Management actually serves three groups and these groups are unified by the activity of management.

3. THESE OBJECTIVES AND THE UNIFICATION OF THE THREE GROUPS CAN BETTER BE SEEN BY A DIAGRAM.

4. *** Handout 2 ***

(Discuss the handout with trainees, taking sufficient time for this discussion. The list of objectives under the three main areas do not constitute a complete list--you may want to develop additions to this list.

Also, in your discussion bring out the unification principle involved in these three areas brought about by management.)

IV. Relationship Between History of Management and Present-Day Concepts

A. The art of managing a business in this country has changed greatly during the past years to reach the level it now is.

B. To get a better understanding of the changes which have taken place, it is necessary to review briefly the history of the economic structure of our country:

1. The first types of businesses to develop in the country after the original colonies and settlements grew along the eastern seaboard were basically agriculture and home enterprises.

2. Persons were self-sustaining in that the family usually made or grew everything that it consumed.

3. During the period of colonization of this country, the people here depended upon the few hard goods and manufactured items which could not be produced in the home, from England which was engaged in the large-scale manufacturing economy brought about by the Industrial Revolution.

4. Also, the political ties of the colonies with England made for a strong dependence upon the mother country for many necessities of life.

5. During this period of home enterprises, the head of the family was the one who managed the affairs--devoting time to both production work and the management of the business and personal affairs of the family.

6. After some specialization of work developed in this country, one person, called the proprietor managed the business; he being responsible for investing capital; supervising the work of employees, the sale of the products, and all other related activities.

7. The era of the one-man owner and manager system remained in effect for many years; in fact, we still have many such businesses operating today.

8. The population growth in the infant United States; the demands of the people for better goods and services; the winning of independence by the

colonies from England; the War of 1812 which made the country dependent upon its own resources for military equipment and supplies; and the opening of new trade opportunities for this country were all responsible for the Industrial Revolution developing rapidly in the United States.

9. With the coming of the Industrial Revolution to this country in about 1807, new processes for doing work were initiated and more and more reliance was placed upon machinery and equipment.

   aa. Industry completely moved from the home and the small shop into the factory.

   ab. Workers in industry became skilled in certain areas of work, such as woodworking, or printing, or machine shop, etc.

10. With the development of factories and large enterprises, the nature of business ownership and management changed also.

11. It was not possible for one person to manage such a large and complex organization, with all its problems, objectives, personnel, and specialized work activities.

12. In addition, large enterprises needed investments of capital for plant establishment, expansion, etc.; thus no one person could be expected to finance an entire industry.

   aa. The corporation, the type of business organization which makes it possible for many persons to invest capital, became necessary.

13. Persons trained in the skills of supervision and management became responsible for the operation of the business and who in turn were responsible to the investors or owners of the business.

14. The techniques of supervision and management became important to this type of business; and such techniques were acquired through training, education, and experience.

15. From the foregoing brief history, it can be clearly seen that management has developed with the nature of business itself; but that today, it is a specialized segment which is the guiding force in meeting the organization's objectives.

V. Relationship Between Our Economic System and Present-Day Management Concepts

A. A better understanding of our present-day management concepts can be had by a discussion of the important principles of our economic system.

1. Our American economic system performs two basic functions:

aa. It must decide in some way what and how much is to be produced.

ab. It must provide a means of allocating or distributing among its citizens the goods and services produced.

B. Our American economic system is referred to in one sense as a free-enterprise system; this means that the decisions of what and how much to produce and the manner in which goods and services are to be allocated are made by the free actions of the businesses and industries in the economy.

C. Sometimes, the American economic system is also referred to as a capitalistic system; this means that the capital goods or the investment in the business are owned by stockholders who are individuals rather than by governmental agencies.

1. Free-enterprise capitalism implies further that individuals and businesses must be free to obtain and use capital; therefore the ownership of private property is essential to such a system.

D. Consumer demand for a product or service is the primary reason why such products or services are produced; of course, the opportunity to make profits serves as an incentive for businesses to produce these goods and services.

(It is necessary to bring to the attention of the group that the profit incentive is of much importance in the American economic system; without such, investors would not be willing to risk capital, nor would businesses be able to expand and grow.)

E. There are usually six broad goals of the American economy:

1. High level of employment

aa. There is a labor force in the United States of about 73 million people (1961 figure);

there will always be some unemployment due to change in jobs, retirements, etc.; however, for purposes of practicability, the economy is considered to have full employment when there is less than 2.5 million persons or 4 per cent of the work force unemployed.

2. Stable Prices

   aa. The purchasing power of money depreciates when prices continue to rise and spiral.

   ab. Persons who put money into insurance policies, pension funds, or savings will find that the value of these amounts will deteriorate greatly as a result of substantial increases in prices over a period of time--thus, a great need for stability of prices.

3. Economic Growth

   aa. Once a level of prosperity has been reached, there must continue to be healthy economy.

   ab. More workers are being added to the work force each year due to population increases; therefore, if the economy doesn't increase, additional unemployment is at hand.

   ac. The productivity of the labor force increases each year; thus the same level of output can be produced with fewer and fewer workers, and additional unemployment will result unless offsetting forces take place.

4. Rising Standard of Living

   aa. A growth in the American economy means a rising standard of living, usually in the form of increased purchasing power of the individual.

5. Economic Security

   aa. The American worker desires security against the loss of his job; or if such happens, unemployment benefits until he can again become employed.

   ab. The American worker also desires to have economic security when he reaches the age that he must retire or cannot work.

6. Economic Freedom

aa. The preservation of economic freedom is of the utmost importance--the freedom in the choice of a job or business, freedom to spend or to save money, freedom to buy from one business rather than another, and freedom to support or to oppose various economic and political measures.

F. A knowledge of economics is essential for a proper understanding and appreciation of the business and industrial elements of our country's make-up; before a complete understanding of the management aspects can be had, these basic economic principles must be clearly viewed; as basic principles so close to management objectives include:

1. The economics of production

2. The economics of distribution

3. The economics of consumption

(Discuss these basic principles of economics in relation to scope and objectives of management philosophy.)

VI. Development of Scientific Management

A. The terms "scientific management" have different meanings to different people and are not widely understood; as:

1. Some think that scientific management is the activity of getting work accomplished in the most effective way.

2. Some think that scientific management is the modern, latest, and best kind of management.

3. Some think of scientific management as a complex system of time and motion studies with some type of statistical evaluation.

B. SCIENTIFIC MANAGEMENT IS NOTHING MORE THAN APPLYING PRESCRIBED PRINCIPLES OF MANAGEMENT BASED UPON EXPERIMENTS WITH ACTUAL PROBLEMS IN THE SOLVING OF CURRENT PROBLEMS--A DEPARTURE FROM THE HIT OR MISS, OR TRIAL AND ERROR METHODS OF EARLY MANAGEMENT TECHNIQUES.

1. MUCH MORE WILL BE SAID LATER ABOUT WHAT PRINCIPLES ARE INVOLVED IN SCIENTIFIC MANAGEMENT AND PERHAPS A CLEARER DEFINITION CAN BE DEVELOPED IN OUR SESSION TODAY.

C. It is necessary to view briefly again the history of the Industrial Revolution so that it can be seen why this revolution or change also brought about a change in management techniques and principles.

1. The Industrial Revolution, as we have seen, changed greatly the industrial activities in a short period of time.

2. This Revolution brought a greater utilization of machines, the centralization of production activities, and new worker-management relationships.

3. Principles of operating businesses which had been used for centuries had to be altered or changed drastically in a short period of time to deal with the enormous changes in industry taking place.

4. From the new industrial complex, there had to arise a new concept in management--based upon some tried and proven principles which could be geared to the factory system which was spreading rapidly.

D. In the early 1800's, a professor of mathematics at Cambridge University in England, Charles Babbage, pioneered some principles based upon a systematic approach to the techniques of management--these were:

1. Recommended that accurate data, obtained as a result of careful investigation and testing be used in the management of an enterprise.

2. Stressed the importance of determining the number of times each operation is repeated each hour; so as to set standards.

3. Pointed out that work can be divided into units or segments; both physical and mental.

4. Advocated that it is proper to pay a bonus to a worker in proportion to his efficiency and has good results with the output of the worker.

E. FREDERICK WINSLOW TAYLOR, HOWEVER, WAS THE MOST INFLUENTIAL OF THE MANAGEMENT PIONEERS IN THE APPLICATION OF SCIENTIFIC METHODS TO THE SOLUTION OF FACTORY PROBLEMS; TAYLOR IS REFERRED TO AS "THE FATHER OF SCIENTIFIC MANAGEMENT."

1. Frederick W. Taylor was a production man, executive, and consultant; He was born in Germanytown, Pennsylvania in 1856; he died in 1915.

2. Taylor's general approach to management is widely accepted; but 50 years or so ago it was a challenge to the established ways of doing things; so controversial a subject that the House of Representatives in 1911 appointed a special committee to investigate it and other systems of shop management.

3. Appearing before several hearings and presenting testimony which Taylor hoped would clear up any misunderstanding about what he believed scientific management to be, he stated:

   a. "...it is not only practicable, but comparatively easy to obtain through a systematic and scientific time study, exact information as to how much of any given kind of work either a first-class or an average man can do in a day."

   b. "Information received from studies used as a foundation, workmen of all classes are not only willing, but glad to give up all idea of soldiering, and devote all of their energies to turning out the maximum work possible, providing they are sure of a permanent reward."

   (The above quotations were taken from a paper presented by Frederick W. Taylor to the American Society of Mechanical Engineers; June, 1903.)

4. From study and observation, Taylor believed that one of the major difficulties in an effort to increase production was the lack of a precise standard by managers of what they expected workers to produce.

   a. It was upon this premise that Taylor carried out experiments and studies to determine if such a standard could be developed; and if so, this would serve as a basis for better management techniques.

5. The work involved in Taylor's approach to a scientific solution to management problems included:

   a. Made studies of machines, equipment, tools, methods, and skills.

   b. Analyzed the sequence of steps taken in performing a job.

   c. Studied information on the operating time of a machine and the operations required to perform certain jobs on the machine.

d. Studied various degrees of skills required to do a job based upon machine operation.

6. From the studies he made, Taylor was able to establish a standard of expected quantity and quality of output.

   a. Most important, too, from the management standpoint, to designate the procedure to be followed in order to obtain the desired quality and quantity of output.

7. IN SUMMARY, FREDERICK W. TAYLOR BELIEVED THAT MANY OF THE PROBLEMS OF MANAGEMENT COULD BE SOLVED BY THE USE OF SCIENCE, THAT USEFUL KNOWLEDGE COULD BE OBTAINED BY MEANS OF EXPERIMENT AND TESTING, AND THAT MANAGEMENT COULD RELY UPON METHODS WHICH WERE NOT BASED UPON CHANCE OR GUESSWORK.

8. Taylor advocated that effective management was based upon the scientific approach; and that it was necessary for the manager to:

   a. Develop a science or recommended procedure for each phase of the employee's work.

   b. Select and train workers in a prescribed manner.

   c. Establish friendly co-operation with employees.

   d. Assume the responsibilities for getting the job done and over-all managing activities.

F. A DEFINITION FOR SCIENTIFIC MANAGEMENT WOULD BE:

THE USE OF STUDY, CONTROLLED EXPERIMENTATION, AND CAREFUL EVALUATION OF BUSINESS PROBLEMS RESULTING IN PRESCRIBED METHODS USED IN MANAGEMENT ACTIVITY.

G. THERE ARE SOME PRINCIPLES OF SCIENTIFIC MANAGEMENT WHICH ARE WELL TO CONSIDER. THESE ARE PRESENTED IN HANDOUT 3.

***Handout 3 ***

(Take necessary time to discuss the twelve principles of scientific management. You will find these principles based greatly on modern management practices of today.)

H. Additional Points Concerning Scientific Management

1. Management practices today incorporate many of the features advocated by Frederick W. Taylor.

   a. Especially true is the setting of standards; the prescribing of good communication channels, the scientific selection and training of workers; and the setting of objectives and goals.

2. Scientific management principles, as we know them now, will be advanced and improved; management has not reached the point of perfection.

   a. There is no doubt that new means will be developed for discovering and correcting errors of management.

3. Scientific management can be applied to every field of management; although easier to apply in some than others.

   a. The foreman who is supervising a production worker has just as much opportunity to practice scientific management as does the corporate executive whose management duties differ greatly from the foreman.

   b. The office manager, the sales manager, the industrial superintendent, the first-line supervisor, or whatever the management level may be, opportunities are available for the practice of scientific methods in the management techniques.

4. Scientific management tells <u>what</u> is efficient, decides exactly <u>how</u> efficient it is, and explain the <u>why</u>.

   a. These consist of applying measurement to management and studying results.

VII. Human Relations Development in Management

A. The development of the human relations aspect--that is, the stress upon the worker as an individual--brought about important changes in management concepts.

B. <u>FRANK GILBRETH</u> WAS AN EARLY ADVOCATE OF HUMAN RELATIONS AS IT APPLIED TO MANAGEMENT PRACTICES.

1. Frank Gilbreth, 1868-1924, played an important part in management development.

2. Gilbreth advocated the interest in human beings and human effort, applying to this interest an enormous capacity for organizing detail,

3. Both Frank Gilbreth and his wife, Dr. Lillian Moller Gilbreth worked as a team in this field of management; the result being the development of motion study as a basic management technique.

4. The basis for the Gilbreths work in management was the emphasis on the employee as an individual whose productivity depended on attitude, opportunity, and physical environment as much as on the use of correct methods and ideal equipment.

   (Stress this point as it will make the principles of Gilbreth as listed later more meaningful to trainees.)

5. As Gilbreth developed his ideas on improving methods, his interests broadened and he became a consultant in management engineering, although his early career was in the construction trade.

C. One feature of the Gilbreth's work proposed in 1916 and referred to as "One Best Way To Do Work" anticipated by almost 50 years of what is called now systematic management development.

1. Systematic management relies upon systems as base guides in directing managerial thinking and operations.

2. Policies, procedures, and assistance in decision making are incorporated in established systems which automatically take care of most problems as they arise and which furnish follow-up reports on what has taken place.

3. As would be indicated from the basis of systematic management, there does exist static features.

   a. Systems of management, like any other systems, have a tendency to remain in force once they are established.

   b. Rigid habits in the way of doing work is in evidence when a system is established.

   c. Attitudes toward the means of solving problems tend to become fixed and to follow a set pattern in a system.

   (From the foregoing discussion, it is evident that systematic management techniques are used today to some degree and supplement the dynamic types of management methods.

If time permits, it would be well to ask trainees to contribute examples for discussion of how or where such systematic techniques are used.)

D. Selected principles of the Gilbreths' theory of management:

(Only a few selected principles will be presented in statement form; they should be self-explanatory for discussion purposes or to answer questions.)

1. It is necessary not only to observe present conditions carefully, but to think things through, and to ask not only what is efficient, but how and why it is efficient.

2. Management cannot properly be compared, rated, or judged without measurement.

   a. Units of measure, which should be able to measure the quality of management, should be applied consistently for as much accuracy as possible.

3. The science of management may not determine standards of right and wrong, it can, and actually does determine standards of efficiency.

4. To determine standards of just and ethical procedure, management must:

   a. First, conserve the best of the past.

   b. Second, organize the present.

   c. Third, forecast and plan for the future.

5. The best way to do a job is always the simplest way after it is learned.

   a. Many jobs are handled in a complicated way because there is no system set up in detail for maintaining the simplest way.

6. Past and present measurements indicate the trends of similar events in the future, as

   a. A man should be able to estimate what he will do if conditions remain the same as they are at present.

   b. A man should be prepared to meet almost any emergency by some planned-for approach in his program.

7. How long it takes to do work is not so important as How to do it in the one best way.

8. Too little attention is given to the great waste of unnecessary fatigue.

   a. A great waste as borne out by time and motion studies is attributed to unnecessary fatigue--the elimination of unnecessary fatigue pays in actual money savings.

9. Workers will co-operate in every respect in the advancement of scientific management if they are assured a fair deal.

10. Enforcing repetitive unproductive and uninteresting motions spoils employees for real work later.

11. Management should be so geared to where it will run along scientific lines, and that it should adjust itself to adhere to predetermined plans based on past and present experiences.

E. Hawthorne Experiment

1. The Hawthorne Experiment is one of the most famous industrial relations studies in the field of management and the human relations aspect.

2. The Hawthorne Experiment was conducted at the Western Electric Company--the experiment was a series of studies aimed at finding the relationship to production of employee working conditions such as rest pauses and length of work day.

3. These studies, which probably had the most influence in the field of human relations and the science of getting work done through people were called the "Hawthorne Experiment" because they took place at the Hawthorne, Illinois works of Western Electric Company, starting in 1929.

   a. The experiment provided the basis for much of what we know about getting along with all employees and with problem employees in particular.

(The following text material will go into detail of the Hawthorne Experiment. If additional reading is required, refer to: "Hawthorne and the Western Electric Company," pages 417-436, Classics in Management, American Management Association.)

4. The Hawthorne Experiment was conducted by George Elton Mayo and F. J. Roethlisberger of the Industrial Research Department of Harvard University and William J. Dickson of the Western Electric Company.

   a. FROM THESE STUDIES OF INDUSTRIAL WORKERS ON THEIR JOBS, IT WAS CONCLUDED THAT A SENSE OF PARTICIPATION AND A FEELING OF BEING A MEMBER OF A TEAM ARE STRONGER MOTIVATING FORCES THAN ECONOMIC SELF-INTEREST, LIGHTING, REST PERIODS, AND SIMILAR MATERIAL INFLUENCES.

   (It is well that the Hawthorne basis for management be contrasted with those of Taylor and Gilbreth so that the trainees will have this distinction clearly understood.)

5. The Hawthorne Experiment was brought about by the team of Harvard consultants (names previously given) and the willingness of the president of Western Electric Company to have such an experiment conducted even though it seemed that the workers would benefit more than management from the results of the studies, if accepted.

   a. In addition, the engineers at Hawthorne excelled in matters of applied science and of organized industrial operation, but who wished to find out why human co-operation could not be as exactly and precisely determined by the administrative organization.

6. Early stages of the studies demonstrating the effect of illumination at Hawthorne proved frustrating to those skilled in the physical sciences.

   a. All conditions of a scientific experiment were in good order, but results were confusing.

   b. Lighting was improved in the experimental room and production went up; but it also rose in the control room.

   c. When lighting was decreased in the experimental room, production again went up; and in the control room with lighting held constant, production also rose.

   d. It had at first seemed so simple that an improvement in working conditions always brings about improvement, this illumination experiment proved not so.

e. It became apparent that not only the physical environment must be controlled and studied, but the physiological changes of personnel must be studied.

7. In the first phase of the experiment at Hawthorne, a test room was used; a group of workers were assigned to this project and allowed to become closely associated with each other in an informal team.

a. In the test room, the conditions of the work changed, one at a time; rest periods of different numbers and length, shorter working day, shorter working week, food with soup or coffee at recess periods.

b. Production of the workers rose to a very high level; workers claimed less fatigue and that they were not making any special effort.

c. DURING THIS PHASE, THE WORKERS HAD BEEN CONSULTED WITH RESPECT TO ALL PROPOSED CHANGES AND THEY HAD ARRIVED AT A POINT OF FREE EXPRESSION OF IDEAS AND FEELINGS WITH MANAGEMENT.

d. After a certain period of time, the workers returned to the original conditions of work--no rest periods, no midmorning lunch, no shortened day, etc.

e. THE IMPORTANT PART OF THIS EXPERIMENT, BUT WHICH AT THE TIME WAS CONFUSING TO THE CONSULTANTS, WAS THAT AFTER THE RETURN TO THE ORIGINAL CONDITIONS OF WORK--NO REST PERIODS, NO LUNCH SERVED DURING BREAKS, NO SHORTENED WORK PERIOD--DAILY AND WEEKLY OUTPUT ROSE TO A POINT HIGHER THAN AT ANY OTHER TIME.

f. THIS WAS CONCLUSIVE EVIDENCE THAT THE CHANGES INTRODUCED IN EXTRA BENEFITS AND COMFORTS WERE NOT RESPONSIBLE FOR INCREASED PRODUCTION--A SITUATION VERY SIMILAR TO THE ILLUMINATION EXPERIMENT.

8. WHAT HAD ACTUALLY HAPPENED IN THIS FIRST PHASE EXPERIMENT WAS THAT THE WORK FORCE BECAME A TEAM EFFORT AND EACH MEMBER GAVE WHOLEHEARTEDLY TO CO-OPERATE IN THE EXPERIMENT.

a. THE RESULT WAS THAT THE WORKERS FELT THEY WERE CONTRIBUTING INDIVIDUALLY AND FREELY; THAT THEY WERE WORKING WITHOUT FORCE FROM ABOVE OR BELOW; THAT THIS FEELING OF WORKING UNDER LESS PRESSURE THAN BEFORE RESULTED IN THE PERFORMANCE THUS MEASURED.

9. In order for the consultants to note the exact differences between conditions in the test room and the departments of the plant, they turned to the interview program to provide this information.

   a. They found out very early that the question-and-answer type of interview was not effective, as the workers wished to talk freely, but did not want to be abused for what they said.

10. Interviewers were trained for this phase of the experiment, and they were instructed to:

   a. Give their whole attention to the person being interviewed.

   b. Listen and don't talk unless necessary.

   c. Never argue or give advice.

   d. As the interview proceeds, plot out tentatively the pattern being set so that a later summarization could be made.

   e. Make it clear to the worker that everything that is said is considered a personal confidence and will not be given to management except as a compiled report.

11. The interview program had much success and the workers participated freely in their comments by expressing their ideas and feelings, something which management had not understood clearly in the past.

12. THE HAWTHORNE INTERVIEW PROGRAM HAD DEVELOPED MUCH SINCE ITS BEGINNING--WHERE IT WAS ORIGINALLY DESIGNED TO STUDY THE COMFORT OF WORKERS IN THEIR WORK AS A GROUP, IT HAS COME TO THE CLEAR UNDERSTANDING OF THE RELATION OF WORKERS TO MANAGEMENT AS ONE OF THE FUNDAMENTAL PROBLEMS OF INDUSTRY.

13. THE HAWTHORNE EXPERIMENT ENABLED THE UNDERSTANDING THAT MANAGEMENT MUST BE CONCERNED WITH ORGANIZING TEAMWORK AND THAT CO-OPERATION AMONG WORKERS IS IMPORTANT TO THEIR EFFECTIVENESS.

14. BECAUSE OF THE IMPORTANCE OF THE HAWTHORNE EXPERIMENT AND ITS CONTRIBUTION TO PRESENT-DAY MANAGEMENT PRACTICES, LET'S TAKE A SUMMARIZATION OF THIS EXPERIMENT.

   a. SO THAT YOU CAN HAVE A REFERENCE OF OUR DISCUSSION RELATIVE TO THIS EXPERIMENT, MAJOR SUMMARIZATION POINTS ARE COVERED IN HANDOUT 4.

*** Handout 4 ***

(Many of the points in the summarization are those already gone over. However, take any questions; discuss any points if time permits.)

VIII. Management and Organization Progress

A. Management today is faced with many diverse and complex problems--owners, stockholders, the general public and government regulations bring many pressures to bear.

B. However burdensome the problems which faced management in the past and which now are always present, much progress has been made over the years in the development of organization unity.

C. It is safe to say that the success of any organization depends upon having an adequate number of human beings in the right job at the right time, all producing at their highest capacity--this has been an achievement of competent management.

1. Many persons define management as "getting things done through the effort of other people."

2. Of course, it is the combined efforts of persons in an organization working toward a common goal which management must control, direct, and supervise.

D. Certainly every organization does not grow just because the entire economy is expanding--the growth of any one particular organization will have to be earned.

1. Progressive management is the requisite for organizational growth; creative management persons have contributed to such growth.

E. The organization to prosper and grow needs the right type of leadership found in its management.

1. Usually the proportion of managers relative to all employees is about 10 to 1; this means that about 90 per cent of the people in an organization look to the top 10 per cent for guidance, support, and leadership.

F. Some of the characteristics which management has demonstrated it must possess to chart the organization on a course of progress include:

1. Assumes and shoulders management responsibilities

2. Stresses good communications, both downward and upward

3. Directs the work of subordinates in an objective manner

4. Displays organizational ability with reference to personnel

5. Realizes financial profits on operations

6. Has a thorough knowledge of the organization and its personnel

7. Practices highest degree of professional ethics

8. Has understanding of basic business economics and finance

9. Possesses emotional maturity and objective viewpoint

10. Possesses leadership qualities

(The list is by no means complete; additional characteristics may be added by the trainer, or by contributions from trainees.)

IX. The Identity of Management Today

A. Through the definitions developed in the session and from the historical approach to management which has been presented, it is evident as to where management stands today.

B. America's economy is expanding at a tremendous rate, and it is predicted that the total production of all goods and services will reach new marks in the not-too-distant future.

1. Management will continue to be the guiding force in this economic growth; decisions will continue to be made from the management level; and leadership will continue to be exhibited at the management level.

C. Management in today's businesses and industries might be thought of as representing three distinct levels.

1. Policy management--this level includes the presidents, vice-presidents, chairmen of the boards, executive vice-presidents in charge of various functions, etc.

a. Normally these management persons are elected and are held responsible under certain company bylaws to stockholders (owners), customers, and public.

2. Executive management--this level of management is that group of persons who are charged by the policy management with the administration of the organization's work within some broad scope.

   a. Persons in this group usually include plant superintendents, sales managers, personnel manager, industrial relations manager, chief engineers, etc.

3. Supervisory management--this level is represented by foremen, supervisors, department heads, first-line supervisor, etc.

   a. It is usually these management persons who directly supervise and manage workers.

   b. A foreman or supervisor is in charge of on-the-job activities and as a member of line management exercises authority delegated by management.

D. It is interesting to note that from federal statutes, a legal definition for the "supervisor" is given; such definition as prescribed by the National Labor Relations Act is:

1. "The chief distinguishing feature of a supervisor is his power to hire and fire employees, or to recommend such action with every reason to expect that his recommendation will be followed; to be exempt from the overtime provisions of the Wage-Hour Law, he must direct the work of at least two persons and must receive a salary of $80 a week for week in which he does any work at all.

   (The purpose of the foregoing has been to again emphasize the status of supervisors as members of the management team.)

X. Functions of the Manager of Tomorrow

A. It is always difficult to predict just what economic conditions will exist in the years to come; however, based upon a study of the past, and a serious look at present trends, much factual information can be had--such information constitutes a reliable base for projections into the future.

B. First, it is ever evident that the trend of economic development will affect the role of management more than any other single factor.

C. Next, the action of government through regulatory practices will play an important part in determining the make-up of future management.

D. From the foregoing comments, it can be concluded that the functions of the manager of tomorrow indicates that:

1. The manager of tomorrow might well find himself in the corporation-type or large business organization, rather than a small or medium-sized organization.

   a. This type of situation will tend to increase the need for more management functions, because big business needs management for the various functions always present.

   b. Even if big business decentralizes, as has been the case in many instances, more managers will be needed; because when a company divides itself into several self-containing parts, each of these parts must be headed by a group of managers.

2. The manager of tomorrow will assume a more professional role, which will include more reliance on a prescribed code of management ethics.

3. The manager of tomorrow will find the management objective toward the community and public an important part of his total functions.

   a. This is in evidence today, as more and more managers and supervisors are taking a more active part in community fund drives, projects, etc.

4. Functions of management in the future will come more and more under the watchful eyes of government regulations and the manager must gear his actions to comply with these edicts.

   a. Examples of such include the Wage & Hour Law, Food and Drug regulations, Security Exchange Commission, Congressional investigations of various kinds, and more recently the Civil Rights Act of 1964.

5. Managers will rely more on scientific principles of management than they have in the past.

6. With the coming of big business and the diversification of various segments of business, management will be called upon to improve and deal more so with communications in the organization.

7. It also seems that management functions will be involved with social problems more so than in the past; this being brought about by the emphasis on human relations and the desire to afford personal security in the economic society.

8. The era of automation will also give additional problems of personnel to management; and on the other hand will add additional areas of organizational supervision based on machine technology.

9. In summary it appears that every organization in the United States will be reshaped by social changes, economic shifts, government policies, new management theories, labor revolution, and innovations in production machinery and techniques--these all represent new horizons which management must recognize as its tomorrow's challenges.

(This completes Session I. Announce the topic for Session II, "Organizational Structure," before adjournment.)

SESSION II

ORGANIZATIONAL STRUCTURE

I. Objectives for Session II

A. (These objectives may be charted before the session begins for convenience and a saving of time.)

Objectives
1. To study types of business organizations; legal aspects, financial aspects, and control
2. To study organization types and their functions
3. To study departmentation and functions of departments
4. To present a clear understanding of department relationships within the organization

(Read through objectives; take questions, add any additional comments concerning these objectives, or for the introduction to Session II.)

B. THESE OBJECTIVES ARE PRESENTED IN HANDOUT I WHICH I HOPE YOU HAVE REVIEWED PRIOR TO COMING TO THIS SESSION.

C. THESE OBJECTIVES OF SESSION II WILL BE COVERED DURING OUR TIME TOGETHER TODAY; AND I AM SURE YOU WILL SEE HOW OUR MATERIAL FOR THIS SESSION TIES IN VERY WELL WITH THAT COVERED IN SESSION I.

II. Forms of Business Organizations

A. FROM THE HISTORICAL APPROACH TO MANAGEMENT DEVELOPED IN LAST SESSION'S WORK, YOU WILL RECALL REFERENCES MADE TO DIFFERENT TYPES OF BUSINESS ORGANIZATIONS; HOWEVER, WE NOW WANT TO TAKE A MORE INTENSIVE LOOK AT THESE ORGANIZATION TYPES.

B. MANAGEMENT IS RELATED TO ORGANIZATION TYPE, SO IT IS WELL TO UNDERSTAND THIS RELATIONSHIP BETTER AND FROM THIS STUDY WE SHALL ACCOMPLISH OBJECTIVE I OF OUR SESSION.

C. When this country was young, our economy was simple compared to what it is now.

1. Capital was scarce; but with hard work and determination on the part of the American people, the economy grew and developed.

2. With determination and a certain amount of leadership qualities, a person could start his own business; with just a small amount of money needed to buy a few simple tools and a small amount of materials.

3. What the infant industries could not provide for the people of this country, the average family made at home, or did without.

4. There were a limited number of companies during this early period of American history--those in the shipping or trading business were relatively big for that period, but business for the most part was small, identified with the family unity or the sole owner.

5. As the population grew and the natural resources began to be developed and used, industry flourished and became increasingly more complex.

6. This growth pattern has not ceased, and today the country is enjoying its greatest economic prosperity in history with business and industry continuing to expand and grow.

D. THE QUESTION, OF COURSE, WHICH NEEDS TO BE ANSWERED HERE IS: WHAT IS THE MAKE-UP OF THIS COMPLEX ECONOMY AS FAR AS THE TYPE OF BUSINESS ORGANIZATION IS CONCERNED?

1. <u>Sole proprietorship</u>

a. The sole proprietorship, sometimes called the single proprietorship, is a business unit owned by a single person who receives all the profits and assumes all the risks of ownership.

b. The sole proprietorship has been a popular type of business organization in this country; being the only type which was in use during this early period of economic history previously mentioned.

c. The sole proprietorship is probably the simplest type of business organization, as all management functions emanate from one person, the owner.

d. The sole proprietorship is in a limited sense popular today, but this popularity seems to be limited to certain types of businesses.

e. In an analysis of statistics for the number of business organizations functioning in our economy today, the percentage represented by sole proprietorships in manufacturing or heavy industrial plants is comparatively small.

f. On the other hand, the number of business organizations functioning in the economy as personal service enterprises and retail establishments represented by sole proprietorship is large.

g. Usually a sole proprietorship is considered "small business," but this distinction does not always hold true; many large business organizations are owned and operated solely by one person.

h. In some cases, large organizations can be found whereby the owner delegates certain management responsibilities to others--this type of organization is still classed as a sole proprietorship.

i. In the sole proprietorship, the owner has the responsibility of raising additional capital if needed; he must do this in his own name based upon his business and personal character.

   aa. If the owner does not have personal funds to turn to, he must borrow from some type of financial institution.

j. The sole proprietor must stand legally responsible for all debts of the business; property of the proprietor may at any time be levied upon <u>regardless of whether it is among the business assets or the owner's personal assets.</u>

   (It is well to stress this point--that the owner's personal property becomes subject to the satisfying of a debt incurred by the business.)

k. A sole proprietorship type of business begins at the will of the owner--it also ends with the will of the owner.

   aa. Death of the owner, of course, ends the business under the ownership of the person.

ab. Heirs or others may continue to operate the business after the death of the proprietorship; but in this case, ownership interests have changed.

ac. Court or legal action may dissolve the sole proprietorship type business; such as a proceedings of bankruptcy.

l. The sole proprietorship is not subject to extra taxes or excessive rates which other business organizations must pay; however, the owner must report the income of the organization as personal income to him, regardless whether it is withdrawn from the business or not.

m. In some respects, the sole proprietorship is at an advantage in ease of functionalizing management in relation to other forms of organizations; the individual proprietor is the sole judge of his business affairs and does not have to be concerned with others in the organization misrepresenting him in legal or other matters.

n. The sole proprietorship does not suffer any disadvantage from undue government regulation based upon the organization structure.

o. In the transfer of ownership of the sole proprietorship, the owner can sell or transfer his interest easily, but subject to the claims of existing creditors against him.

2. <u>Partnership</u>

a. The partnership form of business organization has many of the same features as the sole proprietorship in that two or more persons carry on as co-owners of the business for profit.

b. The Uniform Partnership Act, adopted by a large number of the states, calls the partnership "an association of two or more persons to carry on as co-owners of a business for profit."

aa. This definition states clearly the nature of a partnership from the legal point of view.

c. Partners contribute their property, services, and business experience, or a part of them, for the purpose of engaging in, and <u>sharing the profits or losses</u> of a legal enterprise.

d. The partnership form of organization is also usually found in a reasonably small business where only a few partners are required in order to secure the needed capital, and in the professions where the relations of the firm to its clients involve a personal responsibility.

   aa. Partnerships are very common in the personal service enterprises or professions, such as doctors, lawyers, business services, consulting engineers, etc.

e. In the partnership, each partner is the agent of the partnership; if one partner enters into an agreement, the other partner is bound by this act if the goods or services contracted for are such as the business uses or might use in its operation.

f. A partnership, because of its personal nature is short lived.

   aa. It may be dissolved as the result of the death, incapacity, or withdrawal of one of the partners.

   ab. If a partner sells his interest, the partnership terminates; if the members admit another partner, the old partnership ends, but a new partnership is brought into existence.

g. Each member of a partnership is <u>jointly</u> and <u>individually</u> liable for the debts of the partnership; therefore, a partner may not only lose what he has invested in the partnership, but also be required to use his private property to pay the debts of the partnership if the business becomes insolvent.

h. Suits of law cannot be brought by or against a partnership as a firm, but must be by or against the individual partners, either severally or jointly.

i. There is no legal limitation on the purpose for which a partnership may be organized (except for illegal business operations), or on the length of time for which it may be organized, or on time or conditions of dissolution.

aa. Legal notice must be given, however, of the dissolution of a partnership, or of the withdrawal of a partner, or partners, to avoid liability for further debts incurred in the partnership name.

j. The property invested by a partner in a partnership is no longer his own personal property, but is jointly owned by all partners.

k. Disputes, misunderstandings, and difficult situations are liable to arise in the partnership because of the peculiar relationship existing between the partners.

aa. To prevent these from occurring, a contract is usually prepared, known as the "articles of copartnership" which spells out in definite terms such provisions as: rights of partners, provision for dissolution, duties of each partner, sharing of profits and losses, etc.

l. The partnership form of organization has an advantage over the sole proprietorship form in that a greater accumulation of capital is possible; this usually being the chief reason for the formation of a partnership.

m. The partnership form also permits the combining of skills and experience of two or more people, where the sole proprietorship has only the one person.

aa. A specialization of duties is also possible; one partner may supervise production, the other assume supervision of the office.

n. It must be pointed out that the chief disadvantage of the partnership form of organization is the fact that friction frequently develops between the partners, each of whom has equal powers and rights in the management of the business.

o. However, many successful partnerships are in existence today; their operation based on sound management principles which prescribe integrity, trust, and business competence on the part of each partner.

3. Corporation

a. The corporation or corporate-type of enterprise is the most important organization form currently in use--with the growth of large business units and a demand for more capital, the corporation through its unique features satisfied this demand.

aa. Without question, the corporation has become the dominant form of business organization in the United States.

b. The historical roots of the American corporation were in England from where this type organization was inherited.

aa. At first, the king in England granted the right to a group to incorporate.

ab. Later this right came to be invested in Parliament which granted charters to certain enterprises which met prescribed requirements.

ac. This early granting of rights to incorporate was usually a political favor and was subject to objections by many who felt that such political patronage was not equitable.

ad. Finally, enabling acts were passed in England which granted any group the privilege of incorporating a business by filing an application showing conformity with the law.

ae. The distinguishing feature of the English corporation and the term still used today is "Limited." This term, sometimes abbreviated "Ltd." follows the company name, meaning "limited liability."

af. Some corporations in this country still carry the "Ltd." identity, as these were incorporated under early American statutes which followed closely to those laws of England.

c. The popularity of the corporation type of organization spread from England to this country and in 1811 the first of the general incorporation acts was passed by the state of New York.

aa. The chartering of business corporations, with the exception of the national banks, has been almost exclusively the function of the states, rather than the federal government.

d. The Supreme Court of the United States has defined a corporation as "an association of individuals united for some common purpose, and permitted by the law to use a common name, and to change its members without the dissolution of the association."

e. BECAUSE OF THE IMPORTANCE THAT THE CORPORATE STRUCTURE HAS IN BUSINESS ORGANIZATIONS TODAY, AND BECAUSE THE CORPORATION HAS CERTAIN FEATURES THAT DISTINGUISH IT FROM OTHER TYPES OF BUSINESS ORGANIZATIONS, A CLOSER LOOK MUST BE TAKEN OF THE CORPORATION.

aa. HANDOUT 5 HAS BEEN PREPARED TO GIVE YOU A BRIEF SUMMARIZATION OF THE CHARACTERISTICS.

*** Handout 5 ***

(Cover the 10 characteristics in Handout 5, taking any questions for discussion.

The characteristics of limited liability, increased capital accumulating abilities, and taxation are those which should be stressed greatly, as they relate directly to management principles.)

f. The corporation is managed and operated under a system of delegated authority and definite lines of responsibility.

g. The corporation maintains centralized control over its activities, even though it may have thousands of stockholders.

h. A simple organizational chart showing this delegation of duties is found in Handout 6.

*** Handout 6 ***

(Discuss this handout with trainees. It must be made clear that this is not a complete organizational chart; only an illustration showing a basic diagram of the corporate structure. The following points may be of some value while discussing this material:)

1. In a corporation, the proprietorship is vested in the stockholders--the ownership of the stockholders is evidenced by shares of stock.

2. Although the ownership and control of the corporation is vested in the stockholders, such control and management is delegated to the board of directors.

   a. The board of directors is directly responsible to the stockholders for the supervising and controlling of the operations of the business.

3. The board of directors select the president and the corporate officers (usually vice-presidents, secretary, and treasurer) who determine the operating policies of the corporation.

   a. Although the corporate executives are selected by the board of directors, they act under the authority and control of the president.

4. The executive staff is selected by the president and corporate officers and include department heads.

5. The executive staff selects the supervisory staff which includes all types of supervisors and management personnel; this staff is directly responsible to the department heads.

6. Last on the chart are the workers who are supervised and directly under the department foremen and others on the supervisory staff.

7. Delegation of authority begins at the top and goes down through the entire organization; while responsibility goes from the bottom up, each segment of personnel responsible to that segment above it.

4. <u>Business Trust</u>

   a. This type of organization is not as popular in use as the other three types discussed; however, it is used primarily for:

aa. the business of real estate

ab. temporary situations which make it desirable to fix the control of a business in the hands of trustees for a short period of time.

b. Although the trust has certain desirable features as: freedom of owners from liability to creditors, transferable shares, easy division of managerial functions, and ease in raising capital, it has not had the widespread use as does the corporation.

c. Because state laws are not uniform in relation to the creation and operation of trusts, there has been reluctance to use this form in operations which are not confined to just one state.

d. Trusts do not have long lives; in most states the duration of a trust is limited to a certain number of years.

e. Historically, the trust has not been popular as it has been associated with monopolies, i.e., oil trust, steel trust, etc.

(As the business trust does not seem to give promise of becoming an important type of business organization, only a limited amount of material was thus given.)

5. Joint Venture

a. This type of organization is sometimes spoken of as a "syndicate."

b. The joint venture is limited to a single deal or undertaking as opposed to operating a business on a permanent basis.

c. The joint venture has centralization of authority in the manager--usually the business operates in the manager's name.

d. Today, the joint venture has wide usage in financial operations, whereby a group or syndicate, acting through a manager purchases and sells securities, stocks, bonds, etc.

e. In joint ventures, those who participate or contribute personal efforts are paid a certain

amount, and profits or losses are divided among the participants in the ratio of their capital contributions.

(As the joint venture is not as popular and not used as widely as the sole proprietorship, partnership, or corporation, only a limited amount of material was given.)

III. Principles of Organization

A. Definition of organization:

1. An organization is a grouping of persons together so that they can work effectively toward a goal which members of the group want to achieve.

(In discussing this definition with trainees, the additional following points can be made:)

1. The goal of a business organization, which has been pointed out previously, is to earn profits, to satisfy the needs of customers and community, and to provide employment for a certain number of persons.

2. There are other satisfactions of the organization, in addition to material ones; such as sense of accomplishment, contribution to need of economy, maintaining full employment, etc.

3. The organization provides unity to the persons in the group, as well as to the activity of the group.

4. Without the organized grouping in business and without the unity of action, havoc and confusion would result, with little or no accomplishments.

B. Reasons for Organization

1. The basic reason for organization is found in the need for effective and efficient co-operation.

2. If an organization has no objectives or goals, there would be no reason for it to organize.

3. With some type of organization structure, co-operation toward certain objectives can be more productive and less costly with the reason of economy in attainment of objectives must be considered.

4. Organization provides that every segment of it is contributing toward the attainment of organization objectives.

5. The organization maximizes the satisfaction of individuals while at the same time strives toward meeting the enterprise's objectives.

6. The organization makes it possible to evaluate and study the results of the enterprise's activities.

C. Authority, Responsibility, and Delegation

(These areas will be treated only as they apply to the organization structure; their function as a responsibility of management will be discussed in Session III.)

1. Authority is defined as:

a. The power or the right to act, command, or prescribe action by others.

2. Authority may be given by:

   a. the position as indicated in the organization structure of the enterprise.

   b. acceptance of a custom or way of doing things over long periods of time.

   c. a skill or special knowledge of the situation.

3. Authority is usually handed down to a person from someone above him; this person in turn hands down authority to someone below him.

4. For the supervisor to be held accountable for results, he must be given adequate authority to handle the situations he encounters.

5. The areas of authority must be communicated and made clearly known; such to be effective must be expressly stated, not just implied.

6. Responsibility is defined as:

a. The obligation of a person to carry out assigned tasks and duties to the best of his ability.

7. Responsibility and loyalty to the organization and its objectives are very much related.

   a. Responsibility can be to a person, a cause, a certain job, or to the organization in general.

8. Usually, responsibility is represented from the bottom of the organization chart upward; just as authority is handed downward from the top executive to the supervisor to the worker; responsibility must be exhibited from the worker to the supervisor to the top executive.

9. It is well to have within the organization the duties, authority, responsibility, and relations of everyone clearly and completely prescribed in writing.

10. WHEN CONSIDERING BOTH AUTHORITY AND RESPONSIBILITY, IT MUST BE MADE CLEAR THAT THEY BOTH SHOULD BE EQUAL; AUTHORITY MUST BE MATCHED WITH RESPONSIBILITY, JUST AS RESPONSIBILITY MUST BE MATCHED WITH AUTHORITY.

    a. A person without the proper authority to get a certain job done cannot be responsible to a person above him for this action; he may know what is to be done and how to do it, but he is helpless in not being able to make decisions or to take a decisive hand.

    b. A person with the proper authority to get a certain job done, but without responsibility to someone is ineffective, with his authority being of little or no value and with authority decreasing to the level of responsibility.

    c. In summary, authority and responsibility go together, one without an equal amount of the other is ineffective.

    (This discussion of the coequality of authority and responsibility may at first seem confusing to trainees; stay with the topic; give additional examples, if necessary, until it is understood.

11. Delegation is defined as:

    a. The granting or conferring of equal portions of authority and responsibility from one person in the organizational structure to another.

(In discussing this definition with trainees, these additional following points can be made:)

1. Usually, delegation is thought of as being from a higher position to a lower position; however, it can also be upward or sidewise.

2. A person delegating always retains his inherent authority and responsibility for the task delegated, as delegation does not mean the permanent release from these obligations.

3. The one who delegates always remains accountable for what is or what is not accomplished.

4. It must be remembered that delegation sets up levels of authority and responsibility throughout the organization.

5. An outstanding characteristic of a good management person is his willingness to delegate authority and responsibility to others.

   a. The manager must recognize that no matter how good of a supervisor he is, there will always be more responsibilities than he can carry out himself.

b. LET'S TAKE A SUMMARIZATION OF AUTHORITY, RESPONSIBILITY, AND DELEGATION. HANDOUT 7 HAS BEEN PREPARED TO HELP US WITH THIS REVIEW.

*** Handout 7 ***

(Discuss the 12 principles of authority, responsibility, and delegation; stress that delegation will be taken again in more detail in Session III.)

IV. Organization Types

A. In this section, three basic organization types will be discussed. These are:

1. Line Organization

2. Staff Organization

3. Functional Organization

B. In addition, combinations of the above will be discussed where it will be seen that characteristics are present in organizational structures which present other unique features.

C. Each type of organization structure has certain advantages and certain disadvantages; one type may suit only one kind of business.

D. IT MUST BE STATED HERE AT THE BEGINNING THAT IT IS UNCOMMON TO FIND ORGANIZATION STRUCTURES CONSISTING PURELY OF ANY ONE OF THE THREE TYPES MENTIONED; USUALLY A COMBINATION OF SEVERAL TYPES IS USED.

1. ALSO, AS WILL BE NOTED LATER, THERE IS A TENDENCY TO INCORPORATE STRUCTURES THAT WILL BEST FIT THE NEEDS OR OBJECTIVES OF THE ENTERPRISE.

2. THE MANAGER OR SUPERVISOR, REGARDLESS OF WHAT TYPE ORGANIZATIONAL STRUCTURE HE MAY FIND HIMSELF IN, WILL PRACTICE OR USE FUNCTIONS PECULIAR TO SEVERAL TYPES OF ORGANIZATIONAL FRAMEWORKS.

(Following will be a discussion of the three major organization types)

E. Line Organization

1. The lines of authority and responsibility in the line organization are direct from top management, to the executive staff, to the supervisory staff, to the workers.

2. This type of organization structure is called "line" because the lines of authority and responsibility are fixed and go from top to bottom and from bottom to top of the organization chart.

3. The line organization is probably the simplest form that is used; it has great acceptance in many enterprises today, but finds its greatest popularity in the small company.

4. The line functions of the organization have direct responsibility for accomplishing the objectives of the enterprise; this is why the line organization is said to be made up of people who get things done.

5. The line supervisor has direct authority over a certain number of persons; these persons' responsibilities are definitely fixed whereby they report directly to the supervisor.

6. A SIMPLE LINE ORGANIZATIONAL CHART IS PRESENTED ON THE HANDOUT WHICH WILL BE GIVEN YOU. TAKE A FEW MINUTES AND STUDY IT IN VIEW OF THE COMMENTS WE HAVE MADE THUS FAR CONCERNING FEATURES OF THE LINE ORGANIZATION.

*** Handout 8 ***

(Discuss the line-type organizational structure as presented in this handout. This diagram, of course, is quite simplified and a great deal more symmetrical than actually exists in most organizations; however, this is for illustration purposes only. The following points may be discussed with the trainees in relation to the diagram:)

1. It can be clearly seen that lines of authority are direct from the top, or general manager, to the rest of the personnel in the organization.

2. The general manager represents the source of authority in the illustration; the sales manager, the maintenance superintendent, and the production superintendent are directly responsible to him.

   a. In turn, the sales supervisors, the maintenance, plant, and field foremen are responsible to their respective supervisor; and of course, the workers are directly under the foremen and sales manager.

3. This illustration represents only a small organization or a segment of a large one; as the number of persons increase, the span of control becomes more difficult and more supervisors will be needed.

4. Subsequently, as the organization further develops, additional personnel will be needed, whereby the organizational structure will change considerably.

5. Each part of the organizational structure is separate as shown in the illustration; members in one department of the organization are independent from others and report only to that supervisor directly above.

   a. Each person's responsibility is definitely fixed and he reports and is accountable only to that person above him.

   b. Each person receives whatever authority he may have from the supervisor directly above.

6. The sales activities, the maintenance department, and the production phase of the organization, as shown in the illustration, are separate; however, each department head is accountable to the general manager.

(As a matter of review, have one or two members of the class take the illustration and explain it; correct any errors in their presentation.)

F. Line Organization--Advantages and Disadvantages

1. Advantages

a. The line organization can be used in both small and large organizations.

b. The line organization is quite simple and not as complex as other type organizational structures.

c. Each person knows to whom he is responsible and who is responsible to him.

d. There should never be any question as to whom should be consulted in the chain of command.

e. Better control over personnel is assured, as each area in the organization is independent of the other.

f. Action can be taken quicker in regard to various matters of management, as the organizational structure is not complicated with interlocking personnel arrangements.

2. Disadvantages

a. Co-operation among the members of the organization seems to be limited, as each segment is interested in only their particular problems and work.

b. Supervisors and executives tend to become overloaded with routine work of supervision and thus have little time for planning and research.

c. As the organization grows, it becomes difficult to integrate other units effectively.

d. The organization structure is of a fixed or rigid nature, thus leaving little room for progressive changes.

G. Staff Organization

1. The term "staff" refers to advisory--the staff organization counsels, advises, and assists other segments of the organization.

2. It must be understood that staff functions do not in themselves represent a distinct and separate type of organization; but are part of another type structure, usually line.

3. Staff functions have the responsibility for getting the facts upon which decisions can be made.

4. In the true line-type organization, supervisors see to it that the work is completed; however, where staff components are involved, line management receives plans, advice, and suggestions from staff management.

5. Line organizations are usually supplemented by staff organizations; the line manager has authority over personnel, while staff management has authority over ideas.

6. Production departments, sales departments, and sometimes purchasing departments are the most common line activities; while engineering, maintenance, research, accounting, and industrial relations are examples of staff activities.

7. Some refer to line management as the "doers" and to staff management as the "advisors."

8. The main responsibilities of the staff organization are:

   a. Formulating policy for the organization

   b. Planning for the organization

   c. Evaluating the operations of the organization

   d. Advising and counseling line management

9. From the foregoing points discussed, it can be clearly seen that the staff organization does not exist in a pure form or exclusively in any organization.

   a. No organization which has the normal activities going on and the usual objectives is purely advisory in nature.

b. It can be concluded, however, that the staff function does and must exist in most organizations.

10. Often it is said that line functions are represented vertically on the organizational chart, while staff functions are represented horizontally.

11. HANDOUT 9 WILL GIVE US AN ILLUSTRATION OF AN ORGANIZATIONAL STRUCTURE WHICH HAS STAFF DEPARTMENTS.

*** Handout 9 ***

(Discuss the handout; again, this handout serves only as an illustrative example and does not represent an actual business enterprise. The chart was purposely drawn in symmetrical form and kept as simple as possible. The following points will prove helpful in the discussion:)

1. The horizontal rectangles represent the staff organizational segments; specifically, accounting, purchasing, personnel, and research.

2. The other parts of the diagram represent line structures which have been taken prior to this presentation.

3. It can be seen that the general manager does have authority over the accounting and purchasing departments; but not line control; these act as a service arm of general over-all operations.

4. Note the distinction in the general manager's relationship on the chart to the plant manager and to the accounting and purchasing departments; he exercises line authority over the plant manager.

5. The same is true of the personnel and research departments which provide counsel and assistance to the plant manager, but the plant manager has direct line of authority over the plant supervisors.

(In any one organization, the departments represented in the illustrative example will more than likely take different positions--it is possible that purchasing in some companies be a staff function of the plant manager, or that personnel be a function of general manager, and so on. These are matters

which general policies will dictate based upon the inherent characteristics of the organization--no two organizations are precisely alike.)

6. It must also be remembered that line functions will be practiced within the staff organization; that is, the accounting department head will have line authority over his accountants; the purchasing department head will have line control over his clerks and purchasing agents, etc.

(As a matter of review, have a trainee go through the chart for the entire class, explaining and describing as it is presented.

If time permits, have another trainee compare and contrast the charts on Handout 8 and Handout 9.)

H. Staff Organization--Advantages and Disadvantages

1. Advantages

a. The staff organization furnishes valuable assistance, counsel, and activity which are needed in the organization, especially the large organization.

b. Staff organization types allow line personnel to devote their time and energies to line activities.

c. Staff functions assist the organization in control.

d. There seems to be increased organizational balance among the activities of the organization when staff departments are present.

e. The over-all effectiveness of management is increased when counseling, planning, research, and other service departments are used.

2. Disadvantages

a. Staff functions sometimes give confusion to the organization when those persons, especially at the lower levels, do not have a clear concept of the entire organizational structure.

b. Those performing line functions may become too dependent upon staff for all planning and creative suggestions.

c. There can be a feeling of mistrust or a failure on the part of both line and staff to accept fully the work of the other; line may have the belief that the recommendations of staff are not necessary; staff may feel that line is not utilizing the data supplied to good advantage.

3. Additional considerations of staff and line organizations

(Here it will be pointed out some techniques which can be used to increase the effectiveness of organizations which have both line and staff functions.)

a. It is important that staff members of an organization know and understand the work which line is doing--understand their problems and the organizational relationships existing.

b. When staff understands more clearly the work of line, misunderstanding and conflicting viewpoints can be held to a minimum.

c. Much damage can be done to the organization by staff trying to force certain plans or proposals upon line.

d. Line must be shown how such ideas and proposals can benefit the organization, and how these are workable and practical to line.

e. Staff proposals should not be put into actual use until they have been approved by both the supervisor of staff and supervisor of line where they will be used.

f. Staff should always inform line management of any action it has taken affecting line subordinates--a common rule that should always be remembered is: authority must be exercised only through the line supervisor.

g. If line disagrees with staff, then staff should continue to try to get agreement, rather than assume authority through others and cause hard feelings.

h. If an accepted policy of staff is violated, staff should go through channels and call this to the attention of the line supervisor concerned.

i. A spirit of agreement and trust, friendship, and tolerant actions on the part of both staff and line will do much in co-ordinating the activities of each for a more effective organization.

I. Functional Organization

(The functional organization is not used extensively; consequently, does not rank in importance in relation to line and staff and will not be given detailed attention here.)

1. The functional-type organization normally applies to managerial levels only.

2. Functional organization means that the functions or duties of supervisors deal with specialization of work; that is, each supervisor is a specialist in a certain line of work and he deals with every member of the organization, no matter where he may be, who is doing this specialized work.

3. Similar tasks are grouped together, such as machine work, or carpentry work, or accounting, etc.; persons with these special skills supervise the activities being done by workers, no matter where the work may be going on.

4. The functional organization theory was introduced by Frederick W. Taylor, who believed that supervisors who possessed special skills could strengthen the organization by dealing with workers whose activities were grouped in specialized units.

5. The functional organization does possess some difficulties--these include:

   a. Discipline is rather difficult to have throughout the organization as no line authority is used.

   b. A person, many times in the functional organization, has too many supervisors--for example, if the foreman is supervising workers who perform two or three different types of skill work, he (the foreman) will have that many functional supervisors over him.

   c. It is often times difficult to fix responsibility for happenings, as the responsibility for each specialty is not always clear.

(If additional information is needed concerning the functional organization, refer to Principles of Management by George Terry, Richard D. Irwin, Inc., pp. 189-191.)

J. Formal versus informal organizational channels

1. The question is often asked: "Are all organizations formal?"

   a. The answer, of course, is "no."

   b. Even in large organizational structures, in addition to the formal lines of authority and responsibility, some people just naturally assume responsibility and exercise authority without anyone ever spelling it out.

2. The chances are that in any group of persons working at the same level, some sort of informal organization exists--a person who does not have formal authority may be found to exercise considerable weight among the others.

3. The formal organizational structures are those which are prescribed and set down in detail on an organization chart; whether they be line, staff, functional, or a combination of these.

   a. Organization charts are prepared and used by enterprises as these charts are extremely useful to management to visualize the structure as a whole.

   b. The handouts, Numbers 8 and 9, which were presented are examples of organization charts; however, in addition to the position or department, many enterprises insert the names of those people in their respective place on the chart.

      (The trainees may be asked to discuss their company's organization chart if they are familiar with it.)

   c. The established relationships of the various activities, departments, lines of authority and responsibility are easily seen in the organization chart.

   d. The organization chart shows these formal organizational relationships; especially formal responsibility and authority make-up.

4. The informal groups which do exist in almost every organization affect in some way the operation of the enterprise.

5. Many times the groups are bound together by social relationships, or by common interests, or by some other interests.

6. Informal organizations are not bad in themselves; as in some cases, these informal groups work effectively toward the attainment of the enterprise's objectives.

   a. On the other hand, informal organizational structures can undermine good principles of management.

7. Prudent management should recognize that informal organizations exist within the framework of the formal organization chart--both in the workers' group and in the supervisory group.

   a. Through experience and a study of informal organizations versus formal organizations as they exist, the necessary criteria will be provided to management to use both effectively in the pursuit of meeting objectives of the enterprise.

V. Basic Departmentation

A. The general term "department" refers to a distinct area, division, or branch over which a manager or supervisor has authority for the performance of a specified group or activity.

B. Departmentation is the same as organizing or grouping of activities and the assignment of authority for the purpose of gaining efficiency and co-ordination.

   1. This objective of gaining efficiency is the basic reason why organizations have departments.

C. Departments are necessary in the organization because the span of management is certainly limited; a human being is incapable of managing an excessive number of persons.

D. Not only do departments exist because of the limitations of human ability, but also because of the limitation of time; no person would have enough time to do all the things necessary to operate an effective organization.

E. Without departments, the top executive would have to be sales manager, production manager, etc. and every employee would be required to report directly to him.

F. Studies indicate that a supervisor can manage four to eight persons effectively at the upper levels of management and eight to 15 persons at the lower levels; without departments, this type of supervisor-to-subordinate ratio could not be had.

1. As a result of the lack of balance in this ratio, poor managements practices would come about.

2. Not only does the effective span of control for management result in more effective supervision, but it reduces the cost of organizational operation.

G. Departments may be any division of the organization, whether it be called branch, section, unit, sub-unit, or department.

H. Every department in order to operate effectively must have a responsible head.

I. Process of Departmentation

1. There are various activities, such as planning, delegation of authority and responsibility, etc., which are needed for the accomplishment of organizational objectives.

2. The following steps are those needed for organization and department completeness:

a. The enterprise's objectives need to be clearly established and stated.

b. Next, there should be the formulation of plans and policies for the accomplishment of the objectives.

c. The determination of the activities necessary to carry out the plans and objectives should be made.

d. A grouping of these activities would be the next step--each group becomes a department or unit.

e. Each group or department should be assigned the authority necessary to carry out its activities.

f. The groups or departments must then be tied together, both horizontally and vertically by authority relationships.

J. Departmentation in the organization is not, in itself, the answer to all questions or problems of organizational efficiency.

1. In an organization, levels are expensive and as these increase, more and more of the efforts and cost of the enterprise is devoted to managing.

a. Not only is there the expense of additional managers, but there are extra staff members needed to assist in management.

2. The real production in an enterprise is work done by persons in direct labor categories; departments always carry staff personnel.

3. The existence of different levels of organization complicate the problem of communications.

a. Organizations with several levels have greater difficulty communicating objectives, plans, policies, etc. than those with limited levels.

b. Omissions and misinterpretations are likely to occur, as there are more chances of this when information is passed through several levels.

4. Departments and levels complicate the problems of managerial planning and control; plans which may be definite and clear at the top of the organization structure, may not be so as they are filtered down through the various levels and departments.

K. Although departments and levels of work have disadvantages in the organization structure, they do exist, and will continue to exist because of the necessary part they exercise in the principle of management organization and control.

VI. Visual Aid in Organizational Structure

(The visual aid recommended for this concluding phase of the second session is:
16 mm motion picture
"Internal Organization"
Time for showing: 10 minutes

This film contains: an illustration of the fundamental purposes of business organization and basic organizational principles.
areas of division of labor and assignment of responsibility.
types of organizations which can be adapted to the needs of the enterprise.

The film is a McGraw-Hill Management Film; cost, $70. Available through Industrial Education Film Library, 195 Nassau Street, Princeton, New Jersey. It may also be rented.

The film contents relate exceptionally well to the material covered in the session. It is well to follow suggestions in the guide which accompanies the film for showing and discussion.

Preview the film before showing; have all equipment set up before the session starts to conserve time.

Discuss the film with the trainees after showing.)

(Session II will conclude with the showing and discussion of the visual aid; before adjournment, announce the topic for Session III, "Major Responsibilities of Management.")

SESSION III

MAJOR RESPONSIBILITIES OF MANAGEMENT

I. Objectives for Session III

A. (These objectives may be charted before the session begins for convenience and a saving of time.)

Objectives
1. To make an intensive study of management responsibilities--planning, organizing, directing, controlling, co-ordinating
2. To study relationships between management responsibilities and the organization's objectives
3. To note the effectiveness of each major responsibility of management in current practice.

(Because Session III will deal exclusively with the major responsibilities of management, <u>each responsibility</u> as it is taken will be presented so as to cover all three objectives as listed. The film at the very end of the Session will summarize to a great extent the functions of management.)

II. <u>Planning</u>

A. Planning will be the first major responsibility to be discussed in this session, because it logically is one of the first functions of management.

1. In fact, after the objectives of the enterprise are definitely determined, then management must get busy planning how these objectives will be accomplished.

2. In management, just as in any other activity, if action is to take place in an orderly manner, some plan or approach must be established.

3. Modern management today emphasizes a great amount of planning, or predetermination of what will be done and how.

4. It was pointed out in Session II that staff functions add greatly to the planning phases of management.

5. Old management methods of "hit or miss" tactics have disappeared; because persons charged with carrying out the tremendous responsibilities of operating a business cannot afford to just hope for the best to happen and do nothing.

6. The job of looking ahead, of using past experiences for mapping out proposed avenues of action must be done by competent management.

7. Every manager, no matter what his duties may involve, finds that planning is an important part of his job.

8. Unless all persons within the organizations are working together in accordance with some definite plans, there cannot be efficiency of operation, nor the achievement of organizational success.

B. Definition of Planning

1. There are many definitions which adequately define the term "planning."

2. A short, but inclusive definition of "planning" is:

Planning is organized forethought

(Additional points which can be discussed concerning the meaning of "planning" include:)

a. Planning is organized forethought to take care of proposed action.

b. Sometimes planning is thought of as study or research which becomes the base from which courses of action can be taken toward reaching a certain objective.

c. Planning takes into consideration a projection of the future based on a study of present and past situations.

d. Planning can be done on both the individual and group levels; however, the planning of the individual within the group must be coordinated with the planning of others within the group.

e. Often times, planning is said to determine:

aa. what is to be done

ab. how the thing is to be done

ac. who will take the proposed action

ad. when the thing is to be done

ae. where the action will take place

f. Planning takes into consideration expected difficulties, as well as orderly steps to be used in the accomplishment of the objectives set.

g. Planning is not only thinking ahead of what is to be done, but the putting of such thoughts in an organized manner.

h. Planning involves a great amount of skill--such skill coming from experience and a conscientious study of results and events within the organization.

i. Planning may constitute complex work and research--such must depend upon the nature of the organization and the activities it is involved in.

C. Reasons for Planning

1. The reasons or justification for planning are obvious from the introduction and definitions developed.

2. If planning had no merits, it would not be used as extensively as it is.

3. Large organizations, and many small ones, too, provide a great amount of expenditures with the necessary personnel to carry out the functions of planning.

4. Although, many times thought of as a staff function, planning must be done in line organization relationships--the line manager, supervisor, etc. cannot perform line functions effectively without planning, no matter what these functions are.

a. Planning is a requirement of every supervisory job, no matter what it consists of, or how it is classified on the organizational chart.

b. Any supervisor who has definite plans for his work and personnel will get much more done and have a more productive department, than a supervisor who just lets things go as they will from day to day.

5. Although planning is said to be time consuming and expensive, the results which come from planning outweigh any disadvantages attributed to time and expenses.

   a. Those who usually complain about planning being expensive and time consuming are the ones who do not understand, nor take time to evaluate results of organized endeavor.

   b. Many persons do not think that planning is efficient, because most of it involves mental, rather than physical work and they fail to associate mental activity with production activity.

6. Without planning, objectives for the organization would not be definite and with purpose.

7. Planning has much force in making known information, instructions, and courses of action which the group or organization will take.

8. Planning definitely fixes lines of authority and responsibility within the organization.

9. Planning actually saves time and effort by doing away with non-productive work.

10. Without planning there would be little order or specific system used in the work carried on.

D. Essential of Planning

1. As pointed out previously, careful planning takes time--this time must be taken by management--if not--the organization will find itself unable to compete with others and stay in business.

2. As planning involves looking into the future, experience of the planner must be relied upon heavily for this type activity.

   a. After plans are made, they should be analyzed before putting into effect.

   b. After plans are used, they need to be reviewed--did the results fall short of expectations? If so, why?

c. Experience will provide management with the ability to analyze the planning function much better.

3. As planning involves future activities, the supervisor or manager must become skilled in forecasting ability and the use of sound judgment.

   a. Forecasting for the short-term is not as difficult as forecasting for distant future expectations.

   b. The use of judgment in forecasting ability is important--recognizing a mistake and applying the lesson to future decisions will eliminate major mistakes.

   c. The use of facts, rather than unproved information, aids in the ability to forecast accurately.

4. Planning requires resourcefulness and the willingness to use the imagination.

   a. These elements are required in planning because of the fact that many times untried techniques or areas of work are involved.

5. Finally, an essential of planning which should never be overlooked is careful follow-up--the evaluation of results and corrective action, if needed.

E. Steps in Planning

1. It is impossible to list steps in the planning process which could be used for every organization and every possible situation.

   a. The peculiar characteristics of the enterprise, the type of operations of the organization, the philosophy of management, and other related factors make it extremely difficult to have a prepared list of planning steps which would work in every case.

2. There are, however, some basic steps which <u>most</u> planning work follows:

   a. The first step in planning is the obtaining and study of necessary information about the organization and its activities.

aa. This first step takes into consideration the study of the organization structure and makeup, personnel, and practices and procedures within the organization.

b. The second step in planning involves the intensive study of the data obtained in Step 1.

aa. The organization is studied as a whole, but also how the various compotents of the organizational structure are related.

ab. Current planning which is being done must also be studied.

c. The third step is determining possible plans.

aa. This determination is based on the material and the study completed in Steps I & II.

ab. However, additional factors such as cost, time, and quality must be considered.

ac. The determination of a proposed plan must, of course, be within the broad objectives as set by management.

ad. The determination of a proposed plan must include possible adjustments which can be made after the plan is put into effect.

d. The fourth step is the adoption of a proposed plan.

aa. The adoption of the proposed plan may be made by an individual, or by a group--this being determined by the policy of management.

e. The next step in planning takes into account the proper time schedule and sequence of details for effecting the plan.

aa. Such items as the detailed activities; who will execute the activities; and the proper order of activities are taken.

f. The last step in planning is the evaluation and follow-up of results.

aa. The use of adequate records for evaluation purposes is important.

ab. Plans for corrective action are important.

3. In considering the steps to planning and the effectiveness of planning, it must always be remembered that the success of any plan is greatly affected by the manner in which employees do their work.

   a. The human element need always be given much consideration in whatever plans are formulated.

F. Kinds of Planning

1. Planning can be classified in many different types or kinds, and is done so by various management groups.

2. An over-all classification as to kinds of planning include:

   a. New Planning

      aa. The name itself suggests the type of planning this classification consists of.

      ab. New planning is concerned with initial or original operations of the organization.

      ac. New planning may also be the result of new objectives or goals which the organization has established.

   b. Operative Planning

      aa. Operative planning is the type of planning necessary to keep the present actions of the organization progressing effectively.

      ab. Operative planning is the routine planning which takes care of current operations, but which is based on predetermined objectives or goals.

   c. Remedial Planning

      aa. Remedial planning is that type planning instituted to provide corrective action to plans which may have become deficient.

      ab. Changes may become necessary when it is found that weaknesses in the plan exist, errors in judgment are noted, changes in the objectives are made, or new information affecting the original plan is existing.

d. Long-term Planning

aa. Long-term planning may constitute any of the three previous kinds of planning noted, i.e., new, operative, or remedial.

ab. Long-term planning is more difficult to do than short-term planning, consequently, a more experienced person is needed for long-term forecasting and planning.

ac. A careful study of the organization and its activities is a prerequisite for long-term planning; also adequate follow-up is required.

e. Short-term Planning

aa. Short-term planning does not require as much skill as long-term planning; however, corrective action is often needed on the short-term basis.

ab. There is no definite time period which distinguishes long-term from short-term planning--it may be stated, however, that short-term planning normally is concerned with the current operating year or fiscal period, while long-term planning goes beyond this time period.

G. Planning as a Necessary Function of Management

1. The basic difference between a supervisor who is just a supervisor and the supervisor who also manages is the degree of knowledge and the use of judgment in acts performed.

2. Planning is a necessary function of management--this is a responsibility which is part of the manager's job.

3. There are also leadership qualities which planning tends to bring out in supervisory personnel.

a. Unless the supervisor is doing some planning and is contributing sufficiently to this function, he is simply following in someone else's footsteps.

4. THERE ARE SOME ADDITIONAL POINTS WHICH SHOULD BE TAKEN BEFORE LEAVING THE TOPIC OF PLANNING.

a. THESE ARE PRESENTED IN HANDOUT 10 AND ARE CONCERNED WITH PLANNING AS A FUNCTION OF MANAGEMENT.

b. IT MUST BE REMEMBERED THAT ONE OF THE OBJECTIVES OF GOOD MANAGEMENT IS TO PROVIDE SOUND AND ADEQUATE PLANNING AND TO EVALUATE THE RESULTS TO DETERMINE ITS VALIDITY.

*** Handout 10 ***

(Discuss the material in the handout with trainees. If time permits, additional items can be listed for No. 10, "ways in which planning can save the company money." Have trainees contribute these, and chart.)

III. Organizing

A. Definition of Organizing

1. A definition for organizing is:

Organizing is the orderly arrangement of jobs, people, and machines to accomplish an objective efficiently.

2. (It must be remembered while discussing the definition with the group that "organizing" will be taken here only as it applies as a function of management. It may be necessary to review briefly the factors relating to organization types covered in Session II to note differences in organizational types and the function of organizing.)

B. Purposes of Organizing

1. After the plans for the organization have been formulated, it becomes necessary to decide upon a certain combination of people, jobs, and facilities to fit the plan.

2. The function of organizing has as its main function to unite individuals into an effective team.

3. More specifically, organizing is concerned with the assignment of responsibility and authority so that individuals can work together in large numbers as effectively as they can alone.

4. Organizing is directed toward the work of making sure that the efforts of the enterprise are directed toward the attainment of the objectives as stated.

5. Organizing makes for a better understanding by each person in the organization of exactly what his responsibilities and authorities are; also these same characteristics of others in the organization.

C. How to Organize

1. The organizational structure of any enterprise will be determined mainly by the objectives which have been established.

2. The organizational structure, however, must be simple enough to be understood, accepted, and used by all persons concerned.

3. Because conditions and events change very quickly at times in the business world, organizing must provide for a flexible structure which can be adjusted to meet these changes.

4. Steps in the organizing process include:

a. The first step in the organizing process is to make known the job which is to be done--in other words, have the objective clearly defined.

b. Step 2 is concerned with a determination of the activities which are necessary to meet the objectives of the enterprise.

c. Next, the activities should be grouped into similar units--this is the departmental division of functions.

d. Step 4 deals with the definition and clarification of duties--each activity or group of activities to be performed must be clearly made known, and the persons who will carry out these activities must be made equally definite and clear.

e. Personnel must then be placed in positions for carrying out the defined activities.

aa. Areas of responsibility and authority must be provided to personnel selected and placed in the organizational structure.

f. Training of personnel selected should be administered initially and then continually covering such topics as:

aa. understanding of the organization's objective

ab. organization arrangement

ac. relationships among personnel on the organizational chart

ad. responsibility and authority relationships

ae. understanding of the major functions of the organization and how these relate to objectives

D. Basic Considerations in Organizing

1. There are several basic considerations or principles of organizing which are important.

2. These principles give additional light to those items already discussed.

3. HANDOUT 11 LISTS THESE PRINCIPLES OF ORGANIZING; LET'S TAKE A LOOK AT THEM.

*** Handout 11 ***

(Discuss these principles of organizing after the trainees have had an opportunity to read them.)

IV. Directing

A. What is directing? It may be defined as:

Directing is the guidance of efforts and activities toward a stated objective.

1. Directing points out the course which is to be followed in achieving the goals of the enterprise.

2. There may be a complete and adequate organizational structure, but unless there is a force which prescribes certain avenues through which activities must pass, much of the good advantages of organization and planning will not materialize.

3. Oftentimes, there can be much activity going on in the organization, but unless it is controlled and directed, there is never full realization of its efforts.

4. Directing does not suggest simply the executing of orders or rules, but the guiding of activities in a manner based on set standards of management procedures.

B. Responsibility for Directing

1. Management has several areas of responsibility based on getting certain work done through subordinates

2. Management is very extensive and its functions numerous.

   a. The manager must deal with people, human relations, situations, and procedures.

   b. All of these functions which management must perform require skill and knowledge.

3. If management were negligent in any one of the many functions it is responsible for, the entire job being done would be ineffective and without good results.

   a. This is true because all phases of the work management does is integrated and related so that each phase depends upon the other for success.

4. The manager or supervisor has people who work under his direction; these people are responsible for the production of goods and/or services.

   a. The responsibility for getting a certain amount of work done in the department or in a group rests with the supervisor--he, therefore, must know how to control and direct group activities.

5. Directing actually involves communications, counseling, training, motivating, and delegation.

   a. Each of these constitutes a means for carrying out the job of governing the activities of persons.

   b. Each of these, also, is a vast area in the field of human relations and management principles.

   c. These items are not concerned exclusively with directing, but are found in most areas of human relations and management concepts.

d. The last item mentioned in the list, delegation, is more related to directing than the others and for this reason, some discussion of it will be taken.

(It must be noted that delegation was discussed in Session II. This discussion was centered around the organizational structure and the relations among authority, responsibility, and delegation. In this session, delegation will be discussed as to how it serves as a function of directing.)

C. Delegation

1. Delegation was defined in Session II as: "The granting or conferring of equal portions of authority and responsibility from one person in the organizational structure to another."

   a. From this definition it can be seen that delegation is a prime function of directing.

   b. No one person can assume all responsibility and authority; some must be granted to others so that the necessary work of the organization can be done and in this manner, an act of directing has taken place.

   c. When a supervisor or manager directs a person to perform certain activities, he extends his area of operations because without delegation his actions would be confined to what he could do himself.

2. The supervisor who delegates effectively has more free time to do more actual supervisory work and over-all planning.

3. The function of delegating places greater trust in subordinates which in turn develops qualities of leadership.

4. Delegation enables the supervisor to organize the department's work more effectively as channels of communication are more frequently used.

5. Delegation as a function of directing should not be used as a "once in a while" activity, but should be a part of every supervisor's routine tasks.

6. Because the supervisor can never delegate ultimate responsibility for the job delegated, proper delegation is always based on a system of directionn and control.

7. A simple process of delegation, whereby direction and control are used is:

   a. The job or activity is broken down into clearly defined tasks.

   b. Next, the supervisor determines which of his people can do each task the best.

   c. The task is assigned to each person based upon the supervisor's study of the job; he answers questions for clarification; gives necessary authority and defines responsibilities.

   d. When the task is completed, or during the performance of the tasks, evaluations are made by the supervisor--such points in the evaluation may cover:

      aa. Time required to do the job

      ab. Quality of the work performed

      ac. Reasons for failure

      ad. Quantity of work completed

      ae. Attitude of the person performing tasks

   e. When the evaluation is completed, if it is favorable, recognition should be given; if unfavorable, honest criticisms of the task delegated should be given.

8. Delegation is a true test of a supervisor's skill as when he delegates, he must bring into this activity everything he knows about organizing work and directing people.

9. Although delegation is one of the most rewarding of supervisory skills, it is at the same time the most difficult to use and get good results each time.

10. It is usually found that where the supervisor is having difficulty with delegation, it is the way this management technique is being used and not necessarily delegation itself at fault.

11. There are some mistakes which the supervisor can make when delegating--here are some:

    a. A supervisor often finds it difficult to give a job to a subordinate which he (the supervisor) thinks he can do better.

b. A supervisor may under-delegate because he simply overlooks things he is responsible for which can be delegated to subordinates.

c. Many supervisors try to use some type of formula or set pattern for delegation--this is not possible, because people react differently to changes in circumstances.

d. A most common fault in delegation is that the supervisor does not give enough authority to do the job properly.

e. Supervisors delegate certain jobs and assignments, but many times do not make it clear just how or what is to be done.

f. In any delegation, there must be good communications between supervisor and subordinate--delegation is most ineffective when the subordinate can not come back to the supervisor for additional instructions, help, or clarifications.

g. Delegation involves risk and chance of mistake on the part of the subordinate; many supervisors fail to consider this factor.

12. THERE ARE SOME ADDITIONAL CHARACTERISTICS OF DELEGATING AS A FUNCTION OF MANAGEMENT WHICH NEED TO BE TAKEN. SO THAT YOU WILL HAVE A REFERENCE FOR THESE; A HANDOUT HAS BEEN PREPARED COVERING THESE POINTS.

*** Handout 12 ***

(Discuss the material in Handout 12. Remember that a film will be shown later in the session on delegation and many of the points discussed on the handout will be portrayed in the film.)

D. Communication and Direction

1. Too often supervisors delegate jobs or direct employees to perform certain tasks, but fail to find ways to control the work.

a. Such a situation tends to make for ineffective supervisor-employee relations in meeting production schedules.

b. A lack of proper communications between supervisor and employee is often the cause of this inefficiency.

2. Some ways to get better control from directing through proper communication techniques include:

   a. Make sure that the subordinate knows what is expected of him.

   b. The subordinate must know what he is to do, how he is to do it, and within what time limit he may be working.

   c. The subordinate must be told and he must understand what his limits are as far as company policy, regulations, and personal responsibility are concerned.

   d. The subordinate must know what authority he may exercise in order to get the job done.

   e. The supervisor must make sure the channels of communications are open upward; that is, the subordinate should have the feeling of freedom of communication with his supervisor concerning problems encountered.

   f. If changes occur to affect initial plans of delegation, the subordinate must know what course of action he is to take.

   g. The language of directing must be kept on a plane which the subordinate understands.

E. Evaluation of Directing

1. Directing, like any other management function, can be evaluated to determine its effectiveness in doing the job it is supposed to do.

2. Formal criteria are good to have; that is, certain standards stated and prescribed to measure success or failure of directing.

   a. Of course, formal standards do not have to be established to evaluate effectiveness of directing.

3. A few simple measuring devices are all that are needed for the evaluation of directing.

4. If answers to the following questions are positive, good results from directing are being gotten; if the answers are negative, some strengthening must be done:

a. Do subordinates understand fully the nature of the work or other activities which they have been directed to do?

b. Can the supervisor entrust the work to the subordinate with only occasional inspection?

c. Does the worker appreciate the opportunity to show that he can do the work assigned?

d. Is there respect shown by the supervisor for the subordinate's ability to do the job?

e. Is there respect shown by the subordinate for the supervisor's position in getting work done through his workers?

f. Does the worker have proper authority to go with the work he has to do?

g. Does the worker know to whom he is responsible?

h. Does the worker understand why the work he is entrusted with is important to the total organization's work?

(This list of questions is by no means complete; if time permits, additional ones may be developed.)

V. Controlling

A. Controlling may be defined as:

Controlling is the process of checking and restraining efforts and activities within prescribed limits.

1. Controlling is certainly an important function of management as the activities of the enterprise must proceed within certain desired channels.

2. Controlling aids in the process of making sure that the activities of the enterprise takes the proper direction.

3. Controlling also involves the motivating of persons so that activities are carried out as desired.

4. Controlling is very much related to other management functions and actually is dependent upon these other functions for smooth operation.

5. As has been noted in all management functions, changes and adjustments are always necessary to handle current problems--the same is true with controlling in that it must be flexible and dynamic.

6. The management function of controlling and the qualities of leadership are very much related; however, not all leadership techniques are considered to be controls or restraints of human activity.

7. The degree of control necessary in any organization or in any activity will be dependent upon many factors; management ability, efficiency of workers, morale of persons involved, communications, etc.

B. Types of Controls

1. Controls are not ordinarily classified in a set manner as their use in specific cases will be determined by the type of problem.

2. The degree of control will also be determined by the nature of the problem or situation.

3. Such factors as efficiency of work force, types of leadership needed to supervise personnel, and related items are, in effect, going to govern the types of control exercised by management.

4. Management does, however, exercise control through the following control types:

   a. Orders

   b. Rules

   c. Instructions

   d. Organization Structures

   e. Policies

   (The latter two items have been discussed in Session II; considerable time being given to organization structures. The relations between organizational structures and control can readily be seen. Policies were discussed in terms of management's broad and comprehensive outlines for guiding and directing the enterprise.

   Therefore, only the first three items will be taken here.)

5. Orders

a. Orders are important in the controlling of activities of others.

b. Orders tell or command others what to do; these may be written, oral, or by gesture.

c. Orders are usually given when a directive must be acted upon within a short period of time.

d. Orders should be issued only by a person who has the authority and the responsibility to see that they are carried out.

e. Orders should not be made unless they are intended to be enforced--it is very ineffective to issue orders and then do nothing about violations of such.

f. Orders which are issued should be fully understood by the person who is to carry them out.

g. An order should not be given a subordinate if he is not capable of carrying it out.

h. An overuse of orders is not good--an excess of orders tends to weaken authority of the supervisor.

i. Greater co-operation from the person receiving the order will be had if he understands the importance or reasons why the order is to be carried out.

6. Rules

a. Rules are definite and exact guides for action.

b. Rules must come from those with authority in the organization, as authority is recognized through the setting and enforcement of rules.

c. Rules must be applied the same to each similar situation; as the basis for a rule is that it must be specific and cover exact situations.

d. Rules inform personnel as well as control their activities.

e. Rules should be stated in language simple enough to be understood by everyone in the organization.

7. Instructions

a. Instructions form another important way in which management controls activities.

b. Instructions are information, either in writing or in oral form, which indicate the proper way for doing a certain job or activity.

c. Instructions give the "how-to-do" information so that the correct procedure may be followed.

d. Instructions which are given to workers cover much of the routine work or that work which follows standard procedures.

e. Instructions tend to give uniformity to the procedure for doing work--this gives more value to quality control and standardization.

(Now, have two or three of the trainees contrast the differences among rules, orders, and instructions. This will aid in a better understanding of these management controls; as often times, confusion does exist concerning differences.

Guide the discussion and clear up any misunderstandings.)

C. Considerations in Gaining Effective Control

1. Considerations in gaining effective control must be emphasized.

2. These considerations are summarized in Handout 13.

3. HANDOUT 13 HAS BEEN PREPARED TO GIVE A SUMMARIZATION OF THE USE OF CONTROLLING AS A FUNCTION OF MANAGEMENT AND THE CONSIDERATIONS FOR GAINING EFFECTIVENESS IN ITS USE.

(Read through and discuss contents of Handout 13.)

D. Standards and Controls

1. Although a standard is not thought of as a type of control, it does provide a basis upon which controlling can be guided.

2. A standard is thought of as an accepted or established instrument of measure.

3. Standards are important as tools of management as they provide bases for the determination of the qualifications required to perform a certain activity satisfactorily.

a. Standards involve personnel, materials, machines, and procedures for doing the work.

4. Standards assist greatly in the controlling function as they make clear the performance levels for the work being done and the evaluation of the results of the work.

5. Standards are used to determine the qualifications for improving work procedures, as a degree of measurement is always present when standards are applied to current work practices.

6. Standards provide for better control and co-ordination by management in that a measure or criterion determines the exact quality of factors within the organization.

VI. Co-ordination

A. Co-ordination is defined as:

Co-ordination is the blending together of the activities of the organization which result in a united and common activity.

1. Much of the work of management is making sure that all the efforts being put forth in the organization are blended together in the direction of a common goal.

2. Management must strive to synchronize and hold together the actions of the organization so that a common effort aimed in the direction of the organization's objectives is had.

3. The proper balance among the personnel of the organization must be maintained--this is a function of co-ordination.

   a. Each person must know what he is to do and when he is to do it so that the effort of each will be in unison with the total efforts of the group.

4. For greater organization efficiency, the work of each person or unit must be taken not only from the viewpoint of the individual or unit, but from that of other elements which also contribute toward the common objective.

B. Types of Co-ordination

1. Normally co-ordination within the organization is classified as:

   a. Vertical co-ordination

   b. Horizontal co-ordination

2. Vertical co-ordination is that co-ordination which links together the components of the various different levels of the organizational structure.

   a. This co-ordination goes from top to bottom, and vice versa, in the organization.

   b. There must be co-ordinated activities between top management levels and all other levels below down to workers.

3. Horizontal co-ordination is that co-ordination which links together the components within a level of the organizational structure.

   a. This co-ordination goes across horizontally on the organizational structure; such as that between same level departments, between department heads, and among personnel within each unit or department.

C. Co-ordination and its Effects

1. Certainly, co-ordination as a function of management has many good effects.

2. Without the use of co-ordination, activities of the organization would be done in a manner not necessarily consistent with keeping the individual work unified and dovetailed together toward a common goal.

3. LET'S TAKE A CLOSER LOOK AT SOME OF THE EFFECTS OF CO-ORDINATION.

   *** Handout 14 ***

   (Read through and discuss principles in Handout 14)

D. Techniques of Co-ordination

1. Co-ordination must start within the department or unit; that is, efforts and activities must first be geared to the objectives of the unit.

2. Next, each department or unit should be studied in relation to how it fits into the over-all organizational structure.

3. The dependence of one department or unit on the other must be clearly stated and shown so that the blending together of activities can be done.

4. A charting system can be used to show visually the interrelationship among departments; or a graph can be prepared to show how a function or activity is to be shared by those persons or departments designated.

5. In applying any technique of co-ordination, it must be remembered that the objective of the enterprise must always be the basis for plans of action.

6. The function of co-ordination requires a follow-up periodically to determine the effectiveness of techniques used; adjustments may be needed to bring about desired changes.

VII. Visual Aid in Major Responsibility of Management

(The visual aid recommended for this Session is:
16 mm motion picture
Title: "Breaking The Delegation Barrier"
Time for showing: 30 minutes

This film shows how supervisors prevent or overcome the normal tendency of their people to oppose new ideas and procedures. It helps avoid serious drop in efficiency and morale by showing how to deal with emotional factors which breed resistance to change.

Note that the running time for the film is 30 minutes; the session should be paced so that this amount of time plus a few minutes for discussion will be available.

The film may be purchased from: Roundtable Productions, 275 South Beverly Drive, Beverly Hills, California; cost, B/W, $175; Color, $300; or it may be rented for a nominal fee.

Preview the film before showing; have all equipment set up before the session begins.

There is a Discussion Leader's Guide which accompanies the film; this should also be reviewed for additional suggestions on how the film contents can best be discussed.

The film contents and objectives portray exceptionally well the management function of delegation and its related aspects.

Show the film; discuss.)

SESSION IV

ORGANIZED LABOR

(This material to be presented in Session IV will strive to satisfy two objectives: (1) To acquaint management, in situations where organized labor does not exist, with background and general information concerning the part organized labor plays in this country's economic system; and (2) To present additional information concerning organized labor for the benefit of those trainees who are in situations where organized labor currently exists.

In both cases, much can be gotten from the material to be presented in this session. It must be pointed out, that an objective, impartial approach will be given; that such an educational process as this training conference will not attempt to take either a pro-management or a pro-labor position. You as the conference leader must make this condition known, as management-labor relations can result in misunderstandings and resentment on the part of the trainees, depending upon which stand their respective company or organization may take. However, the session's discussion must be approached from the viewpoint of how management can make better use of the material presented.

Because some of the information presented will be rather detailed, the previous arrangement of using the outline form will not be followed exclusively here, and the text form will be used considerably.

It may be better to pace this session somewhat slower, so that the text material will be understood. Allow ample time for questions from trainees.)

I. Objectives for Session IV

A. (These ovjectives may be charted before the session begins for convenience and a saving of time.)

Objectives
1. To trace the history of labor movement in the United States
2. To present an understanding of union activities
3. To study union-management relationships
4. To trace the history of unions in Louisiana and note present status.

II. History of Labor Unions in America

With about 18 million workers organized in labor unions in the United States today, much of the personnel relations activities in business and industry are affected by unions. Because this country is a democracy, the right to organize by labor has long been a right which workers have enjoyed. More recently, however, legislation was passed declaring that workers had constitutional rights to organize and bargain collectively; a closer look at this legislation will be made later in the session.

Labor unions had their beginning several centuries ago, as it may be recalled from history that absolute national monarchies were unable to check the increasing power of the people in their endeavors to get better representation. Since 1689, the English Bill of Rights has served as a basis for the granting of religious and political freedom. This freedom and opportunity for democratic action spread to the fields of commerce and industry. The Industrial Revolution and the conditions which workers had to endure in the factories had much to do with the organization of free and independent labor unions.

The labor movement in England had a decided effect upon the attitude of the workers in the United States. The American organizations were modified from those of England; however, the early labor activities in this country were influenced greatly by the character of the colonies, the newness of the settlements, the free public lands, the large role which agriculture played, and the scarcity of labor. These factors actually slowed up the organization of labor and prevented a united front by labor.

Prior to 1800 there were several local trade unions in the United States. The first of these was an organization of carpenters, which was founded in Philadelphia in 1791; in 1794 two more unions were formed--the Federal Society of Journeymen Cordwainers in Philadelphia and the Typographical Society of New York.

These early organizations showed some degree of aggessiveness and from time to time in disputes with management, strikes were resorted to. The early labor unions, however, for the most part confined their activities to matters relating to the business of unions and the welfare of the members. The organizations maintained benefits for sickness of their members and in some cases expenses for burial purposes. These early unions enforced rules for apprentices and did all they could to get agreements with management on hours of work, wages, and working conditions. It was probably during this early period of American history that unionism became firmly rooted in labor's objectives and philosophy.

In the early 1800's, manufacturing and transportation industries developed rather rapidly. In the factory towns and cities, there arose many inequalities in living conditions, educational opportunities, and working conditions favored the development of co-operative action by economic groups. Workers came to feel the need for organization so that a united effort could be had. The number of local unions which were organized increased. In addition, there were many who advocated the formation of regional and national labor organizations so that more bargaining power could be had. A start in the direction of national unions and union federation was made in 1827 when the Mechanics' Union of Trade Associations was formed in Philadelphia. This was the first labor movement that affected more than a single trade. This formation came about when the carpenters at Philadelphia had a strike for a ten-hour day--at first, the strike was unsuccessful, but other trades came to its support. This organization went into politics to gain its end and found that such political action could be used to bring pressure to bear.

In 1834 the National Trades Union was formed which had about 26,000 members. This labor organization was instrumental in obtaining a ten-hour working day for government employees. Other national unions followed and all types of co-operative plans were being discussed by labor organizations. The demands which these early labor organizations made were: shorter working hours, free schools, equal taxation, abolition of laws which required imprisonment for debts, and direct election of public officials.

The first permanent national labor organization, the International Typographical Union, had its beginning at the convention of journeymen printers in 1850. The name which this union adopted in 1852 was the National Typographical Union; the union was made international in 1869. This union, which is in existence today, set an example that was followed by unions of stonecutters, molders, machinists, blacksmiths, and locomotive engineers. The principal aim of these organizations was to control the supply of workers in the industries represented by unions.

The panic of 1857 which affected the economic condition of the country weakened the union movement and some of the labor organizations became local in nature again. With the coming of the Civil War, business and manufacturing activities increased; in the North, especially with its factory centers, wartime production of military goods demanded more and more workers. These wartime conditions were very favorable to the development of union activity and there were rising prices, a greater demand for goods, and a shortage of workers. As a result of these conditions, unions grew in number and strength.

The wartime conditions brought about by the Civil War and the resulting favorable conditions for the formation of unions continued even after the war had ended. There developed a feeling on the part of many workers for the need of a single great union of all industrial workers--skilled and unskilled. Under the leadership of W. H. Sylvis, head of the Iron Molders' Union, a new organization was formed in 1866 known as the National Labor Union. It was composed of various types of labor and trade organizations. This union functioned for six years during which time it became identified with political movements and philosophies. It was chiefly concerned with securing laws that would restrict the working day to eight hours, establish a national bureau of labor by the government, and the exclusion of the Chinese coolies from the United States. A number of industrial congresses were held for the purpose of unifying the political aims and efforts of organized labor. In the 1870's there were some destructive strikes; but during this period of time, business depressions occurred again, causing the labor movement to lose considerable ground in its development.

The National Labor Union ceased to function in 1872; however, another organization began to make its appearance--this organization was known as the Knights of Labor. Actually this organization had its start in 1869 as a secret organization, known then as the Noble Order of the Knights of Labor. Prior to 1880 the organization had made little progress as a labor influence. However, it subsequently abandoned its secret meetings and began to enlist membership from all laborers. The Knights of Labor had as an objective the establishment of a co-operative society that would replace the existing capitalistic and competitive economic system. The organization's slogan was "An injury to one is the concern of all." The Knights' of Labor immediate objectives were: (1) increased wages for workers, (2) a reduction in the length of the working day, (3) the abolition of child labor. For several years, membership in the Knights of Labor increased rapidly and by 1886, membership totaled about 700,000. However, the organization failed because of several sympathetic strikes which it took part in were unsuccessful; its activities in political affairs; and because of the overcentralization of power in its general officers.

The labor organization which next was to come on the scene and one which is now presently in existence was the American Federation of Labor (A.F. of L.). The American Federation of Labor dates back to 1881 when several union leaders met at Pittsburgh, Pennsylvania in an attempt to unite existing unions on a nation-wide scale. This meeting resulted in the formation of the Federation of Trades and Labor Unions of the United States and Canada. In 1886, the Federation

of Trades and Labor Unions through a meeting of its union executives, formed a new organization, the American Federation of Labor, which provided for a real federation of unions with revenue-collecting powers, under the guidance of a full-time executive. Samuel Gompers was elected president, and Canada and the United States were included in the jurisdiction of the Federation.

The growth of the Federation was slow because it was difficult to convince workers in some cases of the value of unified efforts on the part of labor to better their circumstances. The Federation survived a number of major obstacles in its earlier years. The panic of 1893 halted union expansion, several strikes had some bad effects upon the Federation, and other labor movements started by the American Labor Union, the Socialist Trades and Labor Alliance, and the Industrial Workers of the World provided competition for membership growth. The Federation weathered the storms of organization and initial growth, and today still has as its primary purpose the advancement of labor through unions banded together in an international association. It seeks to increase the economic strength and political and social influence of the member unions through organization, collective bargaining, legislation, and education.

It is well to discuss briefly, the philosophies of one of the labor organizations which had its beginning some years after the Federation, but which competed against the Federation for membership. This organization, which has been mentioned by name in a preceding incident was the Industrial Workers of the World. This organization brought together many conflicting elements--socialists who believed in political action, the socialists who believed in promoting the economic organization of industry, and the extreme "leftists" who believed in direct action wholly instead of political action. This organization, commonly known as the I.W.W., was formed in Chicago in 1905 and the common ground which its membership believed in was a hatred and distrust of capitalism. The philosophy of the I.W.W., as announced in 1908, was that the working class and the employing class had nothing in common, that the struggle between the two must go on until the workers of the world take possession of the means of production and abolish the wage system. In 1912 the I.W.W. carried on more than 30 successful strikes and its membership increased greatly. At the height of its popularity, its membership reached approximately 500,000. During World War I, opposition to the I.W.W. arose because of the lack of patriotism of its members as it opposed the production of war materials and tried to hinder the draft. Because of this and other reasons such as: extreme radical elements within the organization, suppressive regulations by the government, and the high rate of unemployment, the I.W.W. began to decline.

Industrial unionism did not cease with the decline of the I.W.W., but a more conservative aspect of it continued strongly in the individual unions such as the United Mine Workers of America among the coal miners, the unions of the brewery workers, the Amalgamated Clothing Workers of America in the garment industries, the United Textile Workers in the textile industries, and the Railway unions. Revolutionary unionism had subsided to a great extent; however, communistic tendencies continued to spring up and developed the policy of gaining control from within the labor unions. The Trade-Union Educational League, later called the Trade Union Unity League was organized in 1920 and by 1931 it claimed a membership of 100,000. In all of its characteristics, it was communistic--during the depression of the 1930's it lost strength and by 1938 had disbanded.

The American Federation of Labor in contrast to the unions just previously discussed had a somewhat different philosophy of organization and activity. The Federation and the four brotherhoods of the railroad workers (engineers, conductors, firemen, and trainmen) advocated a continuation of the fundamental institutions of free enterprise and did not question the ethical foundations upon which these institutions existed. The American Federation of Labor gave public notice of its philosophy when it issued its war labor policy at the outset of World War I in 1914. This policy contained: (1) a no strike policy for all war and defense material production, (2) recommendation for the establishment of a National War Labor Board, (3) the settling of grievances by mediation, conciliation, and voluntary arbitration through the War Labor Board, (4) the broadening of government mediation and conciliation services, and (5) due regard for the health, safety, and welfare of workers. Throughout its history, the American Federation of Labor has opposed numerous groups promoting ideals of socialism and communism.

The American Federation of Labor grew in number and strength from its beginning, although the rate of growth in some years was not very high. During the years of war prosperity from 1915 to 1920, membership rose to about five and one-half million workers; membership decreased by one and one-half million from 1920-1923; by 1930, membership in the Federation was approximately three and one-half million.

For some years, there had been a division of opinion among leaders in the American Federation of Labor over the question of the desirability of promoting the growth of unions on an <u>industry-wide basis</u>. The policy of the Federation had been to organize and further the interests of skilled workers in certain specific occupations--in other words, the organization of trades and crafts. There were those

leaders in the Federation, however, who held an opposing theory--they felt that in the organization of unions, the nature and characteristics of an industry, and not the workers with certain skills, should be the guiding considerations. For example, in the automotive industry, it was said that the organizing activity should not be directed to forming separate unions made up of machinists, toolmakers, molders, etc.; rather there should be one union made up of all the workers in the automotive industry. This difference in opinions by the craft unions versus the industrial unions within the American Federation of Labor proved to be a heated and bitter controversy. The failure of the labor leaders in the Federation advocating industrial unionism to persuade the American Federation of Labor to give more attention to the organization of industrial unions led to the formation of a self-appointed committee to organize the mass-production industries.

In November, 1935, apparently without the official knowledge of the executive council of the A.F. of L., eight union leaders met in Washington and formed the Committee for Industrial Organization (C.I.O.). In brief, the Committee's purposes were to: (1) to encourage and promote the organization of the unorganized workers in mass-production and other industries upon an industrial basis; (2) foster recognition and acceptance of collective bargaining in such industries; (3) bring industrial organizations under the banner of the American Federation of Labor. After considerable correspondence between C.I.O. and A.F. of L. officers, the executive council of the A.F.of L. in January, 1936 rendered an opinion that the Committee for Industrial Organization should be immediately dissolved. As the C.I.O. did not carry out the recommendations of the executive council, charges against the Committee were preferred with the result of the charges being that the members of the C.I.O. were suspended by the executive council of the A.F. of L. The suspension became effective in September, 1936, in spite of the fact that the C.I.O. held that it was an illegal ouster, since the executive council had assumed powers reserved for full convention membership. In the same year, at the A.F. of L. convention, at which the C.I.O. unions were not permitted representation, the convention confirmed the split ordered by the executive council.

Numerous meetings of reconciliation by the representatives of the A.F. of L. and the C.I.O. failed to effect a compromise and both organizations began organizing campaigns which had success. After the C.I.O. established an independent federation, it became known as the Congress of Industrial Organizations. The C.I.O. became stronger through increased membership and increasing success in gaining recognition and collective bargaining agreements in the mass-production industries. The C.I.O. was victorious, in the first great test of its strength on a

national scale, when it gained recognition from the General Motors Corporation despite opposition from the A.F. of L. This brought new gains in membership, not only in the automobile industry, but wherever the C.I.O. was carrying on its organizing activities. In 1937 it was noted that almost four million workers were affiliated with the C.I.O., a remarkable growth from its small beginning. Peak membership in the C.I.O. was reached in 1940 when almost seven million workers were members. The C.I.O. organizing campaign swept through a number of industries with considerable success. Workers in many types of industries went into C.I.O. membership--textile workers, oil workers, shipbuilders, transport workers, retail employees, and others. The United Mine Workers under the leadership of John L. Lewis did much in organizing of workers in new industries. In fact, John L. Lewis was elected president of the C.I.O. at its first convention in Pittsburgh in 1938.

The split in the organized labor movement that resulted from the formation of the C.I.O. had several important effects, both on the labor movement and on the public. It caused some of the craft unions in the A.F. of L. to make requirements for admission easier. Rivalry between the A.F. of L. and the C.I.O. caused the leaders of unions identified with each of the two federations to compete with each other in winning concessions from their respective employers. On certain occasions, it resulted in jurisdictional disputes that led to strikes, even though no issue between a union and the employer was involved. The rivalry often led to disunity in political matters such as the support or opposition of a candidate, which weakened the over-all political power of organized labor. Both sides recognized that this split in labor unions was not giving full strength to the purposes and progress of organized labor. There finally started some discussion and negotiations to bring the two federations together into one unit. After a long period of talks and negotiation, a merger of the American Federation of Labor and the Congress of Industrial Organizations was brought about on December 5, 1955. The president of the A.F. of L. became the president, and the president of the C.I.O. became vice-president and director of the A.F.L.-C.I.O. Department of Industrial Organization. The total membership of the new organization was estimated at about 16 million persons. The new organization through its constitution establishes: (1) membership shall be chosen regardless of race, creed, color, or national origin, (2) raiding of members from one union by another and jurisdictional disputes are to be discouraged, (3) protection of labor movement from corrupt influences and practices of all kinds, including the efforts of Communists to gain control of member unions, (4) a Code of Ethical Practices which controls the issuance of charters to local unions, the handling of health and welfare funds, labor racketeers and communists and fascists in unions, investments and business interests of union officials, and the practice of democracy in union affairs.

Besides the A.F.L.-C.I.O., there are the Railway Brotherhoods and the independent unions. Coming into existence as mutual benefit and insurance groups, the railway unions multiplied with overlapping jurisdiction. These many unions did not present a unified front until the Brotherhoods began to co-operate more closely under a federal act of 1934. The railroad unions supplemented collective bargaining to their benefit plan and today they are looked upon as good business unionism. Besides the railway unions, there are independent unions in other industries--newspaper, printing, clothing, steel, etc. Which have developed with the growth of these industries. Even though some independent unions did originate as employee representation plans, many had from their start, and still have, no connection with such a plan or with the management. Many of the independent unions contend that they could and wanted to deal with their employers themselves; that they knew the conditions in the companies and could do a better job of bargaining themselves without any interference or domination by an outside union. In 1958, out of 186 national and international labor unions in existence, 49 were unaffiliated. Most of these unaffiliated unions were in the 1,000 to 5,000 membership range size.

(This concludes the "History of Labor Unions in America." It will be well for you to summarize this material before going to the next section. In your summarization, be sure to cover the explanations for types of labor organizations, as:

Labor Union--refers to any organization of employees that acts as a bargaining agency for its members.

Craft or Trade Union--the membership is comprised of workers in a single occupation or in closely related occupations; The Knights of Labor and the American Federation of Labor advocated this type union organization.

Industrial Unions--composed of all classes of workers in a given industry; The Congress of Industrial Organizations advocated this type union organization.

In the summarization, also cover major points of development of both A.F. of L. and the C.I.O., including the split in 1936 and the merger in 1955.)

III. Character of Labor Unions

A. Labor unions are classified not only as trade or industrial unions, but also as local, national or international, and federated unions.

B. The Local Union

1. Individual members of labor organizations belong to local unions, and only indirectly to national and federated unions.

   a. Some of the large local unions include most of the workers in a number of different plants in the same industrial community.

2. Officers of the small local unions do not receive any pay for serving as an official, but simply continue to work in their regular jobs.

   a. In the larger local unions, however, officers receive so much pay for conducting each meeting.

3. In the large local unions, clerical help is provided on a full-time basis and an office is maintained.

   a. In such a situation, a business agent is employed who is a full-time employee of the local.

   b. A business agent serves as manager of the local union and in general administers the affairs of the union.

4. Shop stewards are elected by the departments in a company which is unionized.

   a. The shop steward is not an employee of the local union, but his main functions are: (1) handle grievances of members of the local union with the management of the company; (2) make sure that the conditions as defined in the union agreement with management are carried out.

5. Dues are paid by members to an officer of the local union, usually the treasurer.

   a. The amount of dues paid by each member is determined by many factors and the benefits members are entitled to.

   b. Dues normally paid once a month; can range between $2 and $20 a month, depending upon conditions which have been set and benefits members have agreed to be assessed for.

c. Dues which are collected by the local union are divided between the local and the national union--a percentage of the dues are sent to the national union.

C. National and International Unions

1. Most local unions join together in national or international unions.

   a. The national unions, however, often direct the organizing of work groups into local unions.

2. The constitution, rules, and regulations of the local unions must observe the general organizational policies and procedures as prescribed by the national unions.

3. The functions of the national unions are:

   a. To assist local unions in negotiations with employers.

   b. To promote and extend union organizations on the local level.

   c. To take active part in the conventions and other meetings of the national federation with which they are affiliated.

4. The Department of Labor reported that in 1958 there were 186 national and international unions; 137 of these affiliated with the A.F.L.-C.I.O., and 49 unaffiliated.

5. The distinguishing feature of the international unions in contrast to national unions is that the former include locals in the United States, Canada, Puerto Rico, and other territories outside the United States.

6. The size of the national unions, as reported by the United States Department of Labor range from less than 1,000 members to more than 1,000,000.

7. The national unions hold conventions every year, or at some other time interval when the business of the organization is discussed by the delegates.

   a. All of the local unions send delegates to the conventions.

8. The affairs of the national unions are handled by an executive board.

a. The executive board executes the rules and instructions which the convention adopts.

b. The executive board may issue or withdraw characters of local unions.

c. The executive board actually supervises all of the business of the organization, including business of the local unions.

D. National Federations of Unions

1. For most part, the national unions are affiliated with the A.F.L.-C.I.O.

a. An exception, however, is noted in the case of the Railway Brotherhoods (Engineers, Firemen, Conductors, Trainmen) and a number of unions composed of government workers who are not affiliated with the A.F.L.-C.I.O.

b. The Teamsters Union was expelled from the A.F.L.-C.I.O. in 1958 for conduct which did not keep with the intent of the constitution the activities of the members of the union and especially its executives in corrupt practices were made public.

c. A total of 15 unions with memberships ranging from 28,000 to over 1,600,000 do not belong to the A.F.L.-C.I.O.

2. The general objectives of the national federations of unions (A.F.L.-C.I.O.) are:

a. Promote the labor movement among local and national labor organizations that make up the federation.

b. Assist all organizations in the federation on matters pertaining to the legislative, judicial, and executive branches of government.

c. Expanding union membership.

d. Providing information of various kinds to members.

e. Providing of guidance in all matters pertaining to labor to unions in the federation.

E. Structural Organization of the A.F.L.-C.I.O.

1. A better understanding of the structural organization of the three types of unions can be had by studying the organizational structure of the A.F.L.-C.I.O.

2. Such an organizational structure, presented in chart form will be utilized for this discussion.

*** Handout 15 ***

(Handout 15 should be discussed with trainees in relation to the basic union structure and organization of the A.F.L.-C.I.O. Points which may be mentioned in the discussion include:)

a. Holders of residual power in most unions are the national and international unions, as they charter most of the local unions.

b. Although not mentioned in the chart, it is significant to note that in 1958, there were well over 60,000 local unions which were members of the national unions in the A.F.L.-C.I.O. compared to about 500 local unions directly affiliated with A.F.L.-C.I.O.

c. Also, the local unions, both those directly affiliated with the A.F.L.-C.I.O. and those affiliated through membership in the national unions may also be members of local and state federations and councils.

d. As can be noted, the organizational structure of the A.F.L.-C.I.O. is rather large and complex--in addition to the basic chart drawn, there are also represented in the structure, many departments at each level, standing committees, and a large staff which work under the officers at the Washington, D.C. office.

IV. Laws Affecting Labor Unions

A. There are several laws which affect the activities of labor unions.

1. These laws have been the outgrowth of attempts to maintain industrial peace and prevent controversies which cause very bad situations.

2. It is a basic right that the American worker have individual freedom and that businesses and industries have the same freedom in the conducting of operations without being subjected to acts of unlawfulness and coercion.

3. One of the ways that the basic rights of the worker and the employer are protected is through the enactment of laws.

4. There must be proper respect shown for both the worker and the employer; and even though in many cases, peaceful relations between workers and employers are maintained, not through the compulsions of law, but by a willingness on the part of the people to concede that these rights exist, laws are still needed to prevent misunderstandings or misinterpretations.

5. The important laws and doctrines which affect organized labor are best classified as: (1) Common law doctrines, (2) State laws and agencies, and (3) Federal laws and agencies.

(Pace the following section slowly. Write the name of each law or agency being discussed on the chart or board.)

B. Common Law Doctrines

1. American common law, unwritten law, is predicated on the ideals of the right of the individual and the right to hold and own private property.

2. This philosophy of common law is the basis for the doctrines presented which attempt to apply legal restraints and solutions in the settlement of industrial disputes.

3. **The Conspiracy Doctrine**

The basic theory of the conspiracy doctrine is that a lawful act when done by an individual may be unlawful when it is the result of combined effort. For example, it has been held that an individual worker asking for an increase in pay is legal, but when individuals combine for the purpose of demanding a wage increase, courts during the early history of trade unions often ruled that a combination of workers in itself was a violation of the law. For many years the courts tended to outlaw all union activity; then, in 1842, the Supreme Court of Massachusetts ruled that a combination of workers as such was not illegal unless it used some criminal or unlawful means. This ruling resulted in a departure from earlier decisions. Now, according to common law,

courts tend to hold that a combination of individuals is legal if the purpose is the benefit of the members of the group, but if the purpose is the injury of the employer, the organization is illegal. This results in sometimes rather close study by the courts since a union may feel that it can gain its point only by inflicting financial loss to an employer. The court must decide whether the loss to the employer or the benefit to be gained by the workers is of the greater importance.

4. The Restraint-of-Trade Doctrine

According to this doctrine, any contract that restrains trade is against public policy and is unenforceable. Also, when persons combine in an agreement to restrain trade, the combination may be a criminal conspiracy. At common law, a combination for the purpose of peacefully persuading an employer to grant an increase in wages was usually allowed to be legal; but if the purpose was to coerce him by using unreasonable means such as a strike, boycott, etc., such was held to be a conspiracy in restraint of trade. What was reasonable in any case depended upon the judgment of the court.

C. State Laws and Agencies

1. Each state has its own statutes which apply to industrial disputes.

2. There is a degree variety noticeable among the states in the laws which apply to union activities; however, most state laws declare that conspiracy is a criminal offense and that combinations to restrain trade are illegal.

3. A closer look at these legal aspects in Louisiana will be taken later in the session.

D. Federal Laws and Agencies

1. Norris-LaGuardia Act

This federal statute enacted in 1932 limited the power of federal judges to issue injunctions in connection with disputes between employers and employees. The general purpose of the act was

to exempt labor unions from injunctions in response to employers; requests in connection with labor disputes. It specifically accorded to labor the right to strike, to belong to a union, and to engage in other practices, many of which rendered union members liable to prosecution under common law.

2. National Labor Relations (Wagner) Act

This federal law was enacted in 1935. It provided that employees have the right to self-organization, to form, join, or assist labor organizations, to bargain collectively, and to engage in organized activities for their mutual aid or protection. The law also stated that it would be an unfair labor practice for an employer to interfere, restrain, or coerce employees in the exercise of rights guaranteed by the act; that the employer must not discriminate in regard to hire or tenure of employment or any term or condition of employment to encourage or discourage membership in any labor organization; and that it cannot refuse to bargain collectively with the representatives of his employees. Provided by the law also, was the creation of a National Labor Relations Board, which was charged with carrying out the provisions of the Act.

3. Labor Management Relations (Taft-Hartley) Act

Opposition to the Wagner Act resulted in 1947 in the passage by Congress, over the President's veto, the Labor Management Relations Act, commonly known as the Taft-Hartley Act. The Wagner Act was not repealed; but the Taft-Hartley Act nullified or modified many provisions which had been objectionable to employers. The law put into operation certain restrictions on labor organizations and practices that businessmen and employers had advocated so as to place management on an equal footing with the unions. Just as the act was highly acclaimed by management, it was denounced by labor unions which called it the "slave labor" law.

In general, the provisions of the Taft-Hartley Act were:

a. The law required that both labor unions and management respect the right of individual workers to join or not to join a union.

b. Annually a union that has been recognized by management may be required to prove that it represents a majority of the workers in the company.

c. A union may be sued by an employer, another union, or an employee for the acts of any one of its officials, including shop stewards.

d. Featherbedding, which is the practice of compelling employers to pay for unnecessary services, is prohibited.

e. The law prohibits the closed and preferential shops, but permits the union shop provided the state does not have a law against it.

(The types of shops mentioned may not be familiar; therefore, definitions of each is given:)

Union Shop -- a union shop agreement requires any nonunion worker who secures employment in the company to become a member of the union at the end of a specified time.

Closed Shop -- is an establishment that operates under a collective-bargaining agreement not to employ nonunion workers.

Before nonunion workers are employed, they are required as a condition of employment to become and remain members of the union which the company has an agreement with.

Preferential Shop -- This type of shop exists when the union contract requires that the company give preferential treatment to union employees. In hiring additional workers, preference is given to hiring union members; or in case of layoffs, union members are given preferential treatment.

f. The act provides that, if the President of the United States believes that an impending strike or a strike that is in progress might endanger the national health and safety, he may appoint a board to study the facts of the case. After the report by the Board, the President may ask the Attorney General to file a petition for a court injunction restraining the calling or the continuation of a strike--such an injunction may run for 80 days.

g. The law prohibits secondary boycotts and jurisdictional strikes.

(These terms will be defined.)

Secondary Boycott -- A secondary boycott is an action by a labor union whereby the union prohibits its members from working for or having any dealings with a concern whose employees are on strike.

Jurisdictional Strikes -- These are strikes which arise due to disputes between rival unions and not due to a demand upon the company.

h. Unions are required to report to the Secretary of Labor: (1) qualifications for admission to the union, (2) manner in which elections are conducted, (3) amount of compensation of its principal officers, (4) amount of initiation fees and annual dues, and (5) sources of receipts and amount of assets.

i. Unions are not permitted to contribute money directly to political party organizations for the purpose of influencing the election of federal officials. Unions are able to get by this provision by setting up a group or unit composed of individuals favorable to the candidates approved by the union.

j. The law provides for the creation of a position of General Counsel of the National Labor Relations Board. This officer investigates complaints under the statute and decides whether or not these may be presented to the Board.

4. Labor-Management Reporting and Disclosure (Landrum-Griffin) Act

This act was passed by Congress in 1959 and came about because there were uncovered some unethical union practices by a Senate investigation committee. This act has become an important amendment to the Taft-Hartley Act. The law is directed toward preventing unscrupulous union leaders from taking unfair advantage of workers, employers, and the public. The law specifically gave state courts and labor agencies jurisdiction over certain union-management cases; requires annual detailed reports to the Secretary of Labor as to union finances, and bars communists from union office. Labor unions were opposed to the Landrum-Griffin Act as they felt it would hamper the growth of unions. The provision which they especially objected to was that which gives state courts more jurisdiction in dealing with labor disputes which the unions claim might result in an increase in the use of court injunction in the control of union activities.

5. The Federal Mediation and Conciliation Service

In 1915 the United States Labor Department started a conciliation service which has been since that time effective in helping to settle industrial disputes. The Taft-Hartley Act changed the name of the Service to the Federal Mediation and Conciliation Service (FMCS) and provided that the Service was to be an independent federal agency. Under the law the FMCS is required to give its services whenever it decides that a dispute may cause a substantial interruption of commerce. In case the director cannot bring parties together, he must urge both to submit the employer's last offer to a secret vote by the employees.

The National Railroad Mediation Board and the National Railroad Adjustment Board each has jurisdiction over the different classes of employees of the railway industry. If a dispute arises and neither board can offer a settlement and a threat is apparent which may tie up transportation, the President is notified. The President then appoints an emergency board of persons who attempt to find facts for a settlement; the report of the situation is then due in thirty days, during which time a strike is illegal.

V. Organized Labor's Objectives

A. The first objective which organized labor promotes is the right to bargain collectively with management in an attempt to reach certain agreements relative to labor matters.

Collective bargaining is the agreement as to wages and working conditions which representatives of organized labor makes with management.

1. The purpose of a labor organization is to form a union that has power to act for the group.

2. It must be remembered that early efforts of unions to bargain collectively were declared illegal.

   a. Even after the legal right was given to workers to bargain collectively with management, the right of workers to enforce collective agreements with employers was uncertain for many years.

3. The Wagner Act, passed in 1935, as has been noted, gave unions definite rights to bargain collectively.

4. Organized labor feels that it is only through collective bargaining agreements between employers and employees can workers enjoy equal bargaining power with employers.

B. Union Security

1. So that workers may deal effectively with employers in collective bargaining, they feel that they must organize and maintain an entity which must be accepted and recognized by the employer.

2. Several methods for achieving union security have been employed; these are:

   a. Closed Shop
   b. Union Shop
   c. Preferential Shop
   d. Maintenance-of-membership
   e. Check-off System

3. The first three methods have been previously defined when the Taft-Hartley Act was discussed.

(It may be necessary to again repeat the definitions and discuss briefly.)

4. As has been seen, the Taft-Hartley Act prohibits the Closed Shop and the Preferential Shop; but does permit the Union Shop provided the State does not have a law against it.

5. Maintenance-of-membership arrangements require that employees who voluntarily become members of a union must remain as members for the duration of the union contract with the company.

6. Checkoff System--this is an agreement between the union and the employer whereby the employer deducts union dues from the pay of union employees and turns over the money collected to the union treasurer.

   The Taft-Hartley Act permits the use of the check-off system, provided the worker has given his written permission to have such done.

C. Standardized Wage Rates

1. Labor unions demand that the rate be the same for each employee in a given class of workers.

   a. Unions do not believe that the total wages of a worker in a given class be the same, as some workers earn more through overtime.

2. Generally labor does not accept the idea of incentive wages, whether they take the form of piece rates or bonuses for faster work.

   a. Unions normally take the position that it asks only for a fair wage for a standard day of work.

   b. In cases where incentive plans have been opposed, unions contend they are protecting the workers from overwork and safeguarding workers from exploitation.

D. Increasing and Maintaining Wages

1. The attitude of labor unions today has been that because of improvements in organizations and techniques of production, real wages should rise.

2. The labor unions also advocate that wage rates should be adjusted to rises in the cost of living.

3. The unions have stated that the requests for wage-rate increases because of an increase in the prices of rent, food, and clothing have been justified because:

a. Wage-rate increases should be such so as to offset decreases in the value of money wages.

b. Only through the maintenance of consumer purchasing power can goods produced find buyers.

E. Hours of Work

1. Organized labor advocates the gradual decrease in the work day and work week based on several reasons:

a. Mass production makes it possible to produce more goods with less work.

b. Workers need to have more time for recreation and cultural improvement.

c. A reduction in the work period would result in an improvement to the health of workers.

d. More leisure time creates more demand for different types of goods.

2. Sometimes it is argued that a shorter work period would create more jobs; however, in the long run this reasoning is not valid as there is just so much work to be done and no more.

3. As a rule, employers have opposed any reduction in the work period as this situation always turns to the question of productivity.

a. Management questions whether workers can produce enough goods in a shorter period of time which would allow the maintenance of the same wage or the increase sought by labor.

F. Use of Machinery and Laborsaving Processes

1. Ever since the advent of machines, workers have seen in their use a threat to their jobs.

2. Labor unions are not as hostile to machines and laborsaving devices as they were years ago, but they still recognize the fact that the loss of jobs and unemployment will result when laborsaving devices are used.

3. The unions argue that if certain jobs are done away with by the use of machines, then the employer has the responsibility to find jobs for the displaced employees at no reduction in wages.

4. The union position concerning finding work for displaced workers got some support when in 1960 the Commission on National Goals stated that some measures would have to be taken to solve some of the problems brought about by technological growth, especially in regard to technological unemployment.

G. Control of the Labor Supply

1. Craft unions insist that new workers be required to meet standards as set by the unions.

2. The objectives of the unions have been to control the number of apprentices who may be trained and admitted for work.

3. Some companies set up their own training programs to train apprentices, but such moves are objected to by the unions.

   a. The unions contend that training given by the employer is too narrow in scope to prepare the apprentice for all types of jobs in the craft.

   b. In some cases, craft unions undertake to spell out the time apprentices shall serve, the qualifications of the instructors, and the conditions under which the training will take place.

4. Unions also limit the number of helpers who may be employed in certain jobs because the helpers after a while on the job become proficient and constitute an additional supply of journeymen.

   a. Because of this factor, several unions have established a journeyman-helper ratio to limit the number of trained workers.

5. Unions also use a licensing practice in order to limit the number of persons who can work in a certain trade.

   a. The requirement of having persons obtain licenses are usually found in the plumbers, barbers, and electricians trades.

H. Regulation of Output

1. This practice of regulation of output refers to the withholding of a certain amount of effort on the part of workers.

2. A painter's union may place a limit on the width of the brush its members may use; a bricklayer's union may set a limit on the number of bricks a worker may lay each day.

3. The unions contend that their policy of regulating output is justified because:

   a. Standards of work performance are used in setting requirements of such.

   b. It is a natural tendency that a worker does not want "to work himself out of a job" by completing his work in less time than is necessary.

   c. Regulation of output which the union sets is considered to be within "reasonable" limits.

4. Employers consider the practice of regulation of output very bad practice and the union takes unfair advantage of them.

B. Because there does arise cases of where agreement cannot be reached by either unions or management, actions by one or the other result.

C. <u>Methods Used by Organized Labor</u>

1. Strikes
2. Picketing
3. Boycotts
4. Political Pressure
5. Sabotage

D. <u>Strikes</u>

1. Strikes are a stoppage of work by a group of employees for the purpose of compelling an employer to meet its demands.

2. Members of unions do not feel that by stopping the work and not performing their duties that they in any way forfeit the right to the job when the dispute has ended.

   a. Management, however, often feel that when an employee leaves his job, he has voluntarily vacated the job.

   b. Any attempt to fill the jobs of those persons on strike by other persons is resented by the unions.

3. The Department of Labor points out that the causes of strikes are from:

   a. Wage and hour disputes

   b. Union organization, wages, and hours

   c. Miscellaneous working conditions

4. Types of Strikes

   a. Jurisdictional strikes--these arise because of a dispute with a rival union and not because of a demand upon the employer. These strikes are prohibited by the Taft-Hartley Act.

   b. Direct strike--a strike between the union and the employer.

   c. Sympathetic strike--this is a strike, the purpose of which, is to assist other workers who have a dispute with their employer. Those workers who go on a sympathetic strike have no dispute with their employer; their action of strike is in sympathy for other workers.

   d. General strike--this is a strike that involves the workers in all industries in a city or region.

   e. Wildcat Strike--a strike which only the members of a local union participate in and this is done without authorization of the national union with which the local is affiliated.

   f. Sit-down Strike--this is a strike in which the workers sit down at their jobs and do no work with the purpose being to prevent other non-union workers from taking their places.

      Although the sit-down strike has been used, it no longer is employed as the United States Supreme Court has declared it unlawful.

   g. Slowdown--this is a form of a strike; however, the workers remain on the job, but purposely withhold the amount of work they are doing.

      The Taft-Hartley Act gives the government the right to decide in any situation in question when there is a slowdown in an establishment which amounts to a strike. The National Labor Relations Board and the courts determine the speed of production and study the conditions to see if workers are guilty of striking.

E. Picketing

1. A union picket is a member of the labor union posted near the entrance of the company or place of employment to inform other workers and the general public that a dispute exists.

2. Picketing is done to discourage other workers from entering the company for the purpose of working.

3. The objective which picketing has is to see that all employees and others observe the strike; for if some workers remain at their jobs, or if other workers take their places, the effectiveness of the strike is weakened considerably.

4. To accomplish the purpose for which it is intended, only a number of pickets sufficient to conduct peaceful picketing is maintained.

5. Sometimes, when workers persist in crossing the picket line and not honor the strike, violence can and does occur.

6. Types of Picketing

   a. Legal Picketing--picketing in peaceful manner with only the necessary number of persons needed to carry out duties.

   b. Mass Picketing--picketing done with large numbers of persons who attempt to block entrances to place of employment--such picketing is held to be illegal.

   c. Secondary Picketing--this is picketing of an employer who does business with the company which the workers are striking.

F. Boycotts

1. A boycott is the activity of withdrawing and inducing others to withdraw from any business relations with certain groups or persons.

2. The purpose of the boycott is to bring economic pressure on a producer or seller of goods.

3. Types of boycotts

   a. Primary Boycott--this is a situation where the workers, who are usually on strike, agree not to patronize a firm because of its dispute with management.

b. Secondary Boycott--this is action taken by a labor union in that it prohibits its members from working for or having any dealing whatsoever with a concern whose workers are out on strike.

The Taft-Hartley Act ruled that the secondary boycott is illegal.

G. Political Pressure

11 1. In any labor-management dispute, the weight of public opinion plays an important part in determining the outcome.

a. Because labor unions recognize this aspect, they do all they can to create an atmosphere where they will receive favorable public opinion.

2. Labor unions do have groups which work toward getting laws passed which are favorable to the unions.

a. The federal and state laws which were passed giving labor unions the right to organize and bargain collectively of conspiracy and restraint of trade did much to foster union growth and development.

3. With the passage of the National Labor Relations Act in 1935, many desires of organized labor were met.

4. The A.F.L.-C.I.O. maintains lobbyists who work in Washington to secure the passage of laws which benefit organized labor.

H. Sabotage

1. The term "sabotage" is used to identify those actions by workers intended to restrict production or cause damage to the employer's property.

2. No important labor group today advocates the use of sabotage in the sense of causing physical damage to property.

a. However, the resentment of workers with grievances has resulted in acts of destruction.

(Before proceeding with methods used by employers in labor-management relations, take a few minutes and review and summarize the preceding section--methods used by organized labor.)

I. Methods Used by Employers

1. It seems that employers have just as many methods at their command as organized labor during labor-management disputes.

2. Some of the methods which employers have used in the past are now prohibited by law; however, they will be mentioned for informational purposes.

J. The Methods Used by Employers include:

1. Lockouts
2. Injunctions
3. Blacklists
4. Yellow-dog contracts
5. Strikebreakers
6. Company Unions
7. Political Pressure

K. Lockouts

1. The lockout is an action by the employer to stop his business operation in an attempt to win a dispute with his employees.

2. The lockout has not been used extensively, as employers do not want to close their business in order to try to win a point with labor.

L. Injunctions

1. An injunction is an order from a court commanding an individual or group of individuals from doing a certain act.

   a. The injunction is granted to prevent damage which could result from proposed action.

   b. When a court issues an injunction, the labor unions must obey it or be held in contempt of court--if found guilty of contempt, a fine or imprisonment could result.

2. As was noted earlier, the Norris-LaGuardia Act now limits the power of federal judges to issue injunctions in labor disputes.

3. The Taft-Hartley Act, however, provided for the use of the injunction in certain cases.

   a. Should a labor dispute, in the opinion of the President of the United States, imperil the health and safety of the nation, procedures are set up so that an injunction which can last 80 days be granted.

   b. This 80-day cooling-off period allows for certain other procedures to be followed so that the dispute can be allowed opportunities to be resolved.

M. Blacklists

1. A blacklist is a list of the names of union members which is secretly kept and exchanged by employers for the purpose of preventing certain workers from obtaining other employment after having been discharged for some type union activity.

2. Prior to the passage of the National Labor Relations Act, there was no legal question as to the right of employers to maintain and exchange such lists.

   a. The National Labor Relations Act now prohibits the use of blacklists.

N. Yellow-dog Contracts

1. Yellow-dog contracts were contracts which the worker signed and agreed to; such contract specifying that as a condition of employment, the worker during his period of employment was not to belong to a union, nor to engage in collective bargaining or striking.

   a. The term "yellow dog" came from usage by fellow workers to name those workers who agreed to such contracts.

2. Yellow-dog contracts were formerly enforced in the courts; however, the Norris-LaGuardia Act of 1932 made such contracts unenforceable.

O. Strikebreakers

1. A strikebreaker is an individual hired by the employer to replace a striking worker.

2. There are state laws which give the conditions under which employers may hire strikebreakers.

   a. Federal statutes make it illegal to transport strikebreakers across state boundaries.

P. Company Unions

1. A company union is an organization of workers in a company that is not affiliated with an outside labor group.

2. Passage of the National Industrial Recovery Act in 1933 gave rise to the company union movement as the Act guaranteed labor the right of collective bargaining and stated that employers might not discriminate against employees because of their union activities or membership in a labor organization.

3. Many employers fearing that their workers would join locals that were affiliated with national unions, encouraged their employees to form company unions.

4. The National Labor Relations Act prohibits employers from giving financial aid to encourage company unions, or to dominate or attempt to control company unions.

Q. Political Pressure

1. Employers, like labor unions, realize the importance of public opinion in the settlement of industrial disputes.

2. Employers, through associations and lobbying interests, seek to secure the passage of laws favorable to them.

3. In the case of a strike that may affect an entire community, employers very often appeal to the public for support by placing newspaper advertisements which state their position.

VII. Collective Bargaining

A. When representatives of an employer and the representatives of workers bargain together to establish wages, hours, and working conditions the process is called collective bargaining.

B. As has been noted, legislation provides many of the rules guiding collective bargaining at the present time.

1. Such legislation as the Labor Relations Act of 1935 and the Labor-Management Act of 1947 set the pattern for such procedures in collective bargaining.

2. There are also some states with laws governing collective bargaining practices.

C. The laws which set up and regulate collective bargaining clearly indicate that the American public favors this system and insist upon free collective bargaining.

D. Collective bargaining usually starts with the negotiation of the union agreement and the signing of the labor contract, but it doesn't end there.

1. Management and labor must live with the agreement as long as it is in effect; the contract like any other contract is rarely changed during its life.

2. There are usually many occurrences, however, which take place between labor and management where differences of opinion exist on what the meaning of the contract is.

3. It is this difference of opinion and differences in interpretation which brings about controversy.

E. Neither an employer nor a union may refuse to bargain if requested to do so by the other party.

1. IT IS IMPORTANT TO NOTE, HOWEVER, THAT NEITHER PARTY DOES NOT HAVE TO AGREE TO THE OTHER'S DEMANDS.

a. Several factors will determine the final disposition of the matter subject to bargaining:

aa. Reasonableness of the union demand

ab. Desirability of the demand by management

ac. The ability of the company to pay the cost

ad. The bargaining strength of weakness of the union or the company.

F. Many union contracts provide that either the union or the company can initiate proposals for changes; in the contract when such is undertaken, the party must notify the other from 30 to 90 days before the termination date.

G. No standard rules dictate who will be employer or union negotiators; negotiations may be carried on by a single representative or by a committee.

1. Usually a large committee is created for planning negotiations by each group; then, a small subcommittee is designated to carry on the actual negotiations, and a single spokesman is named as chairman.

2. For the employer, the large planning committee usually includes representatives from each of its divisions, including several first-line supervisors.

   a. The labor-relations director is normally designated to do the bargaining for the company.

3. For the union, the business agent, local president, or international representative may be chairman of the bargaining group.

4. In the bargaining talks, each side usually has a person who has authority to make commitments.

   a. Bargaining is much slower if each minor concession and adjustment has to be referred to a higher authority for approval.

H. Where adequate facilities on the employer's premises are available, there are usually no objections by unions to hold negotiation sessions at the company.

   1. Also, in many companies, negotiations are held in large part on company time, as employee members of the negotiating committees are excused for the time lost away from their jobs.

      a. If the negotiations run into lengthy sessions, the company usually only pays a part of the total wages.

I. Even the most carefully negotiated and worded agreement may be found to be inadequate for some situations; bargaining may take place to effect a change in the contract.

   1. This is an important feature of bargaining, as most agreements run for one year, although some contracts run for two, three, or five years and within these time intervals, changes are often desired.

J. There are several areas which are considered management prerogatives and not subject to bargaining. These are:

   1. The right to determine sales policies, organization structures, areas, etc.

2. Location and structure of plants.

3. Selection of machines, equipment, and tools.

4. Determination of production schedules.

K. Some items are considered controversial with no clear-cut policy as to whether they are subject to negotiation if not included in the contract. These are:

1. Right to hire, discharge, transfer, promote, and discipline.

2. Granting of leaves.

3. Employee classifications and merit wage increases.

L. Legislation and public opinion have long held that public employees do not have the right to strike or bargain collectively.

1. The reasons for this is that funds for wages and salaries must come from legislative action; and that public agencies are not given power to create or enforce such contracts.

VIII. Grievance Procedure

A. Most union contracts establish grievance procedures as experience has shown to both management and labor that it is best to have some systematic method of handling complaints.

1. It is not uncommon for companies which do not have a union contract to still insist on the establishment of a grievance procedure.

B. Where a union contract is involved, grievances are adjusted through an orderly process known as the grievance procedure.

1. In most cases, grievances are based upon workers' resentment of some decision made by management or some action taken by foremen or supervisors.

2. The grievance may be a large issue, or it may be a small one; it may be concerned with a worker's refusal to do a certain type of work, or the right to smoke in a certain area, or the length of a rest period, etc.

3. Most companies follow the practice of permitting grievances on any subject, but limiting arbitration to disputes over interpretation or application of the contract.

4. Wise management knows that any unsettled grievance, whether it be real or imaginary, is always a potential source of trouble--the grievance machinery helps uncover the causes and get the grievance out into the open.

C. There is no standard grievance procedure set down by law and each company must tailor grievance procedures to fit its own situation, but based upon what union and management have agreed upon and written into the contract.

D. Typical Grievance Steps (Initiated by the Employer)

Step 1 -- The foreman discusses a complaint with the worker and the union steward.

Step 2 -- The superintendent of the company or his representative discusses the complaint with the union grievance committee.

Step 3 -- General company management discusses the issue with national union representative and union grievance committee.

Step 4 -- Dispute is referred to impartial arbitrator for decision.

E. Typical Grievance Steps (Initiated by the Union)

The same four steps as above are followed, except that the union personnel initiate the discussion rather than company personnel.

F. The contract provides that the decision of the impartial arbitrator is binding.

1. Many times, differences and disputes are settled before it reaches arbitration.

2. Both the employer and the union usually prefer settling their own disputes without having to depend upon a third party; however, when needed, peaceful arbitration is far better than strikes or lockouts.

IX. The Supervisor's Role in Labor Relations

A. The first-line supervisor plays an important part in management-union relations.

1. The supervisor is a representative of management, and in the eyes of the law, supervisors and foremen are held to be agents of the company.

B. Since the company is held responsible for any action which the supervisor may take in dealing with workers who belong to unions, it is very important that the supervisor become familiar with the labor contract and all its ramifications.

C. Of foremost importance, the foreman is primarily responsible to his company to protect its interests in labor matters.

1. In most companies, the first-line supervisor is usually the first contact between workers and management and between union representatives and management.

2. The actions and words of the supervisor in such dealings can have important consequences.

3. Actions which the supervisor takes can cause the company to be charged with breaking the union contract.

D. The Supervisor's role under the Wagner Act

1. As the foreman and supervisor are directly affected by the unfair labor practices of the Wagner Act, there are some things which should be avoided:

a. A foreman should never use threat or take action that would affect a worker's job or pay when the union is organizing a drive for membership or during a National Labor Relations Board representation election.

b. The supervisor or foreman should avoid any action such as discharge, layoff, demotion, or difficult job assignment on account of the worker's union membership activities.

c. The foreman or supervisor should not discuss union matters with employees, or to express an opinion for or against a union.

E. As previously pointed out, supervisors are many times expected to participate in collective bargaining negotiations; therefore, a keen and alert understanding of labor practices in the company must be developed.

F. The supervisor must know the rights of the shop steward; but more important what the limitations are to the steward's activities.

1. The steward does not manage the department, this is the supervisor's job.

2. The main activity which the steward has, in addition to doing his assigned work, is to look out for the rights of the workers as prescribed by the union contract.

   a. For this reason, often a steward will advise the foreman concerning something which he thinks is in violation of the contract.

   b. The foreman needs to be just as informed about the contract as the steward, so that an equal footing is had when such matters are discussed.

3. Responsibility for managing and supervising the department is never shared with the steward, and the steward has no right to tell a worker what to do.

G. The general approach which the supervisor should take in regard to labor relations is to become as well informed on these matters as possible--this information will be needed for the job the supervisor will be expected to do.

X. Laws Affecting Terms and Conditions of Work

A. In addition to those laws previously discussed in reference to labor-management relations, there are important laws used in maintaining conditions which meet legal requirements.

B. Federal Wage and Hour Law (Fair Labor Standards)

1. This law regulates methods of wage payment and hours of work for any company engaged in interstate commerce; (commerce between two or more states).

2. This law restricts the employment of children over 14 and under 16 to non-manufacturing and non-mining jobs.

3. Children under 18 years of age are restricted by the law from taking employment in a hazardous job, as defined by the law.

4. The law sets a minimum wage; $1.24 per hour since September 3, 1963, and prescribes that time and one-half must be paid for all hours worked over eight hours a day and 40 hours a week.

C. Walsh-Healey Public Contracts Act

1. This act sets the conditions for any company which works under government contract.

2. Boys under 16 years of age cannot be hired; girls under 18 years of age cannot be hired.

3. Time and one-half rates must be paid for work in excess of eight hours per day and 40 hours per week.

4. The act also sets standards for working conditions, and establishes a minimum wage for a particular industry.

XI. Labor Unions in Louisiana

A. History

The history of labor unions in Louisiana paralleled to some degree the labor movement on the national level. Of course, labor unions did not come to Louisiana as soon as they did to the eastern manufacturing centers. The reason for this is apparent when the economic make-up of the State is compared to other regions of the country during the period of colonization. As factories sprang up along the eastern coast of the United States where labor was plentiful and available water power to run the machines was ample, the South, including Louisiana, turned to an agricultural economy. Because of this predominant economic base built upon agriculture, the early union movements which drew membership in New York, Philadelphia, Boston, Pittsburgh, and other eastern cities, did not find groups of factory workers in Louisiana to enlist.

As there developed some metropolitan centers in Louisiana after the Civil War, national unions came in to organize the workers in the infant industries. The A. F. of L. and the Railway Brotherhoods were forerunners in the organization of local unions. The local unions organized were in the larger cities and towns of the State, as the possibility of securing union members from the agricultural ranks was not feasible. Even today, the agricultural labor force of Louisiana is approximately 10 per cent. Early unions which were organized in the State were affiliated with national and international unions. Such unions as the International Typographical Union, Street, Electric Railway and Motor Coach Employees of America, Maritime Union of America, Horseshoers of the U. S. and Canada, International Union of Journeymen, etc. were some of the early unions noted in the State.

It must be stated that all of the incidents occurring within the A. F. of L. federation, the formation of the C.I.O., and the subsequent merger of the A.F.L.-C.I.O. had the same effects in the State as in other areas where the federations had membership.

B. A.F.L.-C.I.O. Structure in Louisiana

This federation is well represented by Louisiana locals and their membership. There are approximately 130,000 members in the A.F.L.-C.I.O. structure in Louisiana; these members belong to approximately 800 local unions which are affiliated with national and international unions.

THE STRUCTURE OF THE A.F.L.-C.I.O. IN LOUISIANA HAS BEEN PREPARED IN CHART FORM. THIS WILL BE GIVEN IN HANDOUT 16.

*** Handout 16 ***

As noted in the chart, Louisiana workers are members of the A.F.L.-C.I.O. only through the local and national unions to which he belongs. Membership of Louisiana workers in the city central bodies, city building trades councils and the state council is based upon membership in the national unions. The city centrals function as agencies to advance the position of organized labor in the various communities. They are oftentimes active in local political affairs and seek labor representation on the local level.

The top A.F.L.-C.I.O. organization within the state is the Louisiana State Labor Council. This body resulted from the merger of the Louisiana State Federation of Labor, A.F.L., and the Louisiana State Industrial Union Council, C.I.O. in 1956. Offices are maintained in Shreveport and Baton Rouge for the Council; however, the headquarters are in Baton Rouge. The functions of the Louisiana State Labor Council are political and educational and does much in the lobbying of legislation favorable to labor in the state legislature. The Louisiana State Labor Council is represented on Handout 15, "Structural Organization of the A.F.L.-C.I.O." in the section--State Federations. It is well to note that 85 per cent of those persons holding membership in unions in Louisiana are with unions affiliated with the A.F.L.-C.I.O. Federation.

C. Independent Unions in Louisiana

In contrast to the A.F.L.-C.I.O. federation, membership in the independent unions in Louisiana is not large. In fact, it constitutes only about 15 per cent of the total union membership in the State. Of course, there are represented in Louisiana independent national union organizations, independent federations, and independent locals. Some of the independent nationals include: Railway Brotherhoods, United Mine Workers of America,

International Longshoremen's Association, and others. There are three independent federations--Confederated Unions of America, the Engineers and Scientists of America, and the National Independent Union Council. There are approximately 25 independent local unions in the State located primarily in New Orleans, Baton Rouge, Lake Charles, Shreveport, and Bogalusa; representing such workers as bus drivers, oil refinery employees, sugar company personnel, marine engineers and pilots, and longshoremen.

D. Union Membership in Louisiana Industries

There are three basic groups in Louisiana which provide the basic source of labor union membership. These groups are: (1) manufacturing, (2) non-manufacturing, and (3) government. These groups, of course, exclude agricultural employment. In Louisiana, approximately 25 per cent of workers are engaged in manufacturing activities, while the national average is approximately 30 per cent engaged in manufacturing jobs. The distribution of employment in Louisiana by groups as given above is: manufacturing, 25 per cent; non-manufacturing, 60 per cent; government, 15 per cent.

When the distribution of union membership is looked at in these three groups, however, it is found that it is not in the same proportion as the distribution of workers. Union membership among the groups is: manufacturing, 35 per cent; non-manufacturing, 60 per cent; and government, 5 per cent. The non-manufacturing group includes construction, transportation, public utilities, wholesale and retail trade, finance and real estate, and mining. The bulk of the union membership found in the government group is accounted for by post office workers. It will be noted that 15 per cent of workers in Louisiana are employed in the government group, but this group (government) comprises only five per cent of total union membership. The absence of union membership is because state and city employees do not belong to unions; also, the large number of teachers in Louisiana for the most part do not belong to unions, although there is a small number of teachers who belong to unions in the metropolitan areas.

E. Distribution of Union Membership in Louisiana

There are six metropolitan areas of Louisiana in which union membership is concentrated. These areas are: New Orleans, Baton Rouge, Lake Charles, Alexandria, Shreveport, and Monroe. These six areas comprise only nine of the State's 64 parishes. The A.F.L.-C.I.O. Federation accounts for most of the membership in the metropolitan centers, although independent unions

are also present in the areas. There are some unions located in Louisiana in the smaller cities and towns; Bogalusa has over half its non-agricultural employment represented by union membership making it the most highly unionized city in the state. Although New Orleans has the largest number of union members, this accounts for only about 25 per cent of its total non-agricultural workers.

The early labor movement in Louisiana which witnessed beginnings in the metropolitan areas still seems to be confined to this pattern. However, it is now noticeable that with the heavy industrialization of the Louisiana Gulf Coast and the area along the Mississippi River between Baton Rouge and New Orleans, this present picture may change. Many of the industries establishing plants in these areas have had histories of union activities and it is expected these will continue.

F. Political Activity of Unions in Louisiana

Just as the national unions and federations have as one of their objectives the using of political influence and pressure to secure legislation favorable to their cause, this same procedure has been carried on in Louisiana. Perhaps the most controversial issue in recent years in which unions in the state have brought political pressure concerns the "Right-to-Work" law. When the Taft-Hartley Act was passed in 1947, one section of this act permitted the union shop in states which did not have laws against it. This section of the Taft-Hartley Act led to a wave of state right-to-work laws, which made it illegal for an employer to require a worker to join a union as a condition of employment. This right-to-work law provision led to bitter controversies in many of the states--Louisiana was no exception. In the 1954 legislative session in Louisiana, the "Right-to-Work" issue became an important matter; the A.F.L.-C.I.O. in Louisiana stated that it spent over $100,000 in a public relations and lobbying campaign to defeat the measure. However, the "Right-to-Work" measure did become a law on the books--an occurrence which labor unions in the State say came about because the Manufacturers' Association had much influence in electing the legislature.

As a result of the passage of this legislation, the positions of unions in the state were weakened considerably when workers did not have to join unions in companies which in the past required membership. This was hailed as a great victory for anti-labor forces who could see the defensive situation this put the union in.

The American Federation of Labor and the CIO State Industrial Union Council in Louisiana began to take steps to bring about a repeal of this law. One of the first steps it took was an intensive registration campaign to qualify union members, their families and friends to vote. When the "Right-to-Work" law was passed in 1954, less than 25% of the union membership in the State was registered to vote; by 1956, 50% were registered to vote. Another measure which the unions took was to raise funds for lobbying and political purposes. The unions raised over $100,000 between 1954 and 1956; with some locals levying direct assessments on members, while other locals took funds from the union treasury. In the 1956 state elections, 22 senators elected out of 39, pledged to repeal the "Right-to-Work" law; 51 of the 101 members of the House who were elected had also made pledges to vote for the repeal of the law. As a result, the Louisiana Legislature in June, 1956 voted and passed a measure for the repeal of the "Right-to-Work" law. On June 21, 1956, the Governor signed the repeal into law; making Louisiana the first southern state to effect a repeal.

Unions in Louisiana have been active in other political issues. They have lobbyed for increased unemployment insurance benefits and other worker benefits.

General Outlook

The general outlook for union activity in Louisiana is that it will continue to increase with the movement of industries to the State from other sections of the country. Since unions in the State which now exist are closely tied in with national federations, much of what will come about will be the result of the nation-wide union activities. Whatever the results may be, the objectives of both the employer and the union must be directed toward peaceful solutions to labor relations problems and let collective bargaining function in the manner it should.

(Because of the large volume of material presented in this session, time may not permit a summarization; however, if there is any time remaining, take questions which the trainees may have.

Before closing the meeting, announce the topic for Session V, "Leadership.")

SESSION V

LEADERSHIP

I. Objectives for Session V

A. (These objectives may be charted before the session begins for convenience and a saving of time.)

Objectives
1. To point out how effective leadership is related to good supervision
2. To study theories, types, and patterns of leadership
3. To make a self-analysis of each supervisor for leadership qualities
4. To note carefully how supervision, leadership, and productivity form close relationships

II. Importance of Leadership

A. The importance of leadership qualities in individuals has been given close study by today's business and industrial executives.

1. The new quality of leadership and supervision necessary in modern management is an essential element.

2. No longer can it be said that the office boy in the company has an opportunity of becoming its president; more and more is required of persons today than just success in completing routine jobs.

3. In days gone by, it was very likely that a person could rise from the lowest rung on the ladder to a position of importance in the company based solely on his ability to master successive routine jobs.

4. In today's competitive world where technology and educational competence exist, more is needed in the person who is expected to lead than just a working knowledge of day-to-day activities.

5. Even though we have come through periods of great change in recent years, there seems to be periods ahead which will witness even greater changes--these changes will no doubt bring forth new demands and opportunities for supervisors who must possess broad leadership skills.

B. It has previously been noted that management is concerned with the organization of group activities and getting work done through a competent work force.

1. It can definitely be said that leadership has a great deal of effect upon group effort.

2. Group effort is the way by which accomplishments of the organization are made.

3. Whatever group activity is present, effective leadership is a requirement for motivating and giving direction.

4. The role of the leader in any group is primarily the responsibility for developing effective teamwork.

5. Because management now recognizes the necessity of obtaining desired results through organized group efforts, added emphasis is being placed on the human element as a role in leadership.

6. In many cases, even though the organizational structure of an enterprise may be basically weak, effective leadership can bring together individual activities within the group to the achievement of a goal.

III. What Leadership Is

A. The question now needs to be answered: "What is Leadership?"

(Have the trainees give what they believe to be the definition of "leadership." It would be good to chart these.)

B. There are many definitions for leadership which management experts give; however, a simple definition which defines the term adequately is:

Leadership is the activity of inspiring others to follow and do <u>willingly</u> the work requested.

(Compare the contributions of the trainees with this one given. There is surely to be similarities; however, the key word in the definition should be "willingly.")

C. A point which is sometimes argued is: "Are good leaders born or made?"

1. The question can be answered very easily.

2. Most leaders are good leaders because they have worked hard to attain the characteristics of good leaders.

3. This reasoning applies to the current situation of developing leaders for today's challenges; certainly leadership is an art that <u>is</u> and <u>can</u> be developed.

D. Leadership is present and is needed at all levels of management; it is needed just as badly at the lower levels of the organizational structure as at the top levels.

E. Leadership, of course, is not confined only to business--government, schools, hospitals, community organizations, and any group where individuals must be organized, leadership is needed.

1. It is very evident that without a leader in any group, the actions of that group would become without direction, organization, or purpose.

F. The art of inspiring and leading people to do things <u>willingly</u> takes a great amount of skill and a deep understanding of human nature.

1. This does not mean that the leader must be skilled in the principles of psychology, but it does mean he must understand and be able to use common sense reasoning based upon the principle that every person wants to be treated as an individual.

G. Leadership, as we know it today, is very often contrasted with the old-time tough foreman or supervisor who used fear as the chief means of motivating workers.

1. IT WILL BE WELL TO LOOK AT A FEW OF THESE POINTS WHICH HAVE BEEN CONTRASTED BETWEEN THE LEADER AND THE OLD-TIME BOSS, USUALLY REFERRED TO AS THE "DRIVER."

2. THIS IS PRESENTED IN THE HANDOUT WHICH WILL BE GIVEN YOU.

*** Handout 17 ***

(Read through and discuss the contrasts with trainees.)

3. Additional points which can be used in this discussion include:

   a. There were some conditions responsible for the "old boss" type of supervisors and foremen--the ones who drove their men instead of leading them; these were:

      aa. This type of supervision took place during an era of rugged individualism; conditions today are much different from the past.

      ab. There was a supply of cheap labor in the country at one time; this is no longer true with the rise in the standards of living and development of skilled workers.

      ac. The early factory system evolved into conditions which were very bad for the worker, the supervisor, and even top management.

      ad. In the early history of management concepts, there was no knowledge available of how to deal with people; especially so before the advent of scientific management and the Hawthorne Experiments.

   b. Those factors which contributed to the new type of leadership as represented by the right-hand side of the handout were:

      aa. Higher educational standards.

      ab. The rise of organized labor movements.

      ac. The passage of labor laws protecting the rights of the worker from abuse and economic threats.

      ad. Changes in the social and economic standards.

      ae. Advent of scientific management and the human relations aspects of management.

4. The days of the old time "boss" with the crude methods of handling workers have been replaced in most cases with effective leadership.

a. The use of threat and force in order to get workers to do something is not the trait of good leadership.

b. This does not mean that leaders do not take firm, positive action when necessary.

c. Nor, does this mean that the effective leader let part of his authority slip away from him to his subordinates.

d. The leader can be stern; use methods of discipline and still win the respect of the group he leads.

IV. Types of Leadership

A. There are usually considered to be three distinct types of leadership:

1. Autocratic Leadership
2. Democratic Leadership
3. Free-Rein Leadership

B. Autocratic Leadership -- In this type of leadership, the leader assumes full command and bears full responsibility for everything he does. The leader demands obedience from his workers in following his directives and seeks no advice or suggestions from his workers in getting the job done. He sets policy and procedures based upon what he thinks they should be.

C. Democratic Leadership -- In this type of leadership, the leader gets ideas and suggestions from the group he supervises. The spirit of teamwork is advocated with subordinates encouraged to take part in setting policies.

D. Free-Rein Leadership -- In this type of leadership, the leader assumes the role of "one of the group" and uses little control or direction in dealing with the group. He, more or less, lets things go as they will with the subordinates making many of the decisions necessary to further the progress of the work. He does provide the wide guides for action by the group.

E. Which Type of Leadership is the Best?

1. The question arises as to which type of leadership is the best to use.

2. Very often it is thought that the democratic type of leadership is the best to use; however, this is not always the case.

3. The truth of the matter is that all three types are the best to use; that is, each has advantages over the others in different situations.

4. Autocratic leadership, in certain situations, will be the most effective and successful, while democratic and free-rein would not be effective at all.

5. Free-rein leadership, in certain situations, will produce far more successful results than either the democratic or autocratic types of leadership.

6. Democratic leadership, also under the right conditions, will be more effective than either autocratic or free-rein leadership.

F. From the foregoing statements, it must be made clear that there is not "one best method or type" or leadership to use for all situations.

1. It is the situation which the leader finds himself in and the types of persons he is dealing with which will be responsible for the type of leadership best to use.

2. It must also be noted that the leader is not to be thought of as the democratic, or the autocratic, or the free-rein leader; rather, he should be identified with having all three of these types at his command to use as the situation demands.

3. The typical supervisor may use all three types in his day-to-day activities; he must be able, however, to choose the appropriate type to get the action he desires.

a. In some cases, he will consult with fellow-supervisors on matters relating to their mutual problems; if he assumes the leadership of the informal discussions, he certainly would not expect to be autocratic.

b. If the supervisor has an assistant who needs only occasional help or direction, a democratic type of leadership would get the best results with this assistant.

c. The supervisor must be autocratic, if for example, a rather stubborn type of worker is told to do a certain job.

4. Because the leader must choose appropriate types of leadership to use in certain situations or in dealing with certain types of persons, it is well to discuss some of these items which give indications as to the type to be used.

V. Use of Types of Leadership

A. Personality of Followers

1. Perhaps the most important characteristic which dictates the type of leadership which should be used is the personality of the subordinate.

2. There is a strong relationship between leadership methods and types of personality of subordinates.

3. The hostile, stubborn type of person must be dealt with in a stern manner; therefore, the use of any other type of leadership than the autocratic would be very ineffective.

   a. The hostile individual would have little to contribute if allowed free-rein leadership; in fact, such an individual can do much harm to a group, if allowed to have too much freedom of action.

4. The individual who tends to lack the capacity to make decisions or act for himself would also do better with the autocratic type of leadership.

   a. Such an individual finds assurance in authority and firmness.

5. The person who can do his best work when given only minimum direction and supervision would do better under the free-rein type of leadership.

   a. When a person can work alone, can produce more when he's on his own, and requires little supervision does better when he's allowed to work at his own pace.

   b. Such a person, if autocratic leadership is applied, would in all probability slow down considerably because limitations have been placed on his capacity to produce.

6. A person who gets along well with the group and who is interested in contributing what he can toward the work goal must be placed under the democratic type of leadership to get the best results from such an individual.

a. Persons who are co-operative and who want to do all they can toward contributing their share to the work load will make many suggestions and recommendations to the leader that can be useful.

b. Some subordinates can and do contribute much to assisting the leader in getting the work done in the most efficient and effective manner; not taking advantage of these suggestions does not make for good democratic leadership.

B. Job Knowledge

1. The knowledge of the job by the worker or by the person being dealt with by the leader relates very much to the type of leadership which is to be used.

2. If the worker has technical knowledge of the job being performed, the democratic method would be used by the leader.

a. Very often, a worker is more familiar with the details of the job than the supervisor; for this reason, the worker's suggestions or recommendations for planning work activities can be extremely helpful.

b. Leaders can learn much from their followers and the opportunity for learning by leaders from workers who know what they are doing should not be passed up.

c. The leader who assumes the autocratic type of leadership in certain situations causes excess time to be consumed or costly errors to be made because he doesn't have the job know-how and refuses to listen to advice from his subordinates.

3. When the leader is dealing with new workers who do not possess the necessary knowledge initially to do the job, he must use autocratic leadership--the other two types would result in a disorganized group action that had no real purpose.

a. In training situations as well, where workers are there to gain certain information, the autocratic leadership type must be used.

4. When persons of equal rank in the organizational structure get together to work out the solutions to problems concerning the group, the person

serving as leader for the group cannot be autocratic; he must be democratic by allowing those with just as much job knowledge as he has to contribute to mapping the course of action.

C. Situation

1. The particular type of situation the leader finds himself in will indicate the type of leadership to be used.

2. For example, in times of emergency, autocratic leadership must be used.

   a. Person must be told what to do quickly.

   b. There are no opportunities for getting reactions from the group, as time and speed are of the essence.

3. In routine matters of work, the leader will direct certain orders to subordinates as a matter of speeding up normal work schedules; such situations call for direct orders using autocratic leadership.

   a. There are many routine matters which the supervisor must direct workers to do and such matters are not open to suggestions or discussion from the subordinates.

4. In situations, however, where there may be a problem to solve, the leader then wants to have subordinates to help solve it and will then use the democratic leadership type.

   a. There are, of course, some problems which subordinates can not contribute toward solving; such would not be subject to the democratic approach.

   b. In such situations of problem solving, especially where persons of the same job status are involved, a free-rein or democratic process is best to use.

D. Type of Group

1. It is possible to identify groups which have certain characteristics as certain group types.

   a. Certainly, in every group there are some individuals who do not have the same make-up as the majority.

b. The majority of persons in the group which exhibits certain characteristics identifies the group as a whole with these qualities.

2. A group that is untrained or not well disciplined cannot function well under democratic leadership.

   a. Just as the individual who is not disciplined, a group can be wholly undisciplined and disorganized.

   b. A firm control is necessary with this type of group and such firm control is found only in the autocratic type of leadership.

   c. Rigid directions and supervision in such cases must be exercised until the group becomes disciplined and organized into a productive unit.

3. A group made up of professional persons represents just the opposite from the untrained and undisciplined group.

   a. Persons in such a group are well trained, are competent in their respective fields, and if they weren't good leaders in their own right, they would have never attained professional rank.

   b. When such a group of professional persons has an objective to complete, the only types of leadership which can be used and still retain all the characteristics of good human relations, are the democratic or free-rein types.

   c. The leader of a group of persons who have professional standing does not have to provide a great deal of guidance.

   d. Only occasional conferences are needed by the leader to bring up to date the accomplishments made by the individuals.

4. In a group of persons who work well together, the democratic type of leadership is to be used.

   a. Where persons within the group understand the work of the other, have little or no misunderstandings, communicate freely among themselves and with the supervisor, and who try to settle their own problems, the democratic type of leadership is bound to succeed.

b. In a group of this type, the democratic type of leadership tends to make the best use of the brainpower which the group possesses.

c. Also, the democratic type of leadership in such a group brings out the best capabilities of the individuals within the group.

VI. Flexibility of Leadership Types

A. As has been pointed out, the successful leader must master the use of all three types of leadership--autocratic, democratic, and free-rein.

B. The job of the leader is to be able to shift techniques effectively to meet the needs of changing situations, problems, and workers within the group.

1. There must be flexibility in the use of the types of leadership, and this flexibility must be mastered so that there is never a question in the mind of the leader that he must fit a choice of technique to the situation at hand.

2. Certainly, there will be times when the leader may have some doubt as to what technique to use in a particular situation.

3. However, by applying a conscientious effort to evaluate each experience encountered, the mastery of type to use will become easier.

C. It must be stated in conclusion that leadership is an art and skill which can be developed.

1. Good leaders are not just endowed with leadership abilities, they must through hard and diligent work acquire such.

2. There must, however, be that desire present to want to learn to be a good leader before a person ever has a chance to become a good leader.

VII. Patterns of Leadership Behavior

A. There are several patterns of leadership behavior which relate to the types of leadership to be used in certain situations.

1. These patterns are based on the functions of the leader rather than an identification of the type or kind of person.

a. It can be easily seen from the foregoing material presented that it is not so much what makes a good leader or the personality factors of a good leader, as <u>what the effective leader does</u>.

b. Also, it must be remembered that a leader is responsible for group action and that his relationships with the group are of the utmost importance.

2. The leader of any group has certain powers which will affect the outcome of group action; it is the use of this power which will determine the effectiveness of the leader.

3. Some leaders feel that the group should share in the power of the leader, thus resulting in having the group contribute to the decision making of the leader.

4. Other leaders feel that they should handle most of the power, thus resulting in little freedom for decision making of the group.

B. Where the leader has certain choices in the leadership patterns he chooses, he still must be concerned with the principle of flexibility; the patterns which are normally used include:

1. Telling
2. Selling
3. Testing
4. Consulting
5. Joining

C. <u>Telling</u> -- this type of leadership pattern is based on the leader's decision to simply tell the members within the group what to do and does not consider having them participate in any way in the activities of the leader.

D. <u>Selling</u> -- This pattern of behavior is used by the leader when he wants to use persuasion in getting the group to accept his decision.

1. The leader, many times for psychological reasons, may want to convince his group of the advantages of the idea or plan he wants to put into effect.

2. If the group is sold on what the leader advocates, the job of implementing these ideas or plans will not be near as difficult as if the group is simply given instructions.

E. Testing -- In this behavior pattern, the leader is desirous of getting his group's reaction to solutions to a certain problem.

1. He presents the solutions to them and gets their reaction on which they believe to be the best.

2. This brings into play the democratic process.

3. After the leader gets the reactions of the group, he will be able to know which of his solutions will be the best received by the group.

F. Consulting -- In this behavior pattern, the leader has a certain problem to solve, but instead of mapping out solutions himself, he gets the group to give their ideas for solution.

1. He then can choose the best one presented by the group.

G. Joining -- The leader here simply joins in with the members of the group in seeking solutions to problems pending and agrees in advance that whatever decision the group makes will be the one carried out.

1. This pattern works better with professional persons, or persons who have equal rank in the organization.

H. Influences on Patterns of Leadership Behavior

1. There are many influences which will determine which of the patterns of leadership behavior will be used.

2. These influences are found in:

a. The leader

b. The group

c. The situation

3. First, looking at the influences in the leader himself and how these will decide which pattern will be followed:

a. If the leader has a great amount of confidence and trust in the members of his group, he is

apt to use one type of pattern; on the other hand, if he distrusts his group or feels they are limited in their capabilities, he will use another.

b. Of course, it must be pointed out that the confidence he shows in his group may or may not be justifiable.

c. Also, leaders show a tendency to differ greatly in the amount of trust and confidence they place in their workers.

d. There are some leaders who tend to have their own ideas about what the leader is supposed to do; some do not believe in sharing their functions with members of the group, while others believe in sharing leadership with the group.

e. Many leaders have the feeling of wanting a certain amount of security in the jobs being done; and consequently are more inclined to "tell" or "sell" than to "consult."

f. In conclusion to the influence that the leader has in the pattern used, it must be remembered that the leader has certain ideas and ways peculiar only to himself and much of what he will do will be related to these inherent beliefs.

4. Next, the influence of the <u>group</u> will be discussed:

a. The leader knows that each member of the group is an individual; that each individual has perhaps a different type personality make-up.

b. Also, the leader knows that each member of the group has certain beliefs and ideas, just as he does himself.

c. The leader, who can understand his group better, can use the type of behavior pattern which will produce the best results.

d. The patterns of "consulting" and "joining" can be used when:

aa. The members of the group are ready to assume responsibility for decision making.

ab. The members have the knowledge and experience to deal with the problem.

ac. The members of the group can tackle the challenges given with only a minimum amount of direction and guidance.

e. When the conditions do not exist as just enumerated, the leader must then use the "telling" and "selling" techniques.

5. The situation has influence as to the type of leadership behavior that will be used.

a. The pressure of time is very often a common occurrence which makes it necessary that the leader use a high degree of authority by "telling."

b. If the problem is of a complicated nature, such as that which is beyond the knowledge requirements of the workers, then he cannot expect to use the pattern of "consulting."

c. On the other hand, if a problem exists whereby persons in the work force have the knowledge to contribute to solving the problem, then it is expected that the "consulting" pattern could be used.

d. The type of organizational structure will influence the type of leadership--for example, the size of the departments or work units may require the leader to exercise more control or less control as the situation may be.

aa. Large work units under the control of a supervisor usually require tighter controls than if he were in charge of a small and unified group.

6. Even though the leader is influenced by the three factors discussed, he must continually strive to keep in mind the objectives which he is leading his group toward.

a. The manner in which he reaches these goals and develops his group while leading it will determine the effectiveness of the leadership behavior patterns used.

VIII. Leadership Characteristics

A. It has been pointed out rather vividly that every organization and every organized effort needs managerial techniques and leadership.

B. The leader's success in any endeavor depends upon the influence he is able to exert upon the people whom he leads.

C. There are some broad characteristics which a leader must possess; these are:

1. The leader must have the ability to analyze a problem, or a situation, or a set of circumstances and arrive at a satisfactory conclusion.

2. The leader must have the ability to select and assign people properly in the organization.

3. The leader must have the ability to make the organization function by transmitting to those in the group the objectives of the organization and get these objectives accepted by the group.

D. Leadership is interested in how people can be brought together to work together for a common end so that the individuals may better share in realizing group accomplishments.

E. Qualifications for Leadership

1. What are the qualifications for leadership?

a. Certainly there are qualifications which leaders must possess and these are summarized in Handout 18.

*** Handout 18 ***

(Discuss these qualifications listed on Handout 18 with trainees.)

F. The Importance of Teamwork

1. Closely related to leadership is teamwork, as leadership must promote teamwork.

2. Even though teamwork is required in every progressive organization, this does not mean that there should not be room for individual initiative on the part of individuals in the group.

3. The leader, in the interest of teamwork, must many times subordinate his personal desires to the interest of the group.

a. If the group is not ready to move in a certain direction, the leader may have to adjust his plans for action.

b. Certainly, the members of a group need the support of the leader; however, the leader needs the support of the group just as well.

4. A supervisor's success as a leader depends to a great extent upon his success in developing the leaders under him.

   a. These are the people whom the leader comes to rely upon and the people who will be developed into leaders within the organization in their own right.

G. The Leader's Philosophy of Growth

1. The leader must have certain beliefs of growth for for himself, his workers, and the entire organization.

2. The growth factor is important, as every organization must grow and progress if it is to compete favorably with others.

3. There should never be a question as to the growth pattern which the leader becomes responsible for, as actually this is a part of the leader's make-up.

4. The real key to the leader's philosophy of growth lies in his belief that his organization and his group are to grow and develop; this belief must be real and sincere, because if not, the leader can never hope to fulfill any ambitions which he may only think he believes in.

5. The job of the leader is a difficult one, but there are rewards which go to the person who develops and continues to exhibit leadership characteristics.

   a. There is increased prestige and status; but the feeling of personal accomplishment is perhaps the greatest reward of all.

6. The leader who plans for personal growth as a leader knows what he wants to accomplish--at the present time and in the future.

   a. The formulation of such a plan unifies the leader's thinking on what is to be accomplished and in what manner.

   b. The leader is important in this phase of his job, not because of his own production, but because he leads people toward their objectives--objectives that must be channeled toward an over-all, planned result.

H. Self Analysis of Leadership

1. How can an individual measure his leadership abilities?

2. Without an evaluation of actual conduct in dealing with people and situations encountered, a self-appraisal analysis is probably the best way.

3. SUPPOSE YOU WERE ASKED TO MAKE A SELF-APPRAISAL OF YOUR LEADERSHIP ABILITIES, WHAT WOULD BE YOUR REACTION?

   a. LET'S GO THROUGH A SIMPLE SELF-APPRAISAL OF LEADERSHIP QUALITIES; THIS WILL ENABLE YOU TO JUDGE FOR YOURSELF JUST WHERE YOUR WEAKNESSES LIE AND HOW THESE CAN BE STRENGTHENED.

   b. REMEMBER, THIS LEADERSHIP INVENTORY WILL BE FOR YOUR PERSONAL USE ONLY AND WILL NOT BE TURNED IN, OR SHOWN TO OTHER MEMBERS OF THE CLASS.

   c. I SHALL NOW GIVE YOU THIS LEADERSHIP SELF-APPRAISAL TEST SHEET; READ THE INSTRUCTIONS AT THE TOP OF THE PAGE, BUT GO NO FURTHER.

*** Handout 19 ***

(Give each trainee a copy of Handout 19 and permit them time to read the instructions.)

d. ARE THERE ANY QUESTIONS BEFORE WE BEGIN?

(Answer any questions raised.)

e. YOU MAY NOW PROCEED WITH THE SELF-APPRAISAL TEST; REMEMBER THAT NOBODY BUT YOU WILL SEE THE RESULTS, SO BE HONEST WITH YOURSELF AND AS OBJECTIVE AS POSSIBLE.

(Permit necessary time for all trainees to complete the test.)

f. FIGURE YOUR SCORE IN THIS MANNER:

FOR EVERY "YES" ANSWER, GIVE YOURSELF 2 POINTS
FOR EVERY "SOMETIMES" ANSWER, GIVE YOURSELF 1 POINT FOR EVERY "NO" ANSWER GIVE YOURSELF 0 POINTS

NOW, ADD THE SCORES FOR EACH QUESTION TO GET YOUR TOTAL SCORE FOR THE TEST.

(Allow time for this.)

g. NOW LET'S EVALUATE THE TOTAL SCORE:

Score Range	Interpretation
0 - 5	Superior leadership qualities
6 - 10	Average--some improvement necessary
Over 10	Weak leadership qualities; much improvement needed.

(There will probably be some discussion among trainees after the score ranges and interpretation are charted. If there is worthwhile discussion, or questions which trainees would like to ask, take time for such.

Point out to trainees that the appraisal test certainly is not to be considered 100 per cent valid in every case; that there is substantial chance of scores being made which deviate from the interpretations given because of the human factor. It is never possible to evaluate precisely qualities which relate to the human efforts, ideas, and personality.

However, the test is a fairly good indication of the measurement of leadership qualities. Indicate to trainees that they should strive to improve any weaknesses scored on the test.)

IX. Responsibilities of Leadership

A. Leaders must carry certain responsibilities in view of the big job which they do.

1. Leaders are identified with the group or company which they belong to; therefore, the impression which they present must be favorable at all times and of the highest professional caliber.

2. A leader cannot be one type of person on the job or when he is working with the group and then become an entirely different individual when he is somewhere else.

a. The high qualities of leadership cannot be cast off whenever the leader feels that he

doesn't have to present a "good front," but must always be present irregardless of where the leader may be, or what he may be doing.

B. A large responsibility of the leader is to motivate the members of his group and keep them as contented and productive as possible.

1. More will be said about this motivation responsibility later in the session.

C. Other key responsibilities which the leader has include:

1. Responsibility to his group for fair and impartial treatment of all members.

2. Responsibility to his group for a fair assignment of duties and work assignments.

3. Responsibility to his group that there is no disorder or serious personnel conflicts within the group.

4. Responsibility to his group that its individual members receive their rights and privileges accorded by the policy, rules, and regulations of the company.

5. Responsibility to management that the group is productive and meets its production schedule.

6. Responsibility to management that the group shows loyalty to management and the company.

7. Responsibility to management that communications downward and upward flow in free channels through his department.

8. Responsibility to management that rules, orders, instructions, etc. are carried out.

9. Responsibility to management that co-operation with fellow supervisors and department heads is in effect.

10. Responsibility to individual members of his group that he will strive for their personal development and growth.

X. Human Relations and Leadership

A. The area of human relations and leadership go hand-in-hand.

1. Every organization depends upon human beings and there is not any phase of work which is not affected by people.

2. Sooner or later every relationship, every problem, and every decision involves the human element.

3. The function of leadership has to be accomplished through people, and all the things which the leader does must affect people.

B. There is a great amount of material available in the field of human relations; textbooks, publications, studies, etc.

1. At the University of Michigan at Ann Arbor, Michigan there has been established the Foundation For Research on Human Behavior.

2. This Foundation For Research on Human Behavior conducts various studies in the field of human relations; these studies are published and are available at moderate prices.

3. The Foundation also conducts seminars and study sessions for management personnel who are concerned with assessing their organization's performance with behavioral measurements of its people.

C. Some of the principles of effective human relations which the Foundation For Research on Human Behavior and other sources have advocated may be summarized in several major categories.

1. These principles of human relations must be understood and used by the leader if he is to be a successful one.

2. THESE PRINCIPLES OF EFFECTIVE HUMAN RELATIONS HAVE BEEN SUMMARIZED IN HANDOUT 20.

*** Handout 20 ***

(Read through the principles with trainees. Take any questions which may be asked.)

XI. Leadership and Productivity

A. Leadership in management holds the key to increased productivity; and, of course, increased production is a factor which must be dealt with.

1. No company can long compete in the open market unless it can solve its problems of production--the problems of improving machines, materials, and methods.

2. In order to solve these problems, management must have the support of its workers--this is where the leader comes into the picture.

3. The leader has more to do with the effectiveness of the work group than any other factor.

   a. He is at the point of action as he is with the people who do the work.

B. High productivity reflects good supervision and leadership

1. High productivity is important to the supervisor because:

   a. The efficient use of employee ability and energy is one of the major responsibilities of the supervisor.

   b. Management judges a supervisor largely in terms of the productivity of his unit.

   c. A good work unit can be developed which will attract and hold good workers.

   d. There is a feeling of pride and personal satisfaction when workers do well.

   e. A supervisor's chance for advancement will be judged a great deal on his ability to get good work done through his workers.

2. Obtaining High Productivity

   a. Obtaining high productivity is a matter of good management which displays leadership qualities.

   b. The way in which the work is planned, how subordinates are supervised, how materials and equipment are used, and how efficiently the factors of production are utilized determine productivity standards.

3. As a leader, high productivity can be obtained from the work group by:

   a. Helping workers build their skills through training

b. Allowing workers to participate in the planning of their work

c. Giving the more experienced workers the more important assignments

d. Giving recognition for work well done

e. Allowing some employees to become informal leaders of the group; thus utilizing leadership qualities of the subordinates

f. Setting of work goals which are realistic and attainable

g. Allowing workers to participate in the setting of realistic work goals

h. Organizing all elements of the department to meet production schedules

i. Planning and scheduling the flow of work

j. Co-ordinating the activities of the department with others in the company

k. Controlling costs and eliminating unnecessary operations

l. Promoting safe working conditions

m. Assigning and distributing work on a pre-arranged plan

n. Communicating clearly with workers

o. Setting a good example himself for others to follow

4. The foregoing principles and methods of increasing productivity through better supervision and leadership qualities are good to know and every leader needs to have a working knowledge of them as they apply to his particular situation.

5. Of more importance, however, is that every supervisor must consider how these can be put into effect; that is, the using of them will give the answer of how well the supervisor knows them.

   a. It has been pointed out many times in this session that there are many types of leadership; what the results will be from the use of each will depend upon how each is used and under what conditions and circumstances.

b. The same holds true for productivity--productivity depends greatly upon how the supervisor will use his tools of leadership in work he is responsible for.

XII. Leadership and Motivation

A. There are many things which can be used to motivate workers in the jobs they are doing.

1. The knowledge of motivation is of prime concern to the leader who must know how to stimulate his group to standards necessary to meet their obligations.

B. Usually, motivating factors include:

1. Good salary or wages
2. Good working conditions
3. Fringe benefits
4. Good management-employee relations
5. Recognition of good work
6. Job security
7. Impartial treatment
8. Opportunity to grow in job
9. Physical safety
10. Favorable work schedules

C. In regard to the foregoing items, the supervisor has no control over many of the items as they are set by top management.

1. There are some of these, however, which the supervisor becomes involved in and does have an opportunity to affect.

2. The use of leadership qualities can have a decided effect upon the results obtained from the use of motivating factors.

D. In studies conducted concerning motivating factors, it has been discovered that "more money" is not the chief incentive or major desire of most employees and it is not this item which motivates workers the most.

1. Wages are an important item, but it alone does not constitute what employees want most in their jobs.

   a. By providing or attempting to provide some of the things wanted most by workers, the job of motivating them to do their best work is much easier.

   b. It is also surprising to know that many of these motivating factors do not include material advantages, but concern the relations between the supervisor and the worker.

2. Basically workers want:

   a. Recognition for work which they perform which is of outstanding quality or quantity.

   b. To be consulted about things which affect them.

   c. Enjoyment in the work they are doing.

   d. Good working conditions which are clean and safe.

   e. A salary or wage which will give them financial security.

   f. Opportunities to talk things over--to suggest improvements, to share in making decisions, and the discussion of grievances.

3. It can be seen that the effective leader has many opportunities for motivating workers by his sincere desire to meet the basic wants of workers.

   a. As pointed out, most of these wants are non-financial and most of them are within the limits of authority which the supervisor possesses.

   b. An interested and satisfied worker is the type desired; but unless such worker has some of his basic wants satisfied, it will be impossible to motivate such a worker.

4. When the workers are highly motivated through the satisfaction of their basic wants, many good results to the supervisor and to the company are noted:

   a. Productivity rises

   b. Labor unit costs are lowered

c. Fewer grievances from workers arise

d. Less labor turnover

e. Fewer accidents

f. Better management-employee relationships

XIII. Management vs. Leadership

A. Management is concerned with operation while leadership is a function.

B. Management is concerned with:

1. Delegating responsibility and authority

2. Co-ordinating, planning, accounting

3. Establishing organizational structure

4. Supervising

5. The economics of production and marketing

C. Leadership is concerned with:

1. Developing morale

2. Motivating those in the work group

3. Developing a keen understanding of human relations

4. Developing aims and purposes

5. Striving to bring the whole enterprise into harmony with teamwork

D. The function of management is not easy; nor is the function of leadership.

1. The leader, as we have seen, is important in the function of management because he leads people toward their objectives.

a. These objectives must be guided by leadership toward an over-all, planned result as established by management.

b. Oftentimes, the ability to administer, lead, or manage is not rated or considered as important as it really is.

c. Leadership ability is important--a commodity which competent management is willing to pay the price for.

d. There is no doubt that leadership will be needed in even increasing amounts in the future to meet the needs and challenges of tomorrow's times.

XIV. Visual Aid in Leadership

(The visual aid recommended for this Session is:

35 mm. Sound Filmstrip

Title: McGraw-Hill Sound Filmstrip Series on "Supervisory Problems in the Plant"

This film series contains several cases; the case to be used here is:

Case No. 3 -- "The Case of Tim's Three Choices" -- (Leadership)

This case deals with all three types of leadership discussed: (1) autocratic, (2) democratic, (3) free rein.

Showing time for the sound filmstrip is less than five minutes; however, because the nature of the filmstrip is the solving of a provlem in leadership type, much discussion from the trainees will follow; therefore, time to allow for about 15 minutes of discussion should be arranged.

It is suggested that the Leader's Manual which accompanies the series of filmstrips be reviewed before the session. If you have not worked with filmed cases before, it is recommended that the Leader's Manual be studied thoroughly, especially that beginning section which gives recommendations on how to use the filmstrips and conduct the discussion.

The filmstrip, Case No. 3, "Tim's Three Choices," of the McGraw Hill Sound Filmstrip series on "Supervisory Problems in the Plant" may be purchased from Text-Film Department; McGraw Hill Book Company, Inc.; 330 West Forty-Second Street; New York, New York.

Show the sound filmstrip. Use the Leader's Manual as a guide in the discussion which will follow. Before the discussion ends, make sure that the problem cited in the film has been given some workable solutions.)

(The visual aid concludes the fifth and last session of "Introduction to Management.")

XV. Closing the Conference

A. (Briefly summarize the contents of the five sessions; this can be done by referring to Handout I which contains the session titles and objectives for each session.)

B. (Answer any questions which may be asked by trainees concerning the brief summarization.)

C. (Thank the members of the group for their participation in the discussions; their interest shown and the co-operation given.)

D. (Remind the trainees that the handout sheets and the notes which they took during the sessions will serve as valuable reference material when they get back to their respective jobs and want to put some of this to use.)

E. (Also, remind trainees that much of the material presented constituted basic management principles which apply to any organization or company and that by putting such to use will improve greatly their effectiveness of supervision.)

F. (If certificates are to be presented and if such is planned for this final session; certificates should now be presented.

If certificates are to be presented at a later time, give whatever information is necessary for the trainees to know concerning this.

In either case, if certificates are to be awarded, have a management representative of the company for which the training was given, present the certificates to the trainees.)

G. (Thank the trainees again for the part they played in the training conference; adjourn.)

Introduction to Management

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HANDOUT 1

COURSE CONTENTS

Session I History of Management

Objectives:
- To trace briefly the history of management
- To relate the history of management to current management concepts
- To study the work of Frederick W. Taylor, the areas of scientific management, and evolution of such
- To examine current management practices and procedures

Session II Organizational Structure

Objectives:
- To study types of business organizations; legal aspects, and control
- To study organization types and their functions
- To study departmentation and functions of departments
- To present a clear understanding of department relationships within the organization

Session III Major Responsibilities of Management

Objectives:
- To make an intensive study of management responsibilities--planning, organizing, directing, controlling, coordinating
- To study relationships between management responsibilities and the organization's objectives
- To note the effectiveness of each major responsibility of management in current practices

Session IV Organized Labor

Objectives:
- To trace the history of labor movement in the United States
- To present an understanding of union activities
- To study union-management relationships
- To trace the history of unions in Louisiana and note present status

HANDOUT 1 (Cont'd)

Session V <u>Leadership</u>

Objectives:
- To point out how effective leadership is related to good supervision
- To study theories, types, and patterns of leadership
- To make a self-analysis of each supervisor for leadership qualities
- To note carefully how supervision, leadership, and productivity form close relationships

HANDOUT 2

OBJECTIVES OF MANAGEMENT

MANAGEMENT

TO SERVE THE CUSTOMERS

1. Provide goods and services when needed.
2. Provide goods and services at competitive prices.
3. Provide goods and services in quantities desired.
4. Provide fairness, integrity, and surety in all dealings.

TO SERVE THE OWNERS

1. Provide fair return on investments.
2. Provide adequate records on status of organization.
3. Provide efficient operation of organization and freedom from insolvency.
4. Provide assurance of long-range program of operation.

TO SERVE THE EMPLOYEES

1. Provide protection against accidents, occupational diseases, etc.
2. Provide fair wages.
3. Provide information about what is going on in organization.
4. Provide a feeling of job satisfaction.

HANDOUT 3

PRINCIPLES OF SCIENTIFIC MANAGEMENT

1. The scientific study of management is relatively young and it is certain that more advancements will come.

2. Scientific management can be practiced in every field of management and is not restricted to only one type business.

3. Scientific management is not a "true science" because the human element is an important part of management; the exact behavior of a human being under stated conditions can not be precisely determined, only approximated.

4. Scientific management as a method is only a tool for management; management must know how to use it for it to be effective.

5. The scientific management approach to problem solving cannot be expressed by a certain set of formulas; however, it does have a defined pattern which should be followed.

6. The scientific method involves a clear statement of the problem and the collection and recording of data and facts previously discovered about the problem.

7. In every case, the effectiveness of the scientific method is limited by the manager's understanding of it.

8. Scientific management aims toward the motivation of both worker and manager.

9. There must be a level of understanding and mutual trust between the worker and manager for scientific management to be effective.

10. Scientific management stresses that the initiative and hard work of employees must be recognized by management.

11. A scientific selection and training of workers rather than a rule-of-thumb method is necessary for effective management.

12. Scientific management advocates good lines of communication between manager and worker.

HANDOUT 4

SUMMARIZATION OF THE HAWTHORNE EXPERIMENT

1. The Hawthorne Experiment conducted at the Hawthorne, Illinois Division of the Western Electric Company was one of the most famous industrial relations studies in the field of management and the human relations aspect toward workers.

2. The experiment provided the basis for much of what we now know about getting along with employees and understanding employee problems.

3. The experiment was conducted by the Industrial Research Department of Harvard University and a group of Western Electric Company personnel.

4. An early phase of the experiment proved that an improvement in the physical environment of the place which the work is being done does not always bring about improvement.

5. Another early phase of the experiment concluded that improvement in working conditions and the giving of extra worker benefits does not necessarily result in increased productivity.

6. The Hawthorne Experiment showed that management must understand human motivations and group reactions in getting things done through people.

7. The Hawthorne Experiment introduced the interviewing technique so as workers were given an opportunity to discuss with management their reactions to changes during the experiments.

8. Through the interview technique, regardless of the mechanical or physical changes made in the working arrangements, productivity continued to increase--a realization that when the workers were asked for their opinions and were able to register their complaints, these workers became more co-operative with management in general and consequently produced more.

9. The Hawthorne Experiment through the interview program found that the interview aids the individual to get rid of useless emotional problems and aids the worker to associate more easily, more satisfactorily with other persons--both fellow workers and supervisors.

10. The Hawthorne Experiment had several phases of development since its beginning in 1929; originally designed to study the comfort of workers as a group of individuals, it resulted in realization of management that one of the fundamental problems in large-scale industry is the developing and sustaining of co-operation in the work force.

HANDOUT 5

CHARACTERISTICS OF THE CORPORATION

1. The corporation is a distinct entity, separate and apart from its members; it exercises its rights and bears its obligations in its own name and not in the name of its members.

2. The corporation holds title to property in its own name, and may sue or be sued in the courts in its own name.

3. The interests in the ownership of a corporation are divided into transferable units known as shares of stock; the owners of the corporation are known as stockholders; they may sell this stock without interfering with the operation or nature of the corporation.

4. Since a corporation is a legal being in its own name, it is responsible for its own acts and obligations; therefore, creditors of a corporation may not look beyond the assets of the corporation for satisfaction of their claims.

   a. The loss that a stockholder may suffer is limited to the amount of his investment--his personal property is not subject to judgment by creditors.

   b. This feature of only the stockholder's investment in the corporation being liable for the satisfying of a debt is referred to as "limited liability of stockholders."

5. The life of a corporation depends upon the terms of its charter; it may be perpetual or it may continue for a specified period of years; it is not affected by the death or the incapacity of its stockholders.

6. As the corporation is a legal being, it is subject to federal income taxes in its own name; these earnings are again subject to income taxes when distributed to stockholders as dividends.

   a. Although there is an income tax credit given to stockholders when filing income tax returns, this tax situation is referred to as "double taxation of corporation income."

7. Under the corporate form, accumulation of business capital may be done by selling shares of stock to many different individuals.

8. The corporation is given legal form by the state to which it applies for its charter; the secretary of state is the office where this procedure is done.

HANDOUT 5 (Continued)

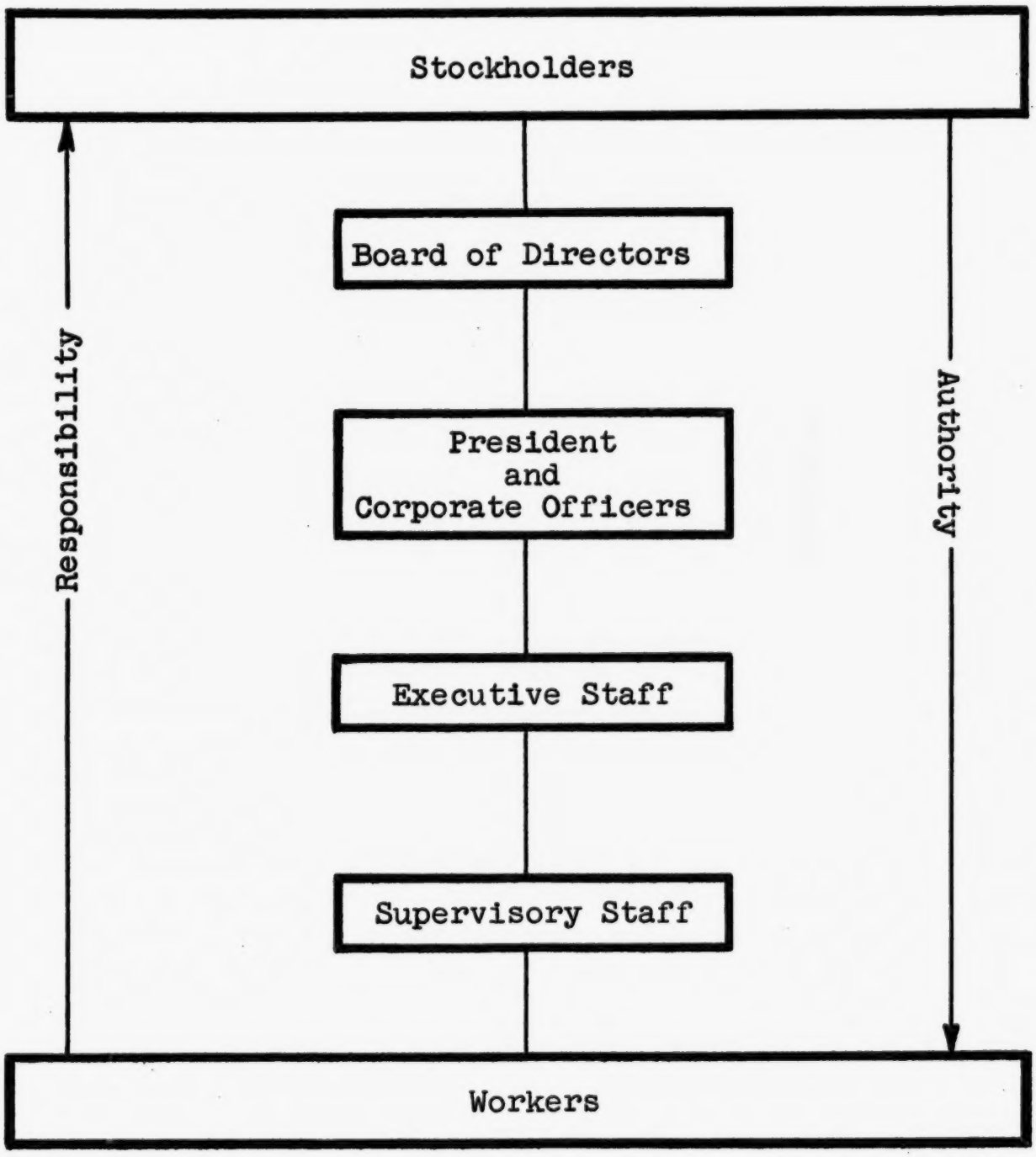
9. The corporation organized under the laws of a state is known in that state as a "domestic corporation."

   a. The corporation must secure a permit to transact business in other states, where it would be referred to as a "foreign corporation."

10. A stock corporation is organized for profit, has its capital stock divided into shares, and is authorized to distribute portions of the profits to the shareholders; a nonstock corporation is not organized for profit, and includes religious, charitable, civic, and similar organization.

HANDOUT 6

CORPORATE FORM OF ORGANIZATION



HANDOUT 7

AUTHORITY, RESPONSIBILITY, AND DELEGATION

1. Authority is handed down from someone at an upper level to someone at a lower level in the organization.

2. If a person is to be held accountable for results, he must be given adequate authority to get the job done.

3. Unless lines of authority are communicated and made clear, such authority is ineffective.

4. Lines of responsibility must be communicated and made clear, otherwise such a situation becomes detrimental to an organization.

5. The axiom "a person should not be given a responsibility without authority to carry it out" has considerable merit.

6. Authority should not be without responsibility, nor should responsibility be without authority--both must be coequal to be effective.

7. A person should know at all times to whom he is accountable--to whom his responsibilities lie for the performance of his duties.

8. Delegation involves the granting of an equal portion of authority and responsibility from one person in the organization to another so that certain activities can be performed.

9. It is impossible for one person to perform all duties, be responsible for such activities, and have all authority in the organization--such have to be given to others.

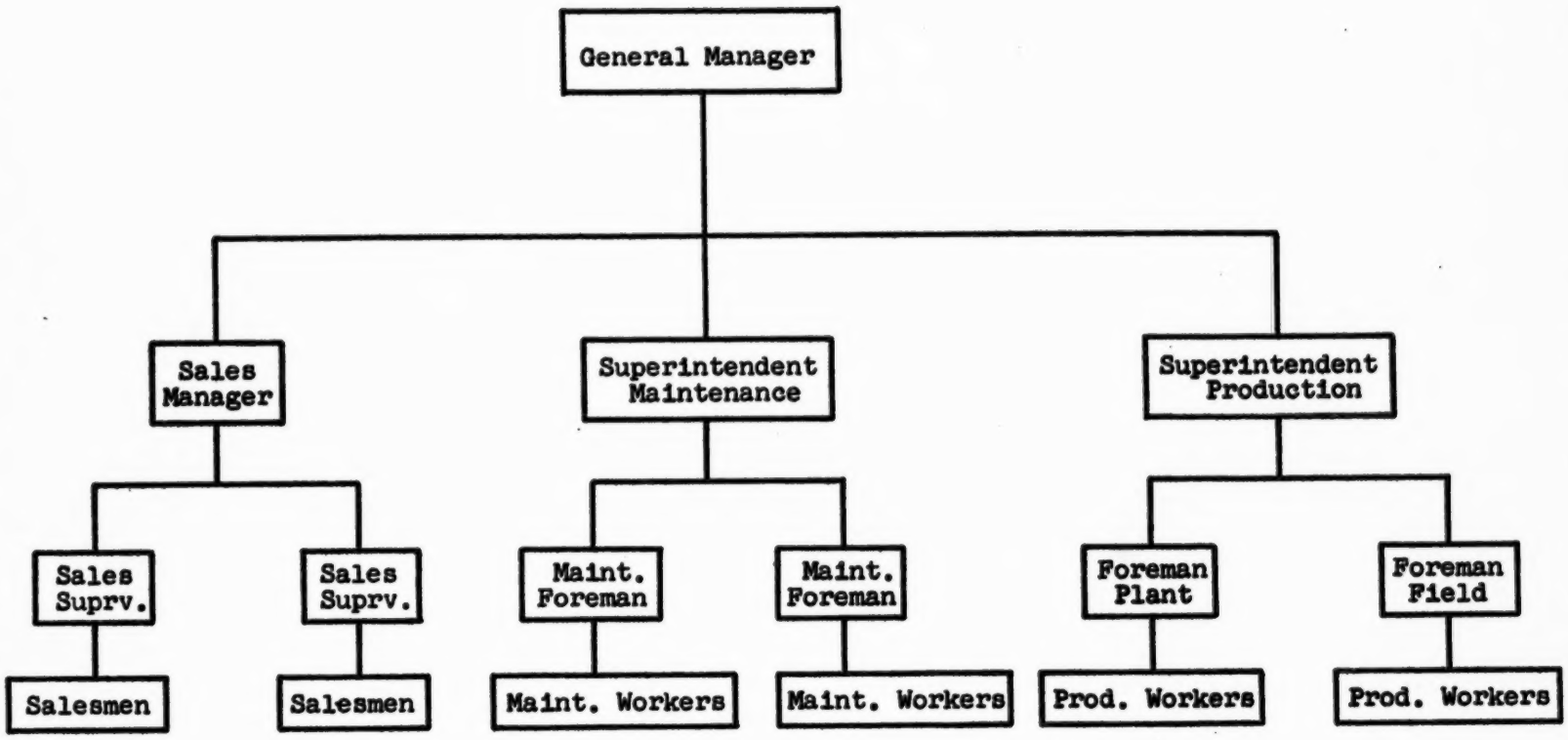
10. Delegation extends the capacity of a supervisor when he can no longer perform his responsibility alone--the supervisor is relieved of many of the routine tasks.

11. There can be resistance to delegation by some supervisors who are reluctant to admit their limitations or because of their desire for personal power.

12. The supervisor who delegates authority and responsibility always remains accountable for what is or what is not accomplished.

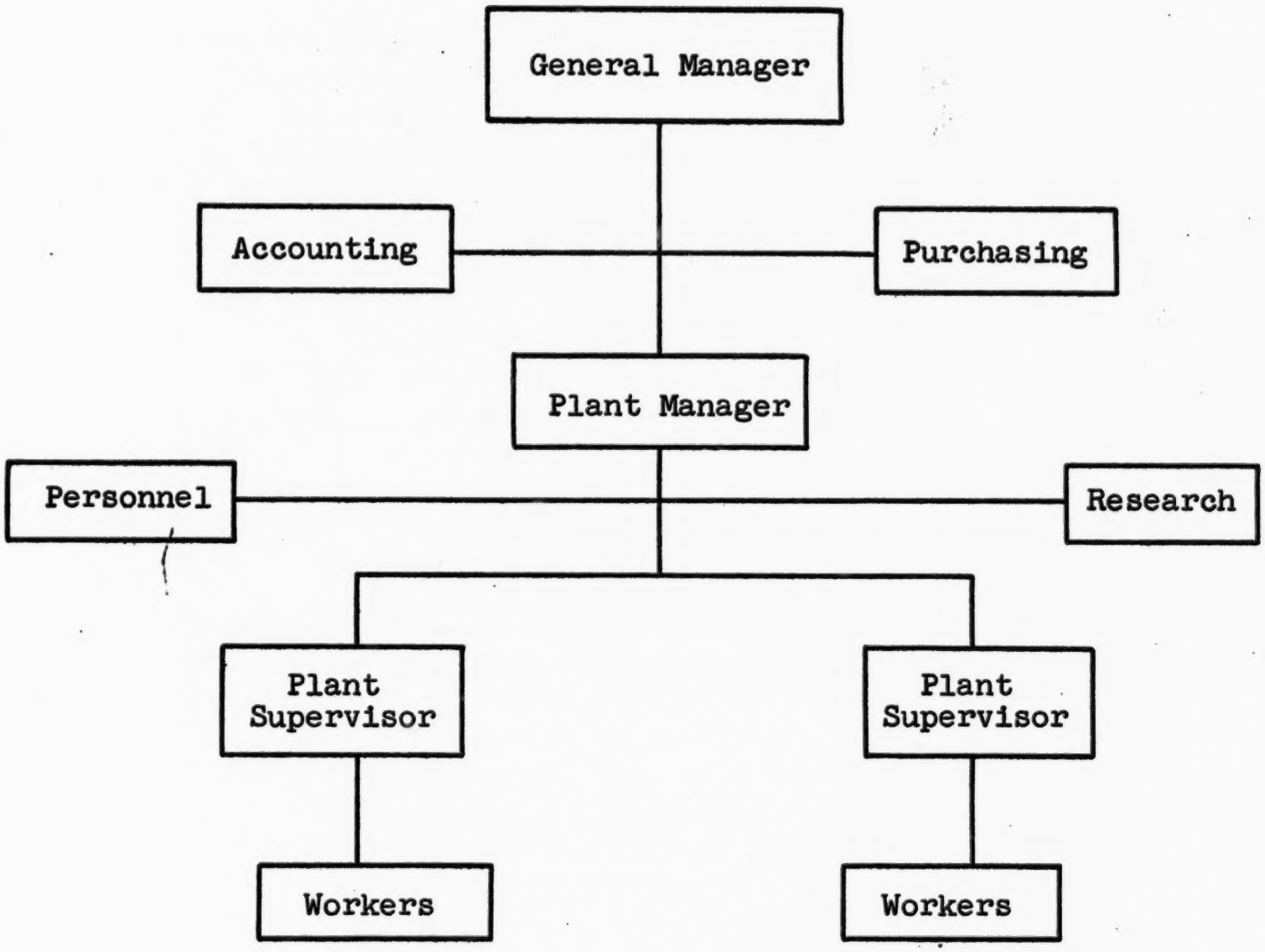
HANDOUT 8

LINE-TYPE ORGANIZATION



HANDOUT 9

LINE AND STAFF ORGANIZATIONAL STRUCTURE



HANDOUT 10

PLANNING--A FUNCTION OF MANAGEMENT

1. Planning is related to all managerial actions--every problem, situation, or activity requires some degree of planning.

2. The planning which each supervisor does must fit into the planning for the over-all organization.

3. The function of planning requires some sacrifices on the part of management--time and extra effort are needed for planning.

4. Since planning means the anticipation of future events, it varies from one situation to the next.

5. Experience is a prime factor in the improving of planning ability.

6. No plan is better than the judgment that goes with it--such judgment can be developed by recognizing and correcting weaknesses in previous planning activities.

7. Planning requires careful follow-up to evaluate successes or failures of proposed activities.

8. All managers must do planning for their respective work areas with such involving factors as "who, what, when, where, why, how" questions.

9. Before the supervisor can do effective planning, he must know his job and responsibilities.

   a. Unless the supervisor fully understands the job--processes, machines, personnel, services or products, customers, etc.--any planning which may be done will be the "hit-or-miss" type.

10. The supervisor who knows how to plan and does so can save his company money:

    a. Poor planning is the most common cause of unnecessary overtime.

    b. Scrap and waste are items which result in large costs--such can be reduced with good planning.

    c. Costly equipment and machine breakdowns can be eliminated with preventive maintenance planning.

    d. Lack of planning can result in poorly trained employees which results in lowered productivity and other related problems.

HANDOUT 10 (Cont'd)

e. A work schedule which is not planned will not keep employees productively employed for the full course of the day--this results in higher unit costs.

HANDOUT 11

ORGANIZING--A FUNCTION OF MANAGEMENT

1. Good organizing requires planning because an organization is constantly changing to keep pace with changing events.

2. People in the organization play a vital factor in its functions--principles of organizing must always consider the human element.

3. Organizing which has been done based on sound management concepts must still be subject to study and constant adjustments to meet the dynamic role it plays.

4. The function of organizing can not be done "overnight"--it requires sufficient time for the many phases of work necessary in the organizing process.

5. Organizing requires that provision be made for the supervision of all essential activities in the organization.

6. Responsibilities assigned and authority given to personnel must be clearly defined in the organizing function.

7. Organizing stresses the organizational structure--that is, the relations between management and workers, the relations between co-workers, and the relations between workers and management--such need to be spelled out in the organizational charts and manuals.

8. Staff and line functions must be differentiated and clearly defined in the organizing function.

9. The principle of organizing, which is often foremost in the minds of management, is that the work of the enterprise must be accomplished through the organized efforts of many persons and groups.

10. Organizing provides unity to the enterprise, as well as to the actions of the groups.

11. Without the function of organizing being performed effectively, much energy, effort, and material would be wasted.

12. Many problems which exist in management are direct results of improper or poor exercise of the organizing function.

HANDOUT 12

DELEGATING--A FUNCTION OF MANAGEMENT

1. The supervisor who delegates and directs work effectively is free to do more supervisory work and over-all planning.

2. Without delegation, a person is limited by what he alone can effectively control.

3. The practice of delegation enables the supervisor to organize the department's work more effectively.

4. The line of communication between supervisor and subordinate must be kept open when delegation is done.

5. A lack of ability to direct is a definite barrier to successful delegation.

6. Delegation requires: (a) that the supervisor be able to think ahead and visualize the work situation, (b) formulate objectives and plans of action, (c) communicate directions to subordinates.

7. Subordinates will hesitate to accept responsibility when they believe that they lack the necessary information and resources to do a good job.

8. Many supervisors fail to delegate because they have the "I can do it better myself" attitude.

9. It is a generally accepted principle that the supervisor must believe that his job requires that work must be done through other people before he will make full use of delegation.

10. The supervisor who fails to delegate duties to his subordinate because he lacks confidence in him should either train the subordinate or get another one.

11. Delegation is a two-sided relationship; the supervisor who is accountable for achieving certain results; and the subordinate on the other hand who is expected to carry out the assigned delegation.

12. The supervisor must always follow up on a delegated job with an appraisal of the employee's performance; pointing out weaknesses and giving praise for good work.

HANDOUT 13

CONTROLLING--A FUNCTION OF MANAGEMENT

1. Controlling constitutes an important function of management as the activities of the enterprise must proceed within certain desired channels.

2. Control efforts on the part of management become easier when each member of the organization knows what the objectives and goals are of the organization, section, and department.

3. Controlling the activities of personnel in the organization by management necessitates the use of good channels of communication.

4. Having each person in the organization with fixed responsibility is effective in achieving good controls.

5. The organization structure has much to do with how effective the control of activities by management will be.

6. Policies which outline clearly the broad and comprehensive outlines for guiding the directions of the enterprise have much to do with control.

7. The use of orders, rules, and instructions aid greatly in controlling the activities of personnel in the organization.

8. An evaluation of control based on expected results must be made to determine the effectiveness of current control techniques.

9. Effective control requires the delegation of authority to those persons responsible for getting work done.

10. The degree of control which the supervisor must exercise is dependent upon several factors--efficiency of workers, morale of workers, motivation needed for effective work, leadership capabilities of subordinates, etc.

HANDOUT 14

CO-ORDINATING--A FUNCTION OF MANAGEMENT

1. Co-ordination makes possible a greater total accomplishment than that evidenced by individuals working along independently.

2. A better understanding of organizational principles is possible where co-ordinating of activities is stressed.

3. Co-ordination results in a minimum of waste of material and worker efforts.

4. Greater competency and skill by workers in relation to their jobs is evidenced when they know exactly what is to be done.

5. Co-ordination results in a better utilization of the elements of human relations--the working together aspect unites individuals toward common goals.

6. Co-ordination results in a better organized work force based oon the division of functions which blend together into a united effort.

7. Many of the problems normally encountered in the area of communications are not present when effective co-ordinating is practiced.

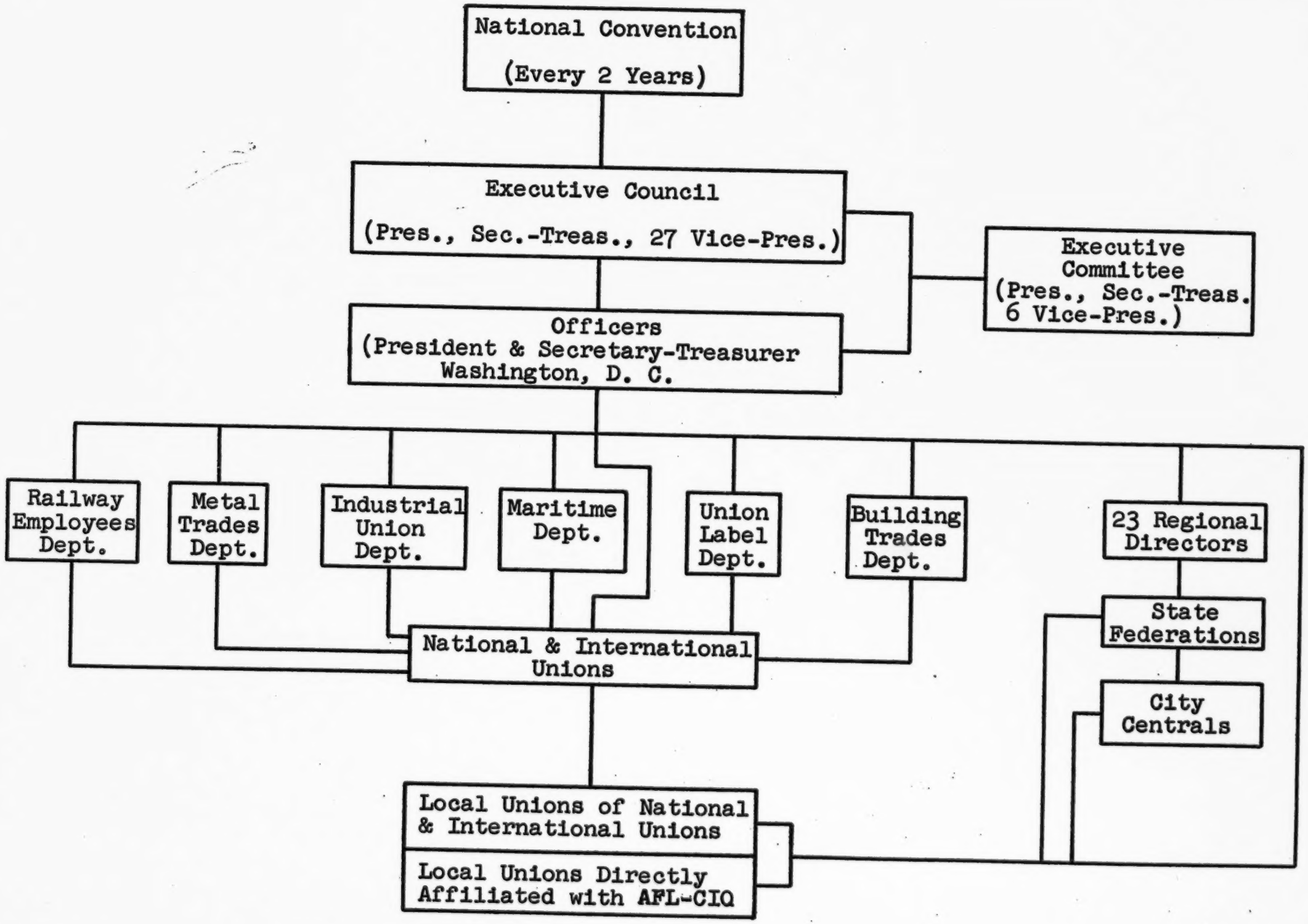
8. The function of co-ordinating gives management an opportunity for further developing their skill for getting work done through other people.

9. When the function of co-ordination is practiced, management has the opportunity to view the entire structure or balance of work being done.

10. Co-ordinating results in a degree of orderliness to operations which would not be evident otherwise.

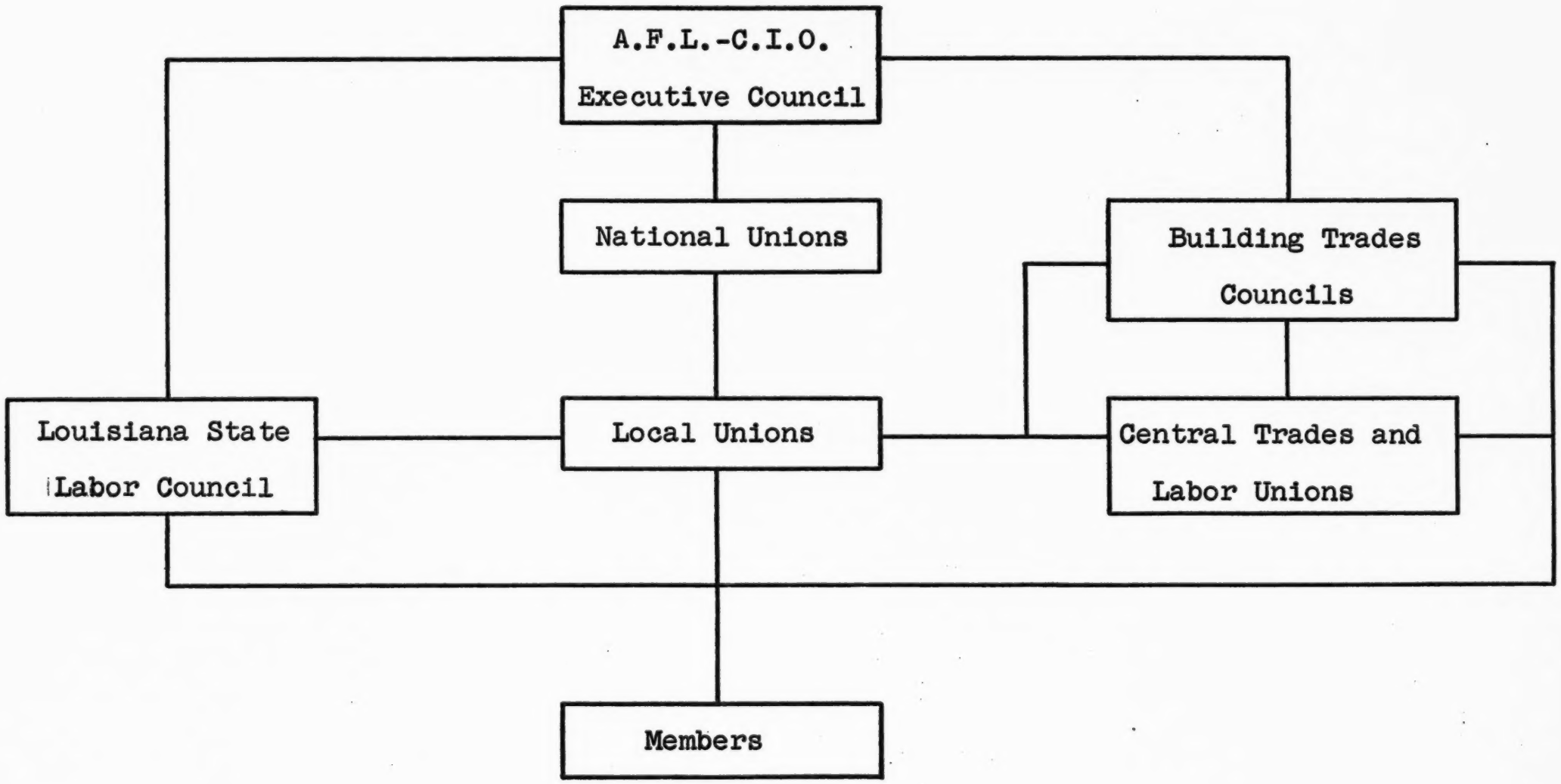
HANDOUT 15

STRUCTURAL ORGANIZATION OF THE AMERICAN FEDERATION OF LABOR AND CONGRESS OF INDUSTRIAL ORGANIZATIONS



HANDOUT 16

THE STRUCTURE OF THE A.F.L.-C.I.O. IN LOUISIANA



HANDOUT 17

THE SUPERVISOR--DRIVER OR LEADER?

DRIVER	LEADERSHIP
1. Drives the worker	1. Inspires and impresses the worker
2. Uses threats and intimidation	2. Uses principle of mutual understanding and recognizes the right of the individual
3. Completes work at the expense of workers	3. Completes work, but develops workers in the process
4. Desires to dominate every person and activity	4. Desires to share and delegate authority and responsibility
5. Is found in the back of the group "driving"	5. Is found in front of the group "leading"
6. Blames others for failures or setbacks	6. Assumes blame; but evaluates situation so it will not happen again
7. Always takes personal credit for the success of any job	7. Gives workers recognition for success of a job
8. Does not give workers a chance to make suggestions	8. Welcomes suggestions from workers
9. Stresses getting the job done by whatever means are necessary	9. Stresses teamwork in getting the job done
10. Shouts insults at workers who make mistakes.	10. Trains and coaches workers so that they know how to do the job

HANDOUT 18

QUALIFICATIONS FOR LEADERSHIP

1. Knowledge of human relations--a leader's job is to develop people.
2. Ability to communicate without misunderstandings.
3. The ability to exercise good judgment in all matters, both business and personal.
4. Persistence in driving toward goal or objective.
5. The ability to inspire confidence in people.
6. A leader must understand people and know their weaknesses and strength.
7. A knowledge and understanding of the broad policies of the organization.
8. Capacity for doing work which requires both mental and physical energy.
9. Willingness to listen to subordinates with a sincere desire to understand the person's point of view.
10. Free from bias in dealings with others.
11. Ability to control emotions and refrain from show of temper.
12. Knowledge of the operations he is responsible for supervising.
13. Teaching and training abilities.
14. Reputation for honesty and forthrightness.
15. Acceptance of responsibilities for getting work accomplished through a group of people.

HANDOUT 19

LEADERSHIP SELF-APPRAISAL TEST

Instructions: Read the questions carefully and answer them honestly. Nobody but you will see the results so be frank and objective. Before answering a question, think back and consider several incidents related to the question that involved you with subordinates, co-workers, or supervisors. There are three possible answers to each question; put a check under the answer appropriate to you for each question.

	Yes	Sometimes	No
1. Do you enjoy the feeling that you have more knowledge of the job than anybody else in the department?			
2. Do you believe that all people are basically alike?			
3. Are your suggestions sometimes turned down by your supervisor because you have failed to consider all possible factors?			
4. Do you discard a new idea when you get opposition to it?			
5. Do you feel that the work in your department would slow down considerably if you were absent for two or three days?			
6. Do you feel that your subordinates do not show enough respect for you?			
7. Have you ever disliked someone because he reminded you of someone else you didn't like?			
8. Do you think there is any harm in letting subordinates know when you're angry?			
9. Do you believe you can just about judge a person's character by his appearance?			
10. Have you found it difficult to speak up in meetings and discussion talks with your supervisors?			
11. Do you feel that it is better to smooth things over with workers than to use authority in personnel problems?			
12. Do you feel that you're doing a good job only when your boss tells you so?			

HANDOUT 20

PRINCIPLES OF EFFECTIVE HUMAN RELATIONS

1. An individual wants to know what is going on in the department and company which he works--he needs to be informed.

2. Every person likes to feel important.

3. There are no two people who are exactly alike in their personalities, interests, dislikes, or likes.

4. A person likes to know that the other person is listening while he is talking.

5. Persons like to be asked their opinions on matters.

6. Most persons like to talk about the subjects which they are interested in.

7. Persons do not like to be criticized while others are present.

8. Most persons are sentimental about personal achievements, experiences, and feelings.

9. A person who is performing under a threat of fear will not put forth his best efforts.

10. When a person makes a mistake, he likes to have a chance to "save face."

11. A person likes to be recognized for a job well done.

12. The one thing which motivates a person more than anything else in his work is his feeling of importance in doing the job.

13. A worker will not show interest in his work unless he gets some personal satisfaction from doing it.

14. Persons want to be accepted as part of the work group or the department.

15. Every person wants those things which he believes he is rightfully entitled to.

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State of New Jersey
Department of Education
Division of Vocational Education

THE CURRICULUM FOR A MODEL BUSINESS EDUCATION PROGRAM

Prepared by
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State of New Jersey
Department of Education
Division of Vocational Education

THE CURRICULUM FOR A MODEL BUSINESS EDUCATION PROGRAM

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June 1967

MEMORANDUM

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DATE: July 28, 1967

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THE CURRICULUM FOR A MODEL BUSINESS EDUCATION PROGRAM

INTRODUCTION

In this scientifically automated age of ours when space flights and news of population explosions are continuously in the headlines, much emphasis has been placed on the "college bound" student. Parental and administrative pressures have been applied to such a great extent that guidance personnel in our public schools must go through great pains in conducting nationwide college placement programs. In the meantime, what is being done by the public schools for the "business education" student? Are the high schools really as concerned about preparing him for suitable employment and life as they are about preparing the college bound student for entrance to college?

It appears that over the years the ambitions and desires of American youth have little relationship to the occupational structure of the world of employment. In 1964, over one-half of our high school graduates went on to institutions of higher learning[1] to prepare for occupations which involve a small fraction of our labor force. This seems to indicate that the national attitude of high school students has not changed. While the number of high school graduates is increasing, the number of students going to college is increasing even more.[2] From this, one can justifiably suggest that more and more students are embarking on college programs which tend to widen the gap between individual ambitions and collective reality.

PURPOSE

The purpose of this study will be to establish a business education curriculum to serve as a guide for implementing and/or improving business education programs in the State of New Jersey.

SCOPE

This study concerns itself primarily with the business education student and what can be done to prepare him for the world of work. An attempt will be made to establish a model* business education curriculum to encompass the entire realm of business career planning and preparation from guidance to job placement.

[1]U. S. Office of Education, Digest of Educational Statistics, 1964, OE 10024-64.

[2]Blackstone, Bruce I., "Functional Patterns for Guidance and Manpower Structure in Office Occupations," EBTA YEARBOOK, Vol. 39, 1966, P-161.

*model--an illustration to serve as a guide.

DEFINITIONS OF TERMS

Before this task is undertaken and in order to meet on common ground, it is necessary to define the following terms used throughout this study.

A Business Education Student, sometimes referred to as a Business Student, shall be considered to be a high school student who intends to enter employment in the office occupations upon graduation from high school.

Office Occupations shall be considered as office jobs that are normally found in practically any business which has a clerical activity--for example: general clerks, clerk typists, stenographers, bookkeepers, statistical clerks, file clerks, key-punch operators, business machine operators, administrative assistants, etc.

A Distributive Education Student, sometimes referred to as a DE Student, shall be considered as a high school student who intends to enter employment in the areas of merchandising, marketing, and management.

Skill Subjects shall be referred to as the subjects of typewriting, shorthand, bookkeeping, record keeping, business mathematics, business English, salesmanship, and related activities such as filing, business machine operation, electronic data processing, office practice, telephone techniques, etc.

General Business Subjects shall be referred to as the subjects of introduction to business, exploratory business, business occupations, business law, consumer economics, business organization and management, economic geography, etc.

Work Experience Programs shall be considered as coordinated programs of on-the-job learning which have been made part of the student's schedule.

Job Placement Programs shall be considered as carefully designed and coordinated services offered to all students for the purpose of assisting them in obtaining full-time employment in their fields of endeavor after graduation from high school.

Vocational Guidance shall be referred to as a full-time guidance activity designed to help a student choose, prepare for, enter, and make progress in an occupation which is appropriate for the student.

Exploratory Courses or Programs, sometimes referred to as Career Courses or Programs, shall be considered as scholastic activities which enable students to become aware of the various occupational opportunities that exist for the high school graduate.

The Secretarial Sequence shall be considered as the pattern of skill subjects and general business subjects necessary in a high school student's schedule in order for him to enter the secretarial field upon graduation.

The Bookkeeping and Accounting Sequence shall be the pattern of skill and general business subjects necessary in a high school student's schedule in order for him to enter the bookkeeping and accounting field upon graduation.

The Clerical Sequence shall be the pattern of skill and general business subjects necessary in a high school student's schedule in order for him to obtain a routine clerical position upon graduation.

The Distributive Education Sequence, referred to as the DE Sequence, shall be the pattern of skill and general business subjects necessary in a high school student's schedule in order for him to enter the fields of merchandising, marketing, and/or management.

The General Business Sequence shall be the pattern of general business subjects which are interwoven throughout the secretarial, DE, bookkeeping, and clerical sequences.

Slow Learners shall be considered as those students who do not progress as rapidly through the sequences as they should.

BASIC CONSIDERATIONS

Practically every business educator will agree that business education serves two major purposes. First, it is concerned with the preparation of students for entrance into business careers, for rendering efficient service in their careers, and for the advancement to higher levels within their careers. From this, one can conclude that business education is one of the divisions of vocational education.

The second purpose of business education is concerned with those principles and practices of everyday business relationships that aid in conducting one's personal business. The need for this type of education arises from the fact that everyone, regardless of occupation or economic status, engages in many activities of a business nature. In this light,

general business education is a form of education that every citizen should have.

To achieve the first purpose of business education--the vocational objective--the business educators, guidance personnel, and school administrators need to know the occupations available to students in their communities, the duties and specialized knowledge required of the workers, and the attitudes, habits, personal characteristics, and human relation skills that will contribute to the development of an acceptable employable personality. Further, they must know the skills and knowledges necessary for workers to advance on the job, once the initial job has been obtained.

To achieve the second purpose of business education--the general business objective--business educators, guidance personnel, and school administrators need to know the business activities in which all citizens of their community engage and the kind of knowledge these citizens need to possess.

The big problem in achieving these objectives is informing business educators, guidance personnel, and school administrators of what they need to know and use in order to implement a sound curriculum in business education. Further, it is necessary for all of these educators to get "off their backsides" and do a little business community research by means of personal involvement, surveys, follow-up studies, and job analyses.

A sample business education survey of a New Jersey school in Morris County is attached as ANNEX "A" along with a sample follow-up study form attached as ANNEX "B". Before any sound program can adequately be improved or revised, a follow-up is necessary.

Such surveys and follow-up studies can easily determine course content for the specific occupational opportunities and requirements. Determining the general business content--those things all citizens should know--is very difficult, however. Some means of determining general business content are offered by H. G. Enterline.[3] He suggests using newspaper analysis, analysis of child and adult life, and analysis of the writings of frontier thinkers.

[3]Enterline, H. G., "Trends of Thought in Business Education," Monograph 72, South-Western Publishing Company, 1947, P-13.

Another means is seeking out advice from the experts. Such examples of expert recommendations can be obtained from such sources as the National Task Force on Economic Education,[4] Gratz's "Major Issues in Business Education,"[5] Warmke's "Distributive Education Issues,"[6] National Business Education Association, New Jersey Business Education Association, and the New Jersey State Departments of Business and Distributive Education.

Role of the Skill Subjects

The primary role of the skill subjects in business education is to develop vocational competency.

Role of the General Business Subjects

The primary role of the general business subjects in business education is to give depth and understanding of our economic society in order that the student can become a productive and informed worker, citizen, and consumer.

Role of Work Experience Programs

The primary role of work experience programs is to provide the student with practical on-the-job learning which is coordinated with his high school business and/or distributive education taking into consideration the student's career objective. Attached as ANNEX "C" are proposals for work experience programs at a New Jersey high school in Burlington County which were completed in 1966.

Role of Job Placement Programs

The primary role of Job Placement programs is to place high school students in full-time jobs leading to their career objectives upon graduation. Attached as ANNEX "D" is a summary and report of the Business Education Job Placement Program at Randolph High School, Randolph Township, New Jersey, which was completed in 1966. Further, attached as ANNEX "E" is an illustration of the duties and responsibilities of a business education job placement coordinator.

[4]Committee for Economic Development, Economic Education in the Schools, 711 Fifth Avenue, New York, 1961.

[5]Gratz, Jerre E., "Major Issues in Business Education," Monograph 106, South-Western Publishing Company, 1962.

[6]Warmke, Roman F., "Distributive Education Issues," Monograph 102, South-Western Publishing Company, 1960.

Role of Exploratory Programs

The primary role of exploratory programs is to provide the student with an opportunity to experiment with skills and knowledges which are encountered later in the student's curriculum. Attached as ANNEX "F" is a brief outline of an experimental exploratory course in business and mathematics. Notice how career and occupational information was integrated.

Role of Occupational and/or Career Programs

The primary role of occupational and/or career programs is to acquaint the student with the various occupational and career opportunities available in or near the employing community. Refer to ANNEX "F".

Role of Distributive Education

The primary role of Distributive Education is to prepare students to enter the fields of merchandising, marketing, and management. Attached to ANNEX "G" is a statement of distributive education in New Jersey according to Mr. Robert B. Joy, Director of Distributive Education for the State of New Jersey.

CRITERIA FOR A CURRICULUM IN A MODEL BUSINESS EDUCATION PROGRAM

In 1965, the Vocational Division of the New Jersey Department of Education enlisted the services of Dr. William Polishook of Temple University to form a committee and establish criteria for a model business education program. Further, fifteen high schools were selected throughout New Jersey to participate in reacting to the criteria. The participating schools were:

Barringer High School - Essex County
Bridgewater-Raritan High School - Somerset County
Dickinson High School - Hudson County
Ewing High School - Mercer County
Hunterdon Central High School - Hunterdon County
Linden High School - Union County
Manchester Regional High School - Passaic County
Moorestown High School - Burlington County
New Brunswick High School - Middlesex County
New Milford High School - Bergen County
Oakcrest High School - Atlantic County
Pennsauken High School - Camden County
Red Bank High School - Monmouth County
Salem High School - Salem County
Vineland High School - Cumberland County

Twenty-six statements of criteria were given:

1. It is assumed that the general aims of education at the high school level shall be the aims of business education at this level. In view of this criterion, only such further assumptions as apply especially to business education in secondary schools will hereinafter be presented.

2. Local conditions, not only within a community but often within a single school in that community, must be taken into consideration in setting up and administering a program of business education.

3. Regardless of the type of school organization which prevails in any community there are two distinct, but articulated, periods of training in the field of business education. For the purposes of our study one may be called the pre-vocational period, and the other may be called the vocational period. The pre-vocational period should be given over largely to exploration, try-out, personal use, and general education.

4. The vocational period should be given over largely to training in preparation for well-defined types of business occupations.

5. During the pre-vocational period, each pupil should decide under guidance which of the office, store, and other initial-contact occupations he wishes to prepare for.

6. In the business career of any pupil, the ultimate goal job is more important than the initial-contact job since it has been demonstrated that any type of clerical or other business work may be used as a stepping stone to higher levels of employment.

7. In view of the greater importance of ultimate goals, try-out courses in business should be so constructed as to reveal the aptitudes, abilities, and interests of pupils with respect to such goals as well as with respect to the more immediate initial-contact jobs.

8. Vocational skill-training should form a part of the training for practically every boy or girl in the business department, but such skill-training should be confined to a single skill or a closely related group of skills--stenographic, bookkeeping, selling, office machine operation, etc., in order to make room for an adequate general education program.

9. The largest possible amount of general education consistent with sound vocational training should accompany all business education, but such general education should, wherever possible, be adapted to the needs of business pupils.

10. Since continuity of practice is essential to the development of skills of all sorts, as far as is practicable, short, intensive courses in skill subjects should replace longer courses with intermittent practice on alternate days.

11. Such skills as are essential to any particular business occupation for which a pupil is training should be developed as nearly as possible to the time when the pupil will leave school and enter upon such employment.

12. The core of the business curriculum should be general education instead of bookkeeping, shorthand, or any business subject or groups of such subjects.

13. Preparation for college cannot be accepted as a major objective of high school business education since the large majority of graduates of a high school business department do not go to college. Preparation for college and training for business positions require different programs.

14. Since the aim of vocational business education is to prepare for the performance of specific office or store or other business duties, the tests of achievement in the technical or skill subjects in this field should square with the requirements of occupational life instead of with the usual academic standards.

15. Since the initial-contact positions and promotional opportunities open to boys are likely to be different from those commonly open to girls, the high school program of business education should be so constructed as to meet the apparent needs of both sexes through specialized or differentiated curriculums.

16. Boys and girls who lack the personal, mental, and physical characteristics which suggest the possibility of advancing beyond the initial-contact job should be encouraged to seek some other form of vocational training since the clerical level of business employment is unsatisfactory as a permanent goal because its financial rewards are inadequate to the needs of adult family life.

17. Since the degree of success in business which may be attained by any individual is dependent upon may factors such as "business ability," "personality," "social qualities," "mental ability," "natural intelligence," "training," "family connections," etc., no pupil should be barred from the business program because his I. Q. is average or even somewhat below average.

18. Since the conventional and traditional subjects of bookkeeping and shorthand require a high degree of "mental ability," or "student ability," or "scholastic ability," it is clear that only those who rate high in this type of ability should be encouraged to pursue training for entrance into business through the medium of a bookkeeping or stenographic position.

19. Since selling (retail or outside) requires what may be called an alert mind and pleasant personality, it is clear that persons who do not possess these qualities should be discouraged from seeking training for selling positions.

20. The high school business program must contain the best possible provision for such pupils as are not likely to succeed in stenographic, bookkeeping, and selling positions.

21. All business courses should be offered with the needs of business pupils in mind and pupils outside the business department should be permitted to elect these courses only when it is clear that they will do the work required exactly as if they were taking such courses with definite vocational intent.

22. The development of vocational skills and occupational understanding is accomplished most expeditiously and satisfactorily when the trainee has an opportunity to establish contact with actual business during the period of training; hence, it is desirable to make provision for some form of cooperative training whenever feasible.

23. The syllabus for each subject in the business curriculum should contain for that subject (a) statement of aims, (b) essential content for use in achieving those aims, (c) suggestive methods for using that content, (d) definite testing procedure for determining whether or not aims have been achieved, and (e) helpful bibliography.

24. Businessmen should be consulted in the organization of any high school business curriculum which is expected to train boys and girls for employment; hence, an advisory committee should be organized and used freely in consultive capacity.

25. The outcomes of a vocational business education program can be improved by providing (as a joint responsibility with guidance personnel) a placement service and continuous follow-up procedures.

26. It must be assumed that the instructional staff is competent from the point of training and experience in the business world and is also up-to-date by maintaining professional as well as business contacts.

Attached as ANNEX "H" is a copy of the report to the Vocational Division of the New Jersey Department of Education, submitted by Ewing High School, Mercer County, in 1966, which indicates very favorable reaction to the criteria.

DESCRIPTION OF CURRICULUM FOR A MODEL BUSINESS EDUCATION PROGRAM

From what you probably have determined, the curriculum for a model business education program would include all the criteria set forth by the Polishook Committee. It is a curriculum designed for meeting the vocational and personal needs of the business education student in order that he may become an effective worker, citizen, and consumer in our society. The curriculum must be established through cooperative effort on the parts of the business teachers, other teachers, guidance personnel, administrative staff, board members, business community, students, and parents within the community. The curriculum must be flexible enough to meet the needs of all business students and be able to provide the resources necessary for students who are not likely to succeed in stenographic, bookkeeping, and selling positions. The core of the curriculum should be general education--those things all students should know--and not merely the skill subjects.

In keeping within the criteria as established by the Polishook Committee and keeping in mind the major objectives of business education, the following model business education subject sequences are offered--one plan without cooperative work experience for those schools who find it impossible to establish cooperative work experience, and one plan with cooperative work experience for those schools that have the community resources at their command. A brief description of each business and distributive education subject at each grade level, along with reasons for implementation, will be given on subsequent pages in this booklet.

Further, it must be realized that a minimum seven period day is necessary and that split or double sessions would be completely undesirable. In addition, it may be assumed that in the sequences for high schools without a cooperative work experience program that an in-school work experience program be established and operated during the later phases of the student's learning.

MODEL BUSINESS EDUCATION SUBJECT SEQUENCES FOR HIGH SCHOOLS WITHOUT AN OUT OF SCHOOL WORK EXPERIENCE PROGRAM (to meet the stenographic, bookkeeping, and clerical sequences)

Grade 9	(all business students)
5	English I
5	Economic Geography
1	Physical Education
5	General Science
5	Exploratory Business & Mathematics
$2\frac{1}{2}$	Electives
$23\frac{1}{2}$	TOTAL CREDITS

Grade 10	(all business students)
5	English II
5	U. S. History I
1	Physical Education
5	Biology or Language
5	Introduction to Business with Related Mathematics
$2\frac{1}{2}$	Typing I
$23\frac{1}{2}$	TOTAL CREDITS

Grade 11

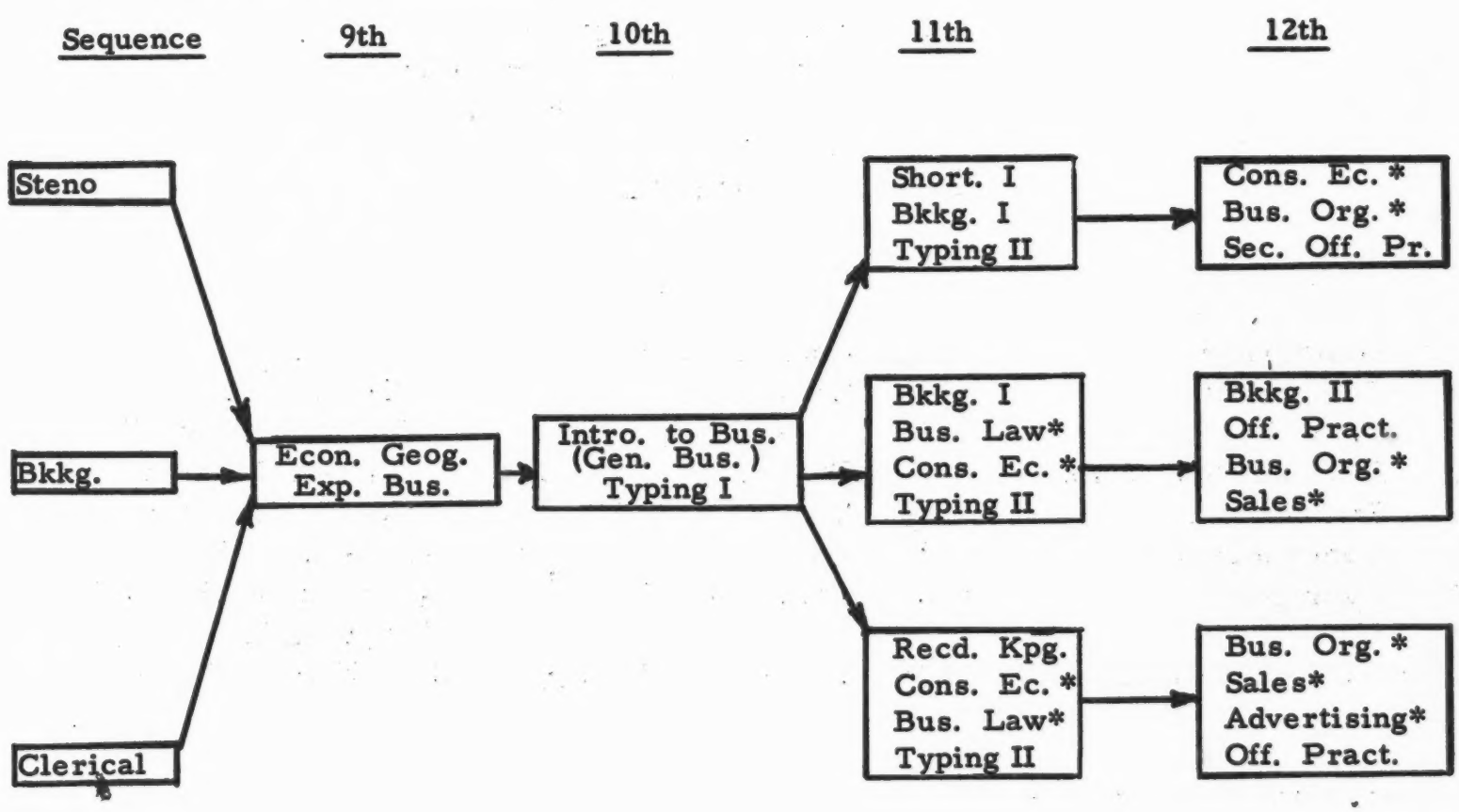
	Stenography		Bookkeeping		Clerical
5	English III	5	English III	5	English III
5	U. S. History II	5	U. S. History II	5	U. S. History II
1	Physical Education	1	Physical Education	1	Physical Education
5	Shorthand I	5	Bookkeeping I	5	Record Keeping
5	Bookkeeping I	$2\frac{1}{2}$	Business Law*	$2\frac{1}{2}$	Business Law*
$2\frac{1}{2}$	Typing II	$2\frac{1}{2}$	Consumer Econ.*	$2\frac{1}{2}$	Consumer Econ.*
		$2\frac{1}{2}$	Typing II	$2\frac{1}{2}$	Typing II
$23\frac{1}{2}$	TOTAL CREDITS	$23\frac{1}{2}$	TOTAL CREDITS	$23\frac{1}{2}$	TOTAL CREDITS

*one-semester courses

Grade 12

	Stenography		Bookkeeping		Clerical
5	Business English	5	Business English	5	Business English
5	Contemporary Gov't.	5	Contemporary Gov't.	5	Contemporary Gov't.
1	Physical Education	1	Physical Education	1	Physical Education
5	Shorthand II	5	Bookkeeping II	2½	Business Org. *
2½	Business Org. *	2½	Business Org. *	2½	Sales*
2½	Consumer Econ. *	2½	Sales*	2½	Advertising*
5	Sec. Off. Practice	5	Bkkg. Off. Practice	5	Cler. Off. Practice
26	TOTAL CREDITS	26	TOTAL CREDITS	23½	TOTAL CREDITS

HORIZONTAL ILLUSTRATION



(Illustration 1)

*one semester courses

MODEL BUSINESS EDUCATION SUBJECT SEQUENCES FOR HIGH SCHOOLS WITH AN OUT OF SCHOOL WORK EXPERIENCE PROGRAM (to meet the stenographic, bookkeeping, clerical, and distributive sequences)

Grade 9 (all business students)

5	English I
5	Economic Geography
1	Physical Education
5	General Science
5	Exploratory Business & Mathematics
2½	Electives
23½	TOTAL CREDITS

Grade 10

Stenography

5	English II
5	U. S. History I
1	Physical Education
5	Shorthand I
2½	Typing I
5	Bookkeeping I
23½	TOTAL CREDITS

Bookkeeping

5	English II
5	U. S. History I
1	Physical Education
5	Bookkeeping I
2½	Business Organization*
2½	Consumer Economics*
2½	Typing I
23½	TOTAL CREDITS

Clerical

5	English II
5	U. S. History I
1	Physical Education
5	Record Keeping (or Bkkg. I)
2½	Business Organization*
2½	Consumer Economics*
2½	Typing I
23½	TOTAL CREDITS

Distributive

5	English II
5	U. S. History I
1	Physical Education
2½	Introduction to DE*
2½	Business Organization*
2½	Consumer Economics*
2½	Typing I
2½	Electives
23½	TOTAL CREDITS

Grade 11

Stenography

5	English III
5	U. S History II
5	Shorthand II
1	Physical Education
2½	Business Organization*
2½	Consumer Economics*
2½	Typing II
23½	TOTAL CREDITS

Bookkeeping

5	English III
5	U. S. History II
5	Bookkeeping II
1	Physical Education
2½	Business Law*
2½	Sales*
2½	Typing II
23½	TOTAL CREDITS

Clerical

5	English III
5	U. S. History II
1	Physical Education
2½	Business Law*
2½	Sales*
2½	Typing II
5	Electives
23½	TOTAL CREDITS

Distributive

5	English III
5	U S History II
1	Physical Education
2½	Business Law*
2½	Sales*
2½	Advertising*
2½	Typing II
2½	Electives
23½	TOTAL CREDITS

*one-semester courses

Stenography

5	Business English
5	Contemporary Gov't.
1	Physical Education
10	Sec. Office Practice with Work Experience
21	TOTAL CREDITS

Bookkeeping

5	Business English
5	Contemporary Gov't.
1	Physical Education
10	Cler. Office Practice with Work Experience
21	TOTAL CREDITS

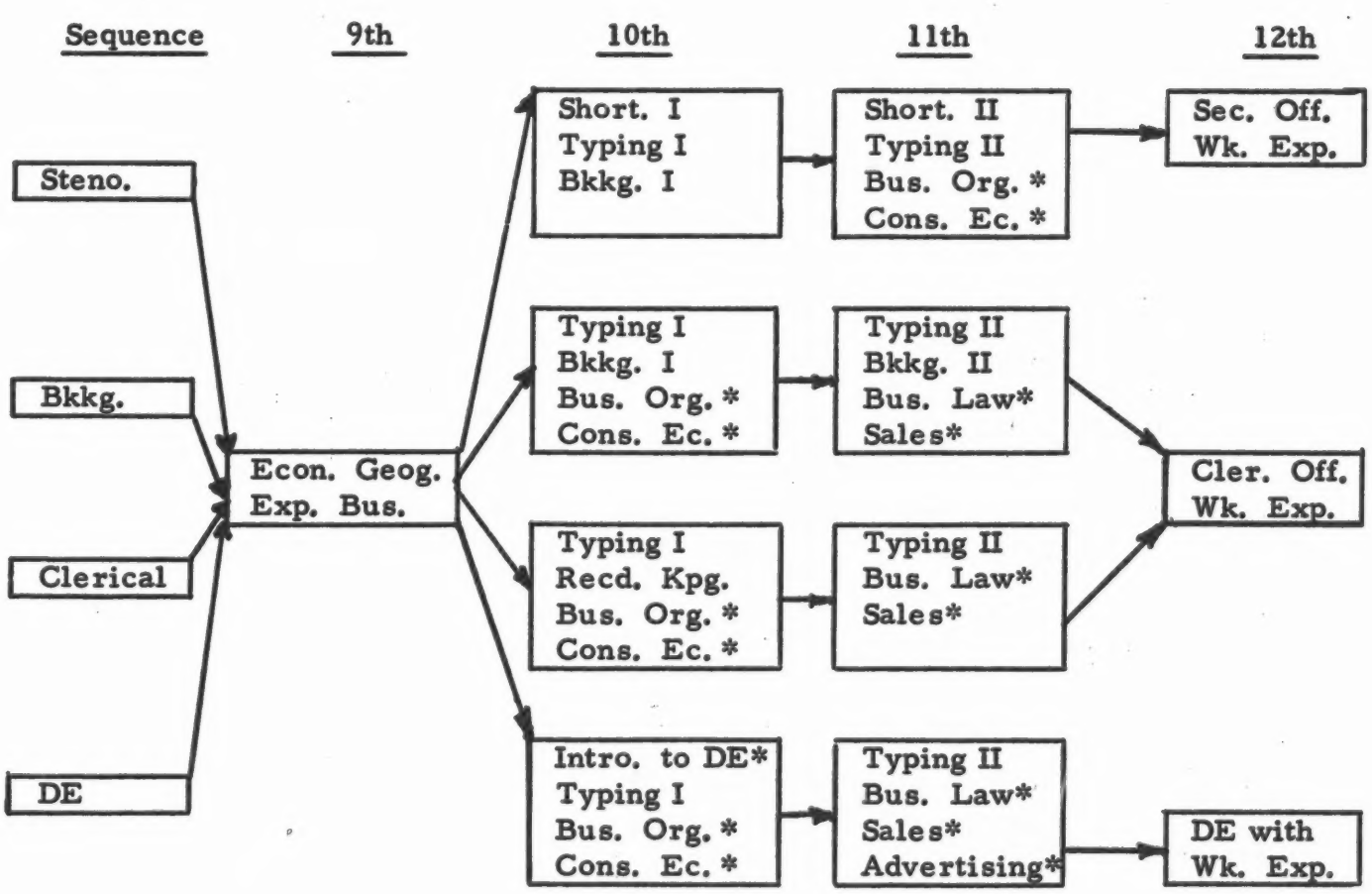
Clerical

5	Contemporary Gov't.
5	Business English
1	Physical Education
10	Cler. Office Practice with Work Experience
21	TOTAL CREDITS

Distributive

5	Contemporary Gov't.
5	Business English
1	Physical Education
10	Distributive Education with Work Experience
21	TOTAL CREDITS

HORIZONTAL ILLUSTRATION



*one-semester courses

(Illustration 2)

DESCRIPTION AND JUSTIFICATION OF SUBJECT MATTER

General Business Subjects

As was mentioned earlier, the primary role of the general business subjects is to give depth and understanding of our economic society in order that the student can become a productive and informed worker, citizen, and consumer. With this role in mind, the following brief course descriptions are offered for the general business subjects, along with justifications for grade placement.

Exploratory Business - a survey course for all ninth grade vocational students, designed to provide the student with an opportunity to experiment with business subjects which are offered later in the curriculum and to acquaint the student with the various career opportunities available in the fields of business and distributive education. Exploratory business is pre-vocational. Therefore, no standards of vocational competency should be used for grading purposes. The course is offered in ninth grade because it leads to all business and distributive subjects taken later.

Economic Geography- a general education course fundamental to developing an understanding of economics and of trade and industry in the local community, nation, and the world. The course should emphasize Man's way of earning a living. The course is offered in ninth grade (or tenth) because it is basic in understanding our economic society and the worker's role in this society. What has happened to economic geography over the years is, indeed, a shame. Business teachers, feeling highly incompetent in teaching the subject, have shoved it over to social studies departments, where for the most part, economic geography has either been dropped entirely or taught from a historical view rather than a current view. Economic geography is living, current, and dynamic if properly taught from up-to-date materials.

Introduction to Business - (General Business) - As the title implies, this course provides an introductory study of business. The course is truly general education for all students who will become active members of our business economy. The main objectives should be business education for personal use and developing an understanding of how businesses operate.

Further, the course can be used for developing occupational explorations if a course in exploratory business is not offered. Applied business mathematics should be integrated, but the emphasis should be on the general education objective rather than on developing a vocational mathematics. Introduction to business should be taught on the ninth or tenth grade level because it is a basic course in how business operates, and it is fundamental to the general business courses that follow.

Business Organization - a one-semester course, offered normally in eleventh or twelfth grade, but can be taught as early as tenth grade, dealing with why businesses are organized as they are. Opportunities are given to students to exercise judgements on such things as the role of the employer, employee relations, management, budgets, and government regulations pertaining to businesses. Potential workers should certainly know how businesses are organized in order to more fully understand their roles in business and everyday life.

Consumer Economics - a one-semester course which can be taught on the tenth, eleventh, or twelfth grade level, dealing with the general principles of buying as applied to various classes of consumer goods. Emphasis should be placed on economic problems that are encountered by the consumer such as installment buying, determining prices, personal budgeting, and agencies designed for the protection of the consumer. Teenagers have more money in their possession than ever before. It is imperative that they learn how to spend wisely in order to prepare for life in our economic society.

Business Law - a one-semester course in general business education normally offered in grades eleven or twelve. The primary emphasis should be on the basic principles of law which apply to the student in dealing with others in his everyday activities as a citizen and worker. The course is not designed to serve as a training ground for lawyers, but is designed to develop an understanding on the part of the individual of knowing one's rights according to the law and respecting the rights of others.

As you can readily see, the core of a model business education program is general education--those things all students should know; namely: general economic principles of our society (economic geography); career information and experimentation (exploratory business); the operation of business (general business); the organization of business (business organization); problems of the consumer (consumer economics); and the role of the citizen and the law (business law).

The Skill Subjects

The primary determining criteria of the grade placement of the skill subjects should be the nearness to the application of that skill to the work situation. You probably noticed earlier that where a work experience program is part of grade 12, the skills are offered earlier in the curriculum. Where there is not a work experience program, the skills are offered later in order that vocational competency will be obtained immediately before the student enters employment.

Typewriting I - (Beginning Typewriting) - Typing is basic to almost all business dealings. Practically all business correspondence and reports are typed or printed. Forms of typewriters are used as input devices for the most complicated types of electronic data processing equipment. All students with career objective in business should be encouraged to take at least one full year of vocational typewriting, with two years strongly recommended to develop adequate vocational competency. Typewriting I should serve as an introduction to vocational typing and typing for the personal use of the business student. Therefore, a separate course in personal typewriting should be offered to non-business students without emphasizing the vocational objective. Typewriting is normally begun in the tenth grade because it is the basic tool of the office worker. In Typewriting I, the student should learn the keyboard, including the numbers, by touch. He should learn how to type routine vocational and personal materials such as letters, simple tabulations, simple reports, and develop proper typing techniques. Emphasis should be placed on developing proper typing techniques rather than on developing complete vocational competency in production speed and accuracy.

Typewriting II - (Advanced Typewriting) - a full-year advanced course in typewriting designed to develop vocational competency as applied to the individual students of stenography, bookkeeping, clerical, and DE occupations. For the stenographic student, typewriting forms the finished product in transcription. For the bookkeeping student, it serves as a tool for preparing bookkeeping reports. For the clerical student, it serves as the primary tool of the office. For the De student, it serves as a tool for preparing sales reports and correspondence. Emphasis should be placed on actual production rather than on words per minute.

Bookkeeping I - (Beginning Bookkeeping) - a full-year course designed to introduce the student to the principles and applications of bookkeeping as applied to business and personal use. Not every student who takes bookkeeping will become a bookkeeper, but the knowledge be obtains will serve

as part of the total knowledge he needs. Bookkeeping is basic to all financial business records; therefore, it will be valuable not only to the bookkeeper, but to the typist, stenographer, clerical worker, and sales clerk. Complete mastery of Bookkeeping I is necessary to succeed in Bookkeeping II.

Bookkeeping II - (Advanced Bookkeeping) - a full-year course in advanced bookkeeping, designed to be wholly vocational in nature. With the rapid influx of automated accounting equipment, the student must not only learn how to keep neat and accurate records through the principles of the bookkeeping cycle, but he should understand the bookkeeping cycle through the eyes of automation and be familiar with the types of equipment used in the process.

Shorthand I - (Beginning Shorthand) - a one-year course designed to introduce the student to vocational shorthand. The primary emphasis should be placed on learning the principles and techniques of reading and writing shorthand effectively enough to progress on to advanced shorthand and transcription. Before progressing to advanced shorthand, the student should possess the necessary English skills and abilities and satisfactory typing achievement which would indicate the potential to succeed in producing mailable transcripts.

Shorthand II - (Advanced Shorthand) - an advanced, full-year course in vocational shorthand, designed to develop vocational competency in taking and transcribing shorthand. It should be understood that taking dictation well in itself does not develop proficiency in transcription. The student must know how to use the skills and knowledges acquired in typewriting and English communication. Emphasis should be placed on taking and transcribing shorthand rapidly and accurately.

Sales - (Salesmanship) - a one-semester skill subject, designed primarily for the DE student; but can apply to all business students as a general business course in the eleventh or twelfth grade. Emphasis should be placed on the principles and techniques of selling as applied to the retail sales clerk, service station employee, restaurant waitress, wholesale clerk, producer, etc. As most business educators will agree, all of us are salesmen in one respect or another. Being able to sell one's skills and abilities is just as important as selling another one's products. Opportunities for demonstrating sales techniques should be fully provided for in class.

Advertising - a one-semester course, offered in conjunction with sales and of primary interest to the DE student. Emphasis should be placed on the principles and techniques of advertising. This course is offered prior to starting DE work experience. Students should be taught the various media through which advertising is disseminated and be provided with career information about this dynamic field. Opportunities for demonstrating advertising techniques should be provided for in class.

Record Keeping - a one-year course, designed primarily for the clerical student who does not have the interest or potential to pursue the formal Bookkeeping I course. Emphasis should be placed on such topics as cash records, merchandising, payroll, banking, and personal income tax. Record Keeping should provide the student with an elementary knowledge of the simple recording activities and mathematics of business and personal life.

Secretarial Office Practice - the final course on the high school level which prepares the stenographic student for work. Emphasis should be placed on real work situations and the student should be completely vocationally competent as a beginning stenographer upon completion of the course. The instruction should include the use of office appliances, care of office supplies, and the development of proper work habits and personality. Where possible, the class can serve as the coordinating headquarters of the work experience and job placement programs. Standards of achievement should be based upon the standards of the employing community.

Clerical Office Practice - the final course on the high school level which is designed to prepare the clerical worker for beginning employment. The instruction should include the use of office equipment found in the employing community, care of supplies, and the development of proper work habits and personality. Some schools provide the bookkeeping student with the opportunity to enlarge his knowledge through the use of special materials obtained from the employing community. As in secretarial office practice, the class may serve as the headquarters for the work experience and job placement programs.

Distributive Education with Work Experience - designed as the coordinating class for DE students. Occupational information is provided, development of work habits and business personality, use of cash register and other sales appliances is learned, and special individual and group instruction is given to coordinate the work experience and job placement programs.

Other Subjects

English Skills - It might seem elementary to mention that English is the major method of communication in our society--oral and written. Yet, with four years of "English" in the high school curriculum, it is a well known fact that employers constantly complain that their office personnel cannot spell, punctuate, make sense in writing business correspondence, or speak effectively. Perhaps, English instruction for the business student should be more vocationally oriented with separate classes for the business student for the entire four years. It may be that emphasis should be placed on writing effective business communications rather than on theme writing. It is possible to have the student read the works of businessmen and economists and make oral and written reports rather than emphasizing other forms of literature. Maybe, grammar, spelling, and sentence structure can be developed through constant use of a vocabulary that is inherent to the businesses within the employing community. It is strongly recommended that business teachers and English teachers work together to formulate a fruitful program of English instruction for the business student.

Social Studies - In the social studies courses, the student should develop an understanding of political institutions, economic systems, cultural ideals, and the duties and obligations of good citizens. Social studies should deal with the past, present, and future. Although the past of our society is important, perhaps more emphasis should be placed on the present and the future as this is when our students are living and going to live. Business teachers and social studies teachers should work cooperatively to establish courses of study which reflect current concepts of political and economic systems.

Physical Education - should be a well organized program of physical activity which will help the student develop physically, mentally, socially, and emotionally. Opportunities for expressions of good citizenship should be reflected in such things as sportsmanship, school spirit, and fair play.

Music, Art, & Crafts - should be culturally oriented courses that can lead to appreciation, participation, and self expression in creative activity. Instruction in these courses should be developed so that the student is made aware of some of the occupations available to talented individuals in the fields of retailing, merchandising, and advertising.

As you can see, the above subjects all contribute to a student's general knowledge and well being. Each is as important as the next if the emphasis is kept in line with the objectives.

ELEMENTS OF A SOUND BUSINESS EDUCATION PROGRAM

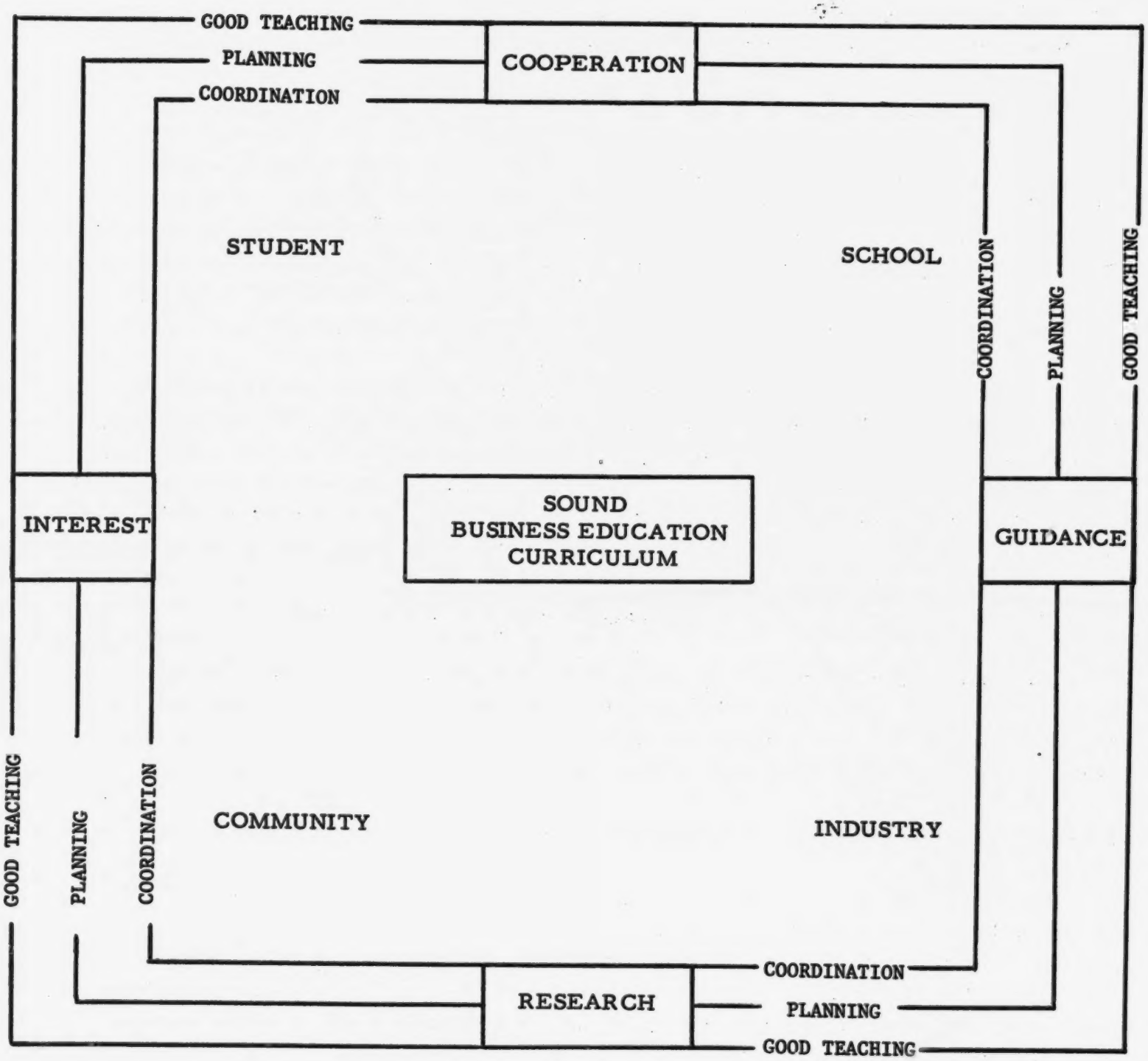
The elements of a sound business curriculum must take into consideration the student, community, industry, and the school: the student, because he and his career objective are of primary importance; the community, because that is where the student is going to live; industry, because that is where the student is going to work; the school, because that is where the student is going to learn how to live and work.

In order to make the elements of a sound business curriculum effective, the school must have the interest and cooperation of the student, community, and industry. Industry must have the interest and cooperation of the student, community, and school to obtain effective workers. The community needs the interest and cooperation of the school and industry to train and employ its youth. The students need the interest and cooperation of the community, industry, and school because that is where they are going to live, work, and learn how to live and work.

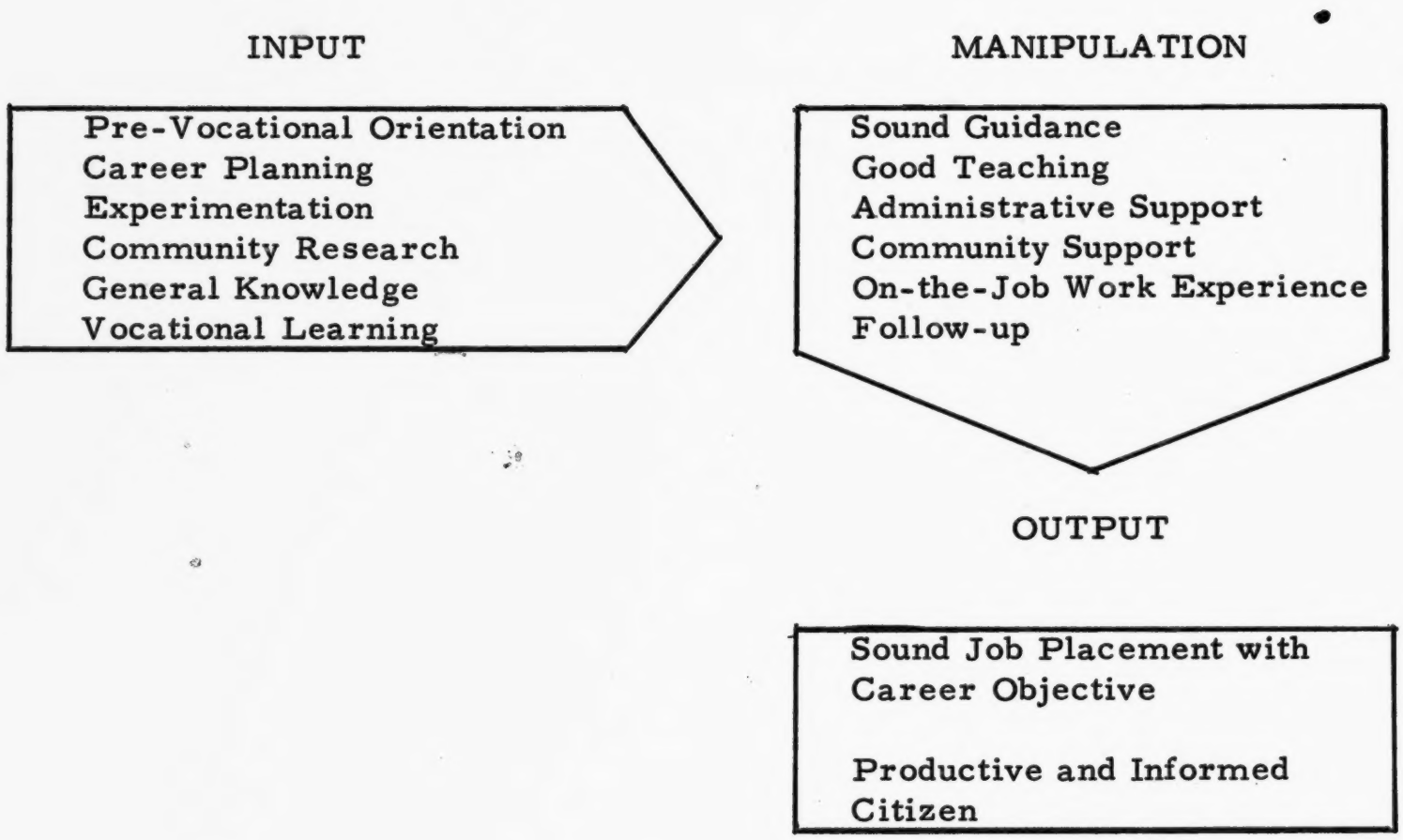
All of these elements require a well-coordinated plan of guidance and community research. The curriculum must be accomplished through the planning of all concerned and held together with a sound balance of good teaching. (See Illustration 3 on page 22)

ELEMENTS OF CAREER PREPARATION

Business educators must realize that the most important product of the school is its students. Sometimes, in the course of supply requests, budget defeats, equipment orders, and collecting milk money, there is a tendency to forget the student--particularly the business student--except when administrators or other teachers need a wide variety of materials typed and duplicated. Expressed in the following illustration is simply what the school should be striving for in student career preparation.



(Illustration 3)



(Illustration 4)

THE SLOW LEARNER

Throughout this booklet, it appears that the primary area of concern has been with the "normal student." What about the slow learner? Is there a place in vocational education for him? The answer is obviously, "yes."

First of all, slow learners may be slow learners for a number of reasons--for example: illness, absence, home problems, physical limitations, mental limitations, just plain lack of interest, etc. Perhaps the best step would be on the part of the school to determine what the individual's reason for slow learning is and work from there. After the individual's reason is determined, special individual and/or group instruction can be given through remedial classes, special laboratory classes, or home instruction. If it is determined that it will be impossible to attain the student's original career objective, a revaluation of this objective must be made and more realistic goals established. Many jobs in business do not require the mind of Einstein or the physical dexterity of Hercules. Students who are slow learners should be directed toward occupations which they can handle. Attached as ANNEX "I" is an example of a special program designed for the slow learner in a school system in Morris County, New Jersey, developed in 1966.

BUSINESS EDUCATION PROGRAMS FOR SMALL HIGH SCHOOLS

Obviously, the small high school that offers business education (one or two teacher departments) cannot possibly provide all the business education offerings and services which would be inherent to a large school, and it is very doubtful that complete vocational competency could be achieved. Limitations such as space, time, equipment, enrollment, teaching personnel, expenses, etc. mean that the business education program to be offered would include only those offerings which appear practical to most students. Therefore, the emphasis would be more on general education rather than on business education. Perhaps it would be practical to offer introduction to business (general business) and consumer economics as the general business education subjects and typewriting as the skill subject. As was mentioned earlier, introduction to business is fundamental to understanding how business works and that it serves as a primary introduction to understanding our economic society. Probably the most active part of a citizen's life is working for his earnings and spending those earnings. In this light, consumer economics would seem most practical. Typing is the basic tool for practically all business offices. Therefore, it would seem desirable to offer typewriting as the major skill subject. The nature of the employing community would determine the other general business and skill subjects.

The business education subject offerings for a typical one-teacher department might include:

Grade 10	Grade 11	Grade 12
Intro. to Business	Consumer Economics*	Typing II
	Typing I	Office Practice
	Sales*	

The business education subject offerings for a typical two-teacher department might be:

Grade 9	Grade 10	Grade 11	Grade 12
Intro. to Business	Consumer Econ. *	Bus. Organization*	Off. Pract.
	Sales*	Bus. Law*	Short. II
	Typing I	Typing II	Bkkg. I
	Bus. English	Short. I	

*one-semester courses

Notice that the teacher (s) involved would have five separate lesson preparations per day, and that any other subject offerings would render preparing for such a day practically impossible, or at least raise a question as to the quality of instruction.

BUSINESS EDUCATION AND THE COLLEGE STUDENT

All business educators will agree that the primary purpose of a business education program is not to prepare students for college. However, provision must be made for those business education students, who possess the desires and abilities, to meet the necessary requirements for entrance into higher learning in order that they may major in business or distributive education. In reviewing the model business education sequences illustrated previously, one can see that the social studies, physical education, and English subjects are required by all business students as well as all college preparatory students. If college requires some form of advanced mathematics and foreign language, up to two years of each can be worked into the business student's schedule as late as grade 11. The student may also be enrolled in the regular college preparatory history and English classes. Further, due to the fact that the student plans on attending college, it would not be necessary for him to participate in work experience.

On the following page is an illustration of a high school subject sequence for business education students which can meet the minimum requirements for many colleges.

For those colleges that require only one year of a foreign language and one year of advanced mathematics, the student's schedule would be much more flexible and the student could decide as late as grade 12.

It must be mentioned here that even if the student followed the entire model business education program without any advanced mathematics and foreign languages, there would still be opportunities for him to attend college and eventually be enrolled in a degree program. Many colleges will initially enroll the business graduate as a special student until he meets the necessary minimum requirements. This generally means that the student enrolls in the evening division and attends college part time. After the minimum requirements are met, it is possible to attend full time and be matriculated in a degree program. Further, some students may not desire to take a full four-year college program. Good business students are readily accepted into two-year business education programs in colleges and junior colleges which can lead to an Associate of Arts Degree.

Career Objective Known in Ninth Grade

9th Grade		10th Grade		11th Grade		12th Grade	
5	World Hist.	5	US Hist. I	5	US Hist. II	5	Cont. Gov't.
5	English I	5	English II	5	English III	5	English IV
1	Phys. Ed.	1	Phys. Ed.	1	Phys. Ed.	1	Phys. Ed.
5	Algebra I	5	Pl. Geom.	2½	Typing I	2½	Typing II
5	Gen. Sci.	5	Biology	5	Short. I	5	Short. II
5	Language I	5	Language II	2½	Cons. Ec. *	5	Bkkg. I
				2½	Bus. Org. *		
26	TOTAL CRS.	26	TOTAL CRS.	23½	TOTAL CRS.	23½	TOTAL CRS.

Career Objective Known in Tenth Grade

9th Grade		10th Grade		11th Grade		12th Grade	
Regular order of Business Subjects		5	English II	5	English III	5	English IV
		5	US Hist. I	5	US Hist. II	5	Cont. Gov't.
		1	Phys. Ed.	1	Phys. Ed.	1	Phys. Ed.
		5	Algebra I	5	Pl. Geom.	5	Bkkg. I
		5	Biology	5	Language I	5	Language II
		2½	Typing I	2½	Typing II	5	Short. I
		23½	TOTAL CRS.	23½	TOTAL CRS.	26	TOTAL CRS.

Career Objective Known in Eleventh Grade

9th Grade	10th Grade		11th Grade		12th Grade	
Regular order of Business Subjects in Work Experience Sequence				5	English III	5	English IV
				5	US Hist. II	5	Cont. Gov't.
				1	Phys. Ed.	1	Phys. Ed.
				2½	Typing II	5	Short. II
				5	Algebra I	5	Pl. Geom.
				5	Language I	5	Language II
				23½	TOTAL CRS.	26	TOTAL CRS.

*one-semester courses

In New Jersey, many businesses and industrial organizations will pay part or all of the costs involved in post high school learning. This is particularly true of the "Equal Opportunity Employers" in the State. Reimbursement for tuition, books, and/or transportation ranges from 25 to 125 per cent depending upon the organization and the courses pursued. Business students must be made aware of the opportunities that exist for them within their own employing community.

SUMMARY

The effectiveness of any business education program can be measured only by seeing how its students prosper as effective workers, citizens, and consumers in our society. In order that this effectiveness can be achieved, it must be realized that there are two major objectives for business education:

1. to provide the student with the general business knowledge which is inherent to his everyday living;

2. to prepare the student to be vocationally competent in his business career.

To attain these objectives requires the combined resources and cooperation of the school, community, student, and industry. Patterns and sequences of study must be designed to meet the needs of the individual student, as well as all students, regardless of how high or low his intelligence and ability ratings may be, while keeping in mind the nature of the community and the requirements of industry. Provisions must be made and maintained to educate as fully as possible all students in the business education program. This requires continuous study of the school, student, community, and industry; expert planning, teaching, and guidance; provision of up-to-date facilities; job placement and follow-up of all graduates; and the interest and cooperation of all parties involved. To deprive the business student of proper business education is to deprive him of the essentials of everyday living.

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ANNEXES

ANNEX "A"

SAMPLE

BUSINESS EDUCATION CURRICULUM PLANNING QUESTIONNAIRE

PURPOSES OF SURVEY

1. To become better informed to trends in the local business community.

2. To become acquainted with the desires of industry in relation to the curriculum of our school.

3. To assist the school in developing a program of Business Education which meets the needs of the employing community.

4. To provide a guide for assisting our students in developing a sense of direction and guidance toward the desirable traits which may assist them in being successful in the business world.

5. To provide one of several guides for our future plans in the development of our Business Education Program.

RANDOLPH HIGH SCHOOL
Millbrook--Mt. Freedom Road
Dover, New Jersey

BUSINESS EDUCATION CURRICULUM PLANNING QUESTIONNAIRE

Please answer the following questions in the manner indicated.

1. What is the nature of your business? _____

2. What designated positions do you normally have in your business office? _____

_____

3. Please rank in the order of their importance to your business office the following English language skills: (1, 2, 3, 4, 5)

_____a. Grammar _____c. Written Composition

_____b. Spelling _____d. Oral Usage _____e. Vocabulary

4. Do your new employees who have recently graduated from high school possess the basic arithmetical and computational skills needed for success on the job in your business? (Check one)

_____a. Yes
_____b. No

5. Please rank in the order of their importance to your business office the following arithmetical concepts: (1, 2, 3)

_____a. Common Fractions
_____b. Decimal Fractions
_____c. Percentage

6. Indicate how these arithmetical concepts are applied in your business. For example: discounts, interest, commissions, etc.

_____

_____

7. Please check: Does your office mainly use electric typewriters ____ manual typewriters ____?

Do you want your new office employees to know how to type on the electric typewriter? _____a. Yes _____b. No

RANDOLPH HIGH SCHOOL
BUSINESS EDUCATION CURRICULUM PLANNING QUESTIONNAIRE

8. Please indicate your minimum speed requirements for:
   a. Shorthand: _____ words per minute for _____ minutes
   b. Typewriting: _____ words per minute for _____ minutes

9. Underline the types of machines you would like high school graduates entering your business office to be proficient in using:

   Ten-key adding; Full-bank adding; Printing calculator; Rotary calculator; Comptometer; Simple bookkeeping; Dictating; Mimeograph; Spirit duplicator; Photo-copier; Micro-film; Addressing; Keypunch; Other _____
   List the three machines you consider most vital:
   a. _____
   b. _____
   c. _____

10. Have you found that the filing systems commonly taught in the high school adequately prepare students to handle your filing system?
   _____a. Yes Please explain: _____
   _____b. No _____

11. Do your new employees need extensive training in office procedures and routines? Please explain: _____
   _____a. Yes _____
   _____b. No _____

12. Are your new employees adequately trained in the proper use of the telephone?
   _____a. Yes Please explain: _____
   _____b. No _____

13. Even though a new employee may not perform a record keeping job, do you believe he should have had bookkeeping in high school?
   _____a. Yes Please explain: _____
   _____b. No _____

RANDOLPH HIGH SCHOOL
BUSINESS EDUCATION CURRICULUM PLANNING QUESTIONNAIRE

14. Do you feel that your new employee should have a broad background in business subjects such as sales, advertising, business law, economics, business organization and management, marketing procedures, and communications?

_____a. Yes Please explain: _____
_____b. No _____

15. Does the new employee tend to utilize his work time wisely?

_____a. Yes Please explain: _____
_____b. No _____

16. Do your new employees come to you with adequate training to practice good housekeeping habits?

_____a. Yes Please explain: _____
_____b. No _____

17. Below is a list of factors which tend to lead to success on the job. Please underline those which you feel the schools could stress to a greater degree in preparing students for the business world.

cooperation; interest and inquisitiveness; pleasant personality; neatness in appearance and work; friendly attitude toward fellow workers; willingness to assume responsibility; comprehension of work assignments with a minimum of explanation, willingness to review one's own work for errors; ability to accept honest criticism by supervisors; poise; capable of using independent judgment; punctuality; other _____

18. What traits do you look for in the personal interview? _____
_____
_____

19. As automation processes move into the business office, do you feel that there is a need for a new approach to the high school business program?

_____a. Yes Please indicate the changes you would recommend:
_____b. No _____
_____

PLEASE INCLUDE ANY FURTHER COMMENTS ON THE REVERSE SIDE OF THIS SHEET

RANDOLPH HIGH SCHOOL
RANDOLPH TOWNSHIP, NEW JERSEY

RESULTS AND CONCLUSIONS
BUSINESS EDUCATION SURVEY

1. That generally speaking, businessmen in this area feel that spelling and grammar are the most important language skills.

2. That most new employees possess the basic arithmetic and computational skills.

3. That computing percentages is the arithmetical process most important and that this process is applied primarily in computing discounts and commissions.

4. That business in this area uses primarily electric typewriters and that the majority of employers prefer that new employees be trained in the use of electric typewriters.

5. That the minimum speed requirements for shorthand and typewriting were so varied that the results could not be justifiably computed.

6. That the business machines most commonly used are the rotary calculator, simple bookkeeping, ten-key adding, dictating machine, keypunch, mimeograph, and spirit duplicator.

7. That new employees need more training in the use of the telephones.

8. That a knowledge of alphabetical and numerical filing is necessary.

9. That there is a need for a new approach to business education in regard to automation.

10. That neatness, personality, alertness, and job knowledge are the four most important traits looked for in an interview.

ANNEX "B"

SAMPLE

BUSINESS EDUCATION FOLLOW-UP QUESTIONNAIRE

RANDOLPH HIGH SCHOOL
Randolph Township, New Jersey

Office of the Job Placement Coordinator
Business Graduate Follow Up

(name) _____ (home address) _____

(phone) _____

(year of graduation from R H S _____

(employer's name & address _____ (name of immediate supervisor _____

(your phone number at work) _____

(your job title) _____ (describe duties performed) _____

Name other schools or colleges you are now attending _____

Name the subject or subjects taken at RHS that appear to be of most value in your job. _____

Name the subject or subjects taken at RHS that appear to be of least value in your job. _____

Please check your weekly salary range ☐ $40--$50, ☐ $50-$60,

☐ $60--$70, ☐ $70--$80, ☐ $80--$90, ☐ over $90

Feel free to use the other side of this sheet for any comments which you think would be helpful.

ANNEX "C"

RECOMMENDED COOPERATIVE WORK EXPERIENCE PROGRAMS

RECOMMENDED COOPERATIVE WORK EXPERIENCE PROGRAMS

for

Rancocas Valley Regional

High School

Mount Holly, New Jersey

by

David N. Fletcher, B. S. Ed.
Rider College, Trenton

John A. Millard, B. S. Ed.
Rider College, Trenton

INTRODUCTION

The author's introduction to this report shall serve a two-fold purpose. The first is to briefly explain the history of work experience since 1900. The second will be to explain the limitations of the report.

The first work experience program was started by Herman Schneider in 1906 at the University of Cincinnati. This program was open to students in the Trades and Industries curriculum. Students enrolled in this program would attend classes at the University for one week and then work in cooperating industries for one week.

Work experience appeared in the secondary public school in 1908. York, Pennsylvania, initiated a cooperative program in trades and industry patterned after the one at the University of Cincinnati. Students attended school two weeks and worked in cooperating businesses for a two week period. A similar program was introduced in Fitchburg, Massachusetts, the same year. Work experience was limited to one week in school and one week on the job.

Federal legislation has played an important part in the development of cooperative work experience programs. The Smith-Hughes Act of 1917 provided federal funds for vocational programs in Trades and Industries, Home Economics, Agriculture, and Diversified Commercial Occupations.

The George-Deen Act of 1936 ammended the Smith-Hughes Act by changing the name Diversified Commercial Occupations to Distributive Occupations. A specific appropriation of 1.2 million dollars was made for Distributive Education. Funding was continued for the other three programs.

In 1946 the George-Deen Act was superseded by the George-Barden Act. This act continues funding the four programs covered in the George Deen Act, but increased to 2.4 million dollars the funds available for Distributive Education.

Congress passed the Manpower Development Training Act in 1962 and provided federal funds for:

a) Unemployed
b) Partially employed
c) Persons with obsolete skills
d) Persons displaced because of automation
e) Persons 16 years old but not 22 and in need of occupational training and further schooling

These funds are available in the following areas; Trades and Industries, Distributive Education, Business Education office occupations, and any vocational education program.

In 1963, the public high school received funds under the Vocational Education Act of 1963. Funds were provided under this act to pay for buildings, materials, equipment, grants, salaries, and state administration of the program.

This is the history of work experience, but our needs are here in the present. We are faced with a drop-out problem which is important to us all. The need for unskilled workers is declining while business demands for skilled workers is increasing. We as educators must be aware of this change and prepare our students accordingly.

If we are able to do this we will better meet the needs of the community and the student. We should also be better able to control the drop-out problems in our school.

The authors included in the original survey, questions pertaining to the Trades and Industries curriculum and Vocational Home Economics curriculum. Since the authors lack the vocational knowledges necessary to develop and evaluate these two programs, this information has been delimited from the report.

It is believed, by the authors, that students in Vocational Home Economics and students in the Automotive Shop could possibly be employed in a cooperative work program through the Distributive Education program.

SUBSTANTIATION OF PROPOSED

PROGRAMS IN THE COMMUNITY

RANCOCAS VALLEY REGIONAL HIGH SCHOOL
JACKSONVILLE ROAD
MOUNT HOLLY, NEW JERSEY
08060

FREDERICK W. EVANS
SUPERINTENDENT

HARRY E. WENRICH
PRINCIPAL

ROBERT C. SHINN
DISTRICT SECRETARY

March 7, 1966

Dear Sir:

This survey is being conducted to establish the need for an expansion of the curriculum of Rancocas Valley Regional High School to include a Cooperative Work Experience Program. Such a program requires the combined efforts of the school, its students, and you, the local businessman.

Students enrolled in the proposed program will attend school part time and work in cooperating businesses part time at an actual job. A member of the high school faculty will plan and supervise this on-the-job training program in cooperation with the employer.

This study is being conducted to determine the feasibility of such a program. To assist us in this survey, will you please complete the enclosed forms and return them to us. A self addressed envelope is enclosed for your convenience.

Respectfully yours,

BUSINESS EDUCATION DEPARTMENT

John A. Millard
David N. Fletcher

John A. Millard
David N. Fletcher

Enclosures

RANCOCAS VALLEY REGIONAL HIGH SCHOOL
JACKSONVILLE ROAD
MOUNT HOLLY, NEW JERSEY
08060

FREDERICK W. EVANS
SUPERINTENDENT

HARRY E. WENRICH
PRINCIPAL

ROBERT C. SHINN
DISTRICT SECRETARY

RESPONSIBILITY OF THE ADVISORY COMMITTEE

The cooperative program is a joint understanding on the part of the school and the businessman. An advisory committee, composed of school and business people, serves to bridge the interests of the school and the business community. It is the purpose of this committee to assist in establishing a desirable and proper environment for the cooperative program. It could be helpful in developing the interest, support and cooperation of the businessman. The responsibility the committee may assume could include the following:

a. Aid in the development of standards for both school and on-the-job training.

b. Aid in developing course content.

c. Aid in setting up school-employer agreements.

d. Aid in developing new training stations.

e. Aid in developing a sound public relations program.

WORK EXPERIENCE SURVEY

Please Check the Appropriate Answer	Yes	No
1. Would you be willing to use one or more cooperative work students:	☐	☐
2. Would you accept female students?	☐	☐
3. Would you accept male students?	☐	☐
4. In which of the following areas would you be willing to employ students?		
a. Clerical occupations--(non-stenographic)--which includes Typing, Filing, 10 Key Adding Machine, Full-Bank Adding Machine, Rotary Calculators, Duplicating Equipment, Voice-Transcription Equipment, and Related Record Keeping Processes	☐	
b. Secretarial occupations--includes all of the above plus skills in Shorthand and Transcription	☐	
c. Distributive occupations--includes Retailing, Stock handling, Inventory control, Advertising and Display	☐	
d. Trades and Industry		
Graphic Arts--relief and offset printing, screen process, rubber stamp, and photography.	☐	
Metals--machine shop, foundry, sheetmetal, welding, forging	☐	
Wood--cabinet work, carpentry.	☐	
Power Mechanics--small gas engines, auto mechanics-(Trouble Shooting and Repair)	☐	

	Yes	No
Electricity--house wiring, circuitry, basic electronics	☐	
Drafting--machine, architectural, reproduction	☐	
e. Vocational Home Economics		
Child Care Aides--Assist small children	☐	
Waitressing.	☐	
Food preparation specialist--Dietary aides, Kitchen assistants	☐	
Fabric and Clothing sales	☐	
Housekeeper aides--Housekeeping assistants	☐	
Power machine operation--factory machines such as sewing machines, etc.	☐	
5. Would you be able to provide a training program which provides the student with several varieties of work experience which is acceptable to the high school Training Program?	☐	☐
6. Would you permit regular supervision (at least once every two weeks), at your place of employment, by the Teacher-Coordinator employed by the school?	☐	☐
7. Would you be a party to a written agreement with the school accepting the conditions of this training plan?	☐	☐
8. Could you provide a minimum of fifteen hours of part-time work per week, as required by the school?	☐	☐
9. Would the compensation given cooperative work experience students be equal to that given beginning workers possessing the same skills?.	☐	☐

	Yes	No
10. Would you be willing to be a member of an Advisory Council? (See explanation on separate sheet)	☐	☐
11. If you cannot employ a student now, would you be able to use one later?	☐	☐

Signature _____

Name of Business _____

Address _____

Telephone Number _____

TABULATION OF RESULTS ON ORIGINAL SURVEY

On March 7, 1966 the survey was sent to 285 businesses and industries within a 15 mile radius of Mount Holly. The tabulation of these results was completed March 31, 1966.

The results of the survey are as follows.

a) 157 questionnaires were returned. This represents 53. 3% of all those sent.

b) 62 of these questionnaires indicated that the firm involved had gone out of business or moved, therefore the tabulation is based on 95 respondents.

c) 48% or 45 of the remaining businesses displayed an interest in the cooperative work experience program.

d) 21 firms indicated they would employ either male or female employees or both. 25 indicated they would employ female only and 23 stated male only.

e) The areas of interest were as follows.

1) 21 businesses in Clerical areas
2) 14 businesses in Stenography areas
3) 9 businesses in Distributive Education areas
4) 9 businesses in Trade and Industry areas

f) 12 employers agreed to form an Advisory Council.

g) 66% or 30 indicated they were willing to pay minimum wages required.

h) All indicated they wished additional information

Those businesses saying no to cooperative work experience had the following reasons.

a) age requirements for employment
b) insurance problems
c) business was too small

PURPOSE

The fundamental purpose of the cooperative work experience program in Rancocas Valley Regional High School is to adequately prepare each student for successful employment in an occupational field of his choice. It is hoped the trainee will develop vocational competence in the type of work in which he has an interest, and will have the opportunity to explore related occupations. Occupational intelligence developed as a result of his part-time work should favorably affect his future employment.

Engaged in such a program, the student should learn to develop a new sense of responsibility as he becomes cognizant that his role is an integral part of the total operation of the employing organization. The trainee will recognize that tasks are assigned to be completed within a reasonable period of time--often within established deadlines. Just as important for the student to learn, is the concept of developing a harmonious relationship between himself and his fellow employees, as this is usually essential for maximal production.

It seems apparent that related classroom instruction would be most beneficial for the trainee, as this would permit the student to resolve all problems raised in relation to his on-the-job training. Thus, students are presented with additional incentives to complete this schooling as the need for skills and knowledge becomes more evident.

Likewise, the school is also a benefactor of the values derived from the cooperative education program as business and industry place their facilities at the school's disposal. Consequently, mutual community benefits and improved relationships between the school, business, and industry are also provided. This places the school in a more favorable position to meet the needs of the young men and women of the community, through a functional, cooperative work-experience program.

OPINION SURVEY FOR HIGH SCHOOL TEACHERS

A work experience program is a cooperative work training program worked out jointly by the school, its students, and local business men. It would mean that students would be attending school part-time and working downtown in a business or industrial position part-time. Only non-academic seniors would be qualified for enrollment in this course and it would be supervised not only by the employer but also by a high school work experience supervisor. A well-rounded training program would be afforded enrollees to enable them to be better prepared for a job upon completion of high school. Each trainee will have contained in his schedule the required courses of physical education, history, and English along with the specialized courses in his major field. The student would spend a minimum of 15 hours per week at an established training station after completing his morning classes.

---

1. Do you feel that a program of this type would be beneficial to the students involved? YES___ NO___

2. Would you be willing to cooperate in an advisory capacity? YES___ NO___

3. Would you like to see such a program initiated into the school curriculum at Rancocas Valley Regional High School YES___ NO___

4. Please make any comments or suggestions that you might have in the space below:

TABULATION OF RESULTS ON TEACHER SURVEY

On March 28, 1966 the survey was sent to 91 teachers in Rancocas Valley Regional High School of Mount Holly. The tabulation of these results was completed April 1, 1966.

The results of the survey are as follows.

a) 65 questionnaires were returned. This represents 71.3% of all those sent.

b) 98.4% or 64 respondents feel that a program of this type would be beneficial to the students involved.

c) 78.4% or 51 members would be willing to cooperate on an advisory committee.

d) 98.4% would like to see such a program initiated into the curriculum at Rancocas Valley Regional High School.

PLEASE READ AND COMPLETE THE ATTACHED QUESTIONS

(The questionnaire need not be signed.)

A work experience program is a cooperative work training program worked out jointly with the school, student and businessman. It would mean that you would be attending school part-time and working down town in a business position part-time. Your work would be supervised by your employer and a high school work experience supervisor. A well-rounded training program would be afforded you to be better prepared for a job upon completion of high school.

STUDENT SURVEY

1. In the event such a program were to be established at Rancocas Valley Regional High School, would you enroll in the course?

   YES____ NO____

2. Do you think your parents would give permission for your enrollment in such a course?

   YES____ NO____

3. In which area would you be interested?

   BUSINESS EDUCATION_____
   DISTRIBUTIVE EDUCATION_____
   TRADES AND INDUSTRIES_____
   HOME ECONOMICS_____

4. MALE_____ FEMALE_____ AGE_____

5. Would transportation be available for you in order to get to work and return home?

   YES____ NO____

TABULATION OF RESULTS ON STUDENT SURVEY

On April 4, 1966, 154 non-academic sophmore students were surveyed in their homerooms. The results of this survey are as follows.

a) 154 questionnaires were returned. This represents 100% of those sent.

b) 142 or 92% of the students indicated they would enroll in a program of this type if it were established in the school.

c) 95% or 147 students thought that their parents would be in favor of such a program.

d) Students were interested in the following areas:

1. Business Education-49% or 74 students
2. Trades and Industries-27% or 41 students
3. Distributive Education-13% or 20 students
4. Home Economics-5% or 8 students
5. 6% or 9 students were undecided about an area of interest.

e) There were 76 male and 78 female students surveyed.

f) The average age of the students surveyed was 16.

g) 58% or 89 students had transportation provided for them.

RESPONSIBILITIES

AND

DUTIES

DUTIES AND RESPONSIBILITIES OF THE PARENTS

Parental interest and cooperation is a vital part of this program. Parents therefore must understand the purpose and the value of such a plan.

The parent can be utilized in this program by impressing upon his son or daughter the importance of regular and faithful attendance not only in school but on the job. The parent should also understand the importance of this program and be consistent in his encouragement of good trainee participation. As a result, the parent is an integral part of the cooperative work program.

All trainees must present written parental permission to participate in the cooperative work program before the application can receive final approval.

DUTIES AND RESPONSIBILITIES OF THE EMPLOYER

When the trainees are placed by the coordinator the following duties and responsibilities of the employer should be clearly outlined and reviewed once again:

1. The employer must ensure that the trainees have fulfilled all legal requirements, i. e., social security, working papers, etc.

2. The employer should understand that the trainee will be paid for his services at the going wage.

3. The amount of time that the trainee will devote to his job must be understood by the employer. The minimum amount required by the school will be fifteen (15) hours per week. Any additional hours can be decided between the employer and trainee with proper notification to the coordinator.

4. The employer must be willing to grant the trainee the same employee benefits as are available to other part-time employees.

5. The employer must be willing to keep the minimum records needed by the coordinator.

6. The employer must be able to devote sufficient time to develop trainee potentials.

7. The employer must be willing to assist the coordinator in making periodic appraisals of the student's performance on the job.

8. The employer must be willing to orient the trainee to his new job. This should include explanation of time and place for work, where personal articles may be kept, introduction to co-workers, how to locate other departments, company rules and the method of salary payment with an explanation of payroll deductions.

SELECTION OF WORK STATIONS

Selection of appropriate employment opportunities for the trainees in the cooperative program should be made on the basis of the following criteria:

1. Only progressive business establishments should be considered.

2. The business should provide a well-rounded learning experience for the trainees.

3. The work station should feature employees of high moral character.

4. It should be a clean place to work.

5. It should provide the maximum safety measures.

6. The work station should be conveniently located to the school and home of trainee.

7. The employer should be able to devote sufficient time to give proper supervision.

8. The work station should be able to prepare trainees for full time responsibilities and contribute to career preparation.

9. The employer should be one of understanding with a definite interest in the training program and should not exploit the trainee.

BUSINESS / DISTRIBUTIVE EDUCATION
WORK EXPERIENCE PROGRAM

Rancocas Valley Regional High School
Mount Holly, New Jersey

GENERAL CRITERIA FOR SELECTION OF STUDENT LEARNERS FOR WORK EXPERIENCE PROGRAMS

1. The prospective trainee must be a senior enrolled in the business / distributive education department.

2. He must be at least 16 years of age and be eligible for a working permit.

3. He must have his parents' consent to participate in all phases of the program.

4. He should express a career interest in the work experience field, with a willingness and an aptitude for studying the related course content.

5. He should be employable from the standpoint of having the personality traits and skills, with adequate health and school achievement records, for reasonable probability of success on the job assigned.

6. He should have the potential for making a good representation for the school in the business community.

7. The prospective trainee must not be involved in extra-curricular activities such as football, basketball, track or baseball, or any other activity that would make it difficult for the trainee to undertake part-time work.

DISTRIBUTIVE EDUCATION

RANCOCAS VALLEY REGIONAL HIGH SCHOOL

Mount Holly, New Jersey

DISTRIBUTIVE EDUCATION PROGRAM

OBJECTIVES

1. To increase skill, technical knowledge, occupational information understanding, morale, appreciation, and judgement of workers in the field of distribution.

2. To provide the student with a well-rounded practical education in school and on the job.

3. To develop an understanding of the importance of distribution in our economic organization and to appreciate its services.

4. To provide the student with the opportunity to learn the basic principles of merchandising.

5. To train students according to their abilities to become occupationally established in the field of distribution.

6. To develop qualities in students which make for personal efficiency and success in working with other people.

7. To assist students to develop into active and effective members of business and community life.

8. To prepare the students for initial employment in the field of distribution and to provide them with the knowledge to advance on the job.

RANCOCAS VALLEY REGIONAL HIGH SCHOOL
Mount Holly, New Jersey
FUNCTIONS AND DUTIES OF A DISTRIBUTIVE EDUCATION COORDINATOR

DE COORDINATOR

Continues professional development

Operation	Public Relations	Training	Personnel Management (Coordination)	Records and Reports (Control)
Makes community surveys	Works with civic business and school groups	Develops the DE curriculum	Selects personnel for training	Orders supplies and equipment
Plans program of work	Works with guidance counselor	Prepares and revises course material	Assists in student placement	Takes care of clerical details
Sets up classes	Confers with individuals	Teaches DE high school students	Coordinates classroom activities with work experience	Organizes and maintains current student and source files
Arranges schedules	Plans and prepares publicity	Teaches DE part-time and adult classes	Counsels students	Prepares necessary school reports
Secures instructors and speakers	Gives talks	Works with store sponsors	Acts as training consultant in stores	Prepares State reports
Provides and maintains training facilities	Arranges for and directs special events	Secures and trains adult instructors	Follows up on student progress	
Registers class members	Organizes and sponsors DE Club, takes part in school and extra-curricular activities	Conducts research	Makes home and store visits	

Proposed Distributive Education Curriculum For Those Students in Work Experience

Distributive Education is a cooperative program designed to give students practical training in the fields of distribution, marketing and service. Students of the 11th and 12th grades interested in a career in these fields may take part.

Students may elect to participate in this program but are selected by the teacher-coordinator only after a thorough screening process has taken place.

Each student must spend a minimum of 15 hours each week at work in an approved work station for the entire 12th school year.

In 9th and 10th grade a student may pursue any curriculum. However, if he or she is decided it is recommended they take the following schedule.

Tentative Schedule

9th	Credits
English I	5
Gen. Science	5
Civics and Geography	5
Math	5
P. E. & Health	1
Art or Shop	$2\frac{1}{2}$
Electives:	
Home Economics I	$2\frac{1}{2}$
Band Dev.	
Orch. Dev.	

11th	Credits
English III	5
U. S. History	5
Dist. Ed.	5
Record keeping or Bkkp.	5
Health & P. E.	1
Art, Shop or Typing*	
Electives:	
Home Economics	5
Band Dev.	
Orch. Dev.	

Tentative Schedule

10th	Credits
English II	5
Biology	5
Bus. Math	5
Bus. Principles	5
P. E. & Health	1
Art, Shop or Typing	$2\frac{1}{2}$
Electives:	
Home Economics II	5
Band Dev.	
Orch. Dev.	

12th	Credits
English IV	5
U. S. History	5
Distributive Ed. (2 periods)	10
Health & P. E.	1

Cooperative work experience to begin at 1:00 P. M.

*Typing, art and shops are related courses that may be elected by the student. Typing is useful in all business areas. Art will benefit students interested in display work, advertising or fashions. Shop work will aid in construction and design of displays.

_____
(Date)

I request that my son/daughter _____ be permitted
(Name of Student)
to undertake employment through the distributive education cooperative work experience program.

Signed _____
(Signature of Parent)

_____
(Date)

I have reviewed _____ high school records and find it possible for him/her to be enrolled in the distributive education cooperative work experience program.

Signed _____
(Signature of Guidance Counselor)

The above student has met the requirements set forth and has my permission to be enrolled in the distributive education cooperative work experience program.

Signed _____
(Signature of Coordinator)

_____
(Date)

DISTRIBUTIVE EDUCATION
WORK EXPERIENCE PROGRAM
GRADUATE FOLLOW-UP STUDY

RANCOCAS VALLEY REGIONAL HIGH SCHOOL
MOUNT HOLLY, NEW JERSEY

Will you please fill in and return the following questionnaire to the Distributive Education Work Experience Coordinator at the High School. A self-addressed envelope is enclosed for your convenience. Thank you.

Name _____ Date _____
(Last) (First) (Maiden)

Present Employer _____ Date Employed _____

Address of Employer _____

Number of years since you last attended a distributive education class. ___
Are you still employed at the same job you had while you were a student? ____ If you have changed jobs, please indicate the following: (Place your present position last)

Title of Job	Name of Company	Months Employed

What is the nature of the business of the company that employs you now?

_____

If you have left store employment, please give reasons: _____

_____

_____

Approximately how many people are employed by your present employer?

_____

What was your weekly salary at the time you left school? $_____

What is your weekly salary at the present time? $_____

If your present job is in a distributive occupation, list the duties of your job in order of importance: _____

_____

Of what value to you was the training you received in the distributive education classes? _____

_____

Are you using that training, either in business or for personal use? ____
How? _____

_____

_____

What subjects in the distributive education course were of the greatest help to you? _____

_____

What subjects in distributive education were of no help and should be eliminated from the course? _____

_____

What subjects should be added to make the course more worth while?

_____

_____

What additional training (if any) have you had since graduating from high school, or since your last distributive education class?

School	Course	Dates From To

Are you planning to study further? _____
Are you married? _____
Additional comments:

BUSINESS EDUCATION

RANCOCAS VALLEY REGIONAL HIGH SCHOOL

Mount Holly

BUSINESS EDUCATION PROGRAM

OBJECTIVES

1. To increase skill, technical knowledge, occupational information understanding, morale, appreciation, and judgement of workers in the field of office occupations.

2. To provide the student with a well-rounded practical education in school and on the job.

3. To develop an understanding of the importance of office occupations in our economic organization and to appreciate its services.

4. To train students according to their abilities to become occupationally established in the field of office occupations.

5. To develop qualities in students which make for personal efficiency and success in working with other people.

6. To assist students to develop into active and effective members of business and community life.

7. To prepare the students for initial employment in the field of office occupations and to provide them with the knowledge to advance on the job.

RANCOCAS VALLEY REGIONAL HIGH SCHOOL
Mount Holly, New Jersey
FUNCTIONS AND DUTIES OF A BUSINESS EDUCATION COORDINATOR

BE COORDINATOR

Continues professional development

Operation	Public Relations	Training	Personnel Management (Coordination)	Records and Reports (Control)
Makes community surveys	Works with civic business and school groups		Selects personnel for training	Orders supplies and equipment
Plans program of work	Works with guidance counselor	Prepares and revises course material	Assists in student placement	Takes care of clerical details
Sets up classes	Confers with individuals	Teaches BE high school students	Coordinates classroom activities with work experience	Organizes and maintains current student and source files
Arranges schedules	Plans and prepares publicity	Teaches BE part-time and adult classes	Counsels students	Prepares necessary school reports
Secures instructors and speakers	Gives talks	Works with store sponsors	Acts as training consultant in stores	Prepares monthly State reports
Provides and maintains training facilities	Arranges for and directs special events	Secures and trains adult instructors	Follows up on student progress	
Registers class members	Takes part in school and extra-curricular activities	Conducts research	Makes home and store visits	

Proposed Business Education Curriculum
For Those Students in Work Experience

This curriculum is necessary because schools and business must make it possible for students to keep pace with changes in business. Students of the 12th grades interested in a career in bookkeeping, clerical, and stenographic fields may take part.

Students may elect to participate in this program but are selected by the teacher-coordinator only after a thorough screening process.

Each student must spend a minimum of 15 hours each week at work in an approved work station for the entire school year.

Tentative Schedule

9th	Credits
English I	5
Gen. Science	5
Gen. Business	5
Typing I	$2\frac{1}{2}$
P. E. & Hlth	1

Tentative Schedule

10th	Credits
English II	5
Biology	5
Bookkeeping I	5
Typing II	$2\frac{1}{2}$
P. E. & Hlth	1

Electives	
Civics and Geog.	5
Languages	5
Algebra I (sub. for Gen. Biol.)	5
Art	$2\frac{1}{2}$
Home Economics I	$2\frac{1}{2}$
Basic Draw - Shop	$2\frac{1}{2}$
Band & Orch.	

Steno		Clericals		Bkkp.
Steno I	5	Clerical I	5	No Requirements

Electives	
Languages	5
Plane Geometry	5
Art	$2\frac{1}{2}$
Home Economics II	5
Shop	$2\frac{1}{2}$
Band & Orch.	
Choral Development	

Tentative Schedule

11th	Credits
English	5
U. S. History	5
P. E. & Hlth	1
Steno	
Steno II	5
Transcription	5
Law & Math	5
Clericals	5
Clerical Off. Procedures	
Law & Math	5
Bkkp.	
Bkkp. II	5
Office Procedures	5
Law & Math	5
Electives	
Language	5
Art	$2\frac{1}{2}$
H. Economics	5
Shop	$2\frac{1}{2}$
Band	
Orch.	
Choir	

Tentative Schedule

12th	Credits
English IV	5
U. S. History	5
P. E. & Hlth	1
Office Procedures II (Stenos, Bkkps, Clericals) with Work Exp.	10

No Electives

_____
(Date)

I request that my son/daughter _____ be permitted
(Name)
to undertake employment through the business education cooperative work experience program.

Signed _____
(Signature of Parent)

_____
(Date)

I have reviewed _____ high school records and
(Name)
find it possible for him/her to be enrolled in the business education cooperative work experience program.

Signed _____
(Signature of Guidance Counselor)

The above student has met the requirements set forth and has my permission to be enrolled in the business education cooperative work experience program.

Signed _____
(Signature of Coordinator)

_____
(Date)

BUSINESS EDUCATION
WORK EXPERIENCE PROGRAM
GRADUATE FOLLOW-UP SURVEY

RANCOCAS VALLEY REGIONAL HIGH SCHOOL
Mount Holly, New Jersey

Will you please fill in and return the following questionnaire to the Business Education Work Experience Coordinator at the High School. A self-addressed envelope is enclosed for your convenience. Thank you.

Name _____ Date _____
(Last) (First) (Maiden)

Present Employer _____ Date Employed _____

Address of Employer _____

What are the major duties of your present job? Please check the following:

TYPING
____ Fill in forms
____ Reports-Manuscript
____ Reports-Numbers
____ Stencils
____ Form Letters
____ Elec. ___ Manual

OFFICE MACHINES
____ Adding Machine
____ Bookkeeping Mach.
____ Dictaphone, etc.
____ IBM (Key Punch)
____ Key Driven Calc.
____ Rotary Calc.

BOOKKEEPING
____ Cashiering
____ Journalizing
____ Financial reports
____ Posting __ Manual
____ Payroll

SHORTHAND
____ Less than 5 hours
____ 5 to 15 hours
____ Over 15 hours

OFFICE CLERICAL
____ Switchboard
____ Handling mail
____ Other, explain

RECEPTIONIST ___

What areas do you feel you were not adequately prepared? _____
_____

Have you been employed in any other job previous to this one?

Yes_____ No_____

If yes, give date and place: Date____ Place_____

Date____ Place_____

What course or courses do you think were A) most helpful B) least helpful to you in your work?

A)_____ B)_____

_____ _____

Do you feel that the work experience program was helpful to you?

Yes_____ No_____

Have you had any additional schooling (training) since graduation?_____

If yes, where?_____

Signature_____

Comments:

MISCELLANEOUS FORMS

BUSINESS/DISTRIBUTIVE EDUCATION
COOPERATIVE
WORK EXPERIENCE PROGRAM
TRAINING MEMORANDUM

RANCOCAS VALLEY REGIONAL HIGH SCHOOL
MOUNT HOLLY, NEW JERSEY

_____ _____ _____
(Name of Student-Learner (Age) (School)

Business Establishment _____

_____
(Address)

Job Sponsor (supervises student-learner) _____

Dates of Training Period _____

Student's Career Objective _____

Basic skills, attitudes, and knowledge needed in this occupation:

Main areas of related instruction in the classroom during the school year:

IT IS AGREED that the student-learner will consider his job experience as contributing to his career objective and will perform his training station responsibilities and classroom responsibilities thoroughly.

IT IS AGREED that the employer will recognize that a training plan is being followed and that close supervision of the student-learner will be needed. He will provide (1) work experiences listed in this training plan, (2) part-time employment of __ hours a week on the average, (3) wages to the student-learner at the start of $__per_____, and (4) will consult with the coordinator on any major problems that arise concerning the performance of the student-learner.

IT IS AGREED that the coordinator will provide instruction directly related to the student's job activities and career objective, will suggest ways of supervising the student-learner, and will assist the employer with training problems pertaining to the job.

Additional Comments

_____ _____
(Student's Signature) (Parent's Signature)

_____ _____
(Employer's Signature) (Coordinator's Signature)

BUSINESS/DISTRIBUTIVE EDUCATION
COOPERATIVE
WORK EXPERIENCE PROGRAM

Rancocas Valley Regional High School
Mount Holly, New Jersey

INDIVIDUAL STUDENT WORK RECORD

Employer _____ Salary per week _____

Address _____ Student:

_____ _____

WEEK ENDING	HOURS WORKED	SALARY
TOTALS		

BUSINESS/DISTRIBUTIVE EDUCATION
COOPERATIVE
WORK EXPERIENCE PROGRAM

Rancocas Valley Regional High School
Mount Holly, New Jersey

WEEKLY WAGE AND HOURLY REPORT

Name_____ Week Ending_____

DAY	WORKED From To	Selling Hours*	Non-selling Hours*	DEPARTMENT If Non-selling	TOTAL HOURS
Monday					
Tuesday					
Wednesday					
Thursday					
Friday					
Saturday					
TOTALS					

*Not applicable to cooperative office skills

Rate per hour $_____ Total Wages for Week $_____

_____
(Signature of Employer)

BUSINESS/DISTRIBUTIVE EDUCATION
COOPERATIVE
WORK EXPERIENCE PROGRAM

Rancocas Valley Regional High School
Mount Holly, New Jersey

RATING SHEET

Name of Trainee _____ Date _____

Employer _____ Length of Employment _____

Address _____

THIS RATING SHEET WILL BE USED TO ASSIST IN GRADING TRAINEES FOR THE EMPLOYMENT PERIOD. IT IS REQUESTED THAT THE EMPLOYER COMPLETE AND SEND IN THIS FORM ON _____. (A FINAL RATING SHEET WILL BE COMPLETED JOINTLY BY THE EMPLOYER AND COORDINATOR UPON COMPLETION OF TRAINEE'S EMPLOYMENT) PLEASE INDICATE YOUR OPINION OF THIS TRAINEE BY PLACING A CHECK MARK IN THE COLUMNS OF YOUR CHOICE.

	Excellent 4 pts	Good 3 pts	Fair 2 pts	Poor 1 pt
PERSONAL APPEARANCE				
COOPERATION				
INDUSTRY				
RELIABILITY				
JOB PERFORMANCE				
ATTITUDE				
ABILITY TO FOLLOW INSTRUCTIONS				
KNOWLEDGE OF MECHANICS OF OFFICE EQUIPMENT, SELLING TECHNIQUES, ETC.				
TOTALS				

Total Score _____

ANNEX "D"

S A M P L E

BUSINESS EDUCATION JOB PLACEMENT PROGRAM

JOB PLACEMENT AND BUSINESS EDUCATION

By Rodney G. Jurist, Business Education Job Placement Coordinator

Randolph High School, Randolph Township, New Jersey

February, 1966

Randolph High School, Randolph Township, New Jersey, has established a formal Business Education Job Placement Program which boasts a 100% record for its first year of operation. Before any explanation of the plan is made, however, it is necessary to say that this plan is designed specifically for those schools that find it extremely difficult to institute out of school work experience programs. The duties and responsibilities of the Business Education Job Placement Coordinator at Randolph High School are strictly for coordinating job placement and not for coordinating an out of school work experience program.

OBJECTIVES

1. To assist business students obtain full-time employment in the office occupations upon graduation from high school.

2. To establish and maintain liasion between potential employers and the high school by means of an employer advisory committee and through scheduled visits to business and industry.

3. To coordinate classroom activities with those occupational activities found in the employing community.

4. To keep the Business Education and Guidance Departments informed of the latest developments in the employing community in order to improve or modify guidance and instruction.

OPERATIONAL PLAN

The operational phase of the Business Education Job Placement Program at Randolph High School takes place during the student's senior year. Students are informed of the program through the office practice classes.

At the beginning of the school year, students are asked to fill in the Job Placement Record (see illustration "A") on which they indicate their career desires. These desires normally fall into the following categories:

1. Office position with a large firm.

2. Office position with a small firm.

3. Office position in a specialty such as legal, medical, or technical.

4. Further education in a business school, special school, or college.

5. Interested in other fields such as nursing, military, beautician, etc.

6. Positions in the field of retailing and merchandising.

7. Undecided.

After the students' desires are known by the Job Placement Coordinator, a sincere attempt is made to acquaint the individual student with all the information about his anticipated career. Through the Coordinator's Employer Lead File (see illustration "B") arrangements are made during the school year for the student to actually visit the places in which he would like to work. Office manuals are obtained from these concerns; personnel managers are invited to the school; and the student is counseled by the Coordinator, Guidance Director, and the Employer Advisory Committee. Further, the student is provided with realistic training in the field or endeavor through a unique office practice program, the content of which has been determined by a survey and follow-up study of the employing community. Students are also given the opportunity to participate in an informal, but well supervised, work experience program within the school by working for such people as the Job Placement Coordinator, Curriculum Coordinator, Librarian, Guidance Director, and Administrative Staff. The type of work is of such a nature that it is not merely "busy work" but the type of work that challenges the students' knowledges and skills--for example: direct dictation at the typewriter, shorhand transcription, machine transcription, letter composition, telephone usage, etc.

Starting in April, the students are scheduled for interviews with the business concerns for which they would like to work. Before the student reports for an interview, he has been informed of the proper manners, attire and procedures. Further, no student is sent out for an interview unless the Job Coordinator and Business Department feel that the student is qualified for the job. The student's qualification is determined by comparing the student's scholastic record with that which is expected by the employer. Specific job vacancies and qualifications are obtained by the Job Placement Coordinator in advance of any interview and the students are informed of the requirements which are expected. Many times students are so well known by their participating in demonstrations at Employer Advisory Committee Meetings that they are hired without taking an employment test. Most of last year's business graduates were hired solely upon the recommendation of the school. Prior to the interview, employers are mailed a summary of the applicant's scholastic and job placement records (see illustration "C").

If the student is given a promise of employment before graduation, specific training for his job begins immediately by close coordination with the business involved. Shortly after graduation, the student begins work with the company.

During the next school year, the Job Placement Coordinator visits all companies where business graduates were hired. Here, he discusses with the supervisors how the students measure up to what is expected. Further, he discusses what can be done jointly to improve instruction for future business students. A follow-up study is made of each class of business graduates every first, third, and fifth year to determine whether or not the school is meeting the needs of these students--not only in their obtaining initial office jobs, but whether the instruction adequately provided them with the skills and knowledges to advance on the job.

A follow-up study taken of last year's business graduates, used in conjunction with job placement records, indicated:

1. 44 business students were among the diploma recipients.

2. 22 business students elected to secure an office position of some sort through the Job Placement Program.

3. 22 business students elected not to participate in the Job Placement Program; but to obtain employment on their own, attend post high school business training, enter the service, go on to college, or enter other fields of endeavor such as nursing and beautician training.

SUMMARY OF FOLLOW UP

(Students non Participating in the Job Placement Program)

1. Employed full time - 6 students (2 clerks and 4 clerk typists)

2. College - 2 students

3. Beautician School - 2 students

4. Business School - 5 students

5. Marriage - 2 students (not employed)

6. Art School - 1 student

7. Unreturned questionnaires - 4

(Students Participating in the Job Placement Program) (and employed full time)

1. Clerks General - 4 students

2. Clerk Typists - 10 students (none in pools)

3. Stenographers - 6 students (none in pools)

4. Bookkeepers - 1 student

5. Librarians - 1 student

COMPARATIVE ANALYSIS

(Follow-up study with job placement records)

1. 77.2 per cent (17 students) who participated in the Job Placement Program were given written promises of employment in the jobs of their choice before graduation.

2. 100 per cent (22 students) who participated in the Job Placement Program were actually employed in the jobs of their choice by September 1.

3. Students who obtained their jobs through the Job Placement Program received a mean salary of $9 per week higher than those students not participating in the program. Average salary for participating students was $71 per week. Average salary for non-participating students was $62 per week.

INCIDENTAL OUTCOMES OF THE FOLLOW UP

1. 22.7 per cent (5 students) who participated in the Job Placement Program are directly involved in electronic data processing to some degree.

2. 13.6 per cent (3 students) who participated in the Job Placement Program are attending evening college classes through company paid benefits.

CONCLUSIONS

1. The Job Placement Program at Randolph High School for school year 1964-65 was successful in that all students gained employment in the jobs of their choice within 90 days after graduation.

2. Students who obtained employment through the Job Placement Program are earning higher salaries than those who did not obtain employment through the Job Placement Program.

3. Electronic data processing is becoming a significant factor in beginning office employment in our area.

4. Some Business Education students can go to college.

RECOMMENDATIONS

1. More emphasis should be given to Business Education Job Placement Programs in the public high school.

2. More emphasis should be placed on the role of electronic data processing as applied to beginning office jobs.

3. Better liasion between the school and business and industry should be established and maintained in order to operate a successful Job Placement Program.

ILLUSTRATION "A"

NAME: (Last, First, Middle Initial)

HOMEROOM | PHONE NUMBER | AGE

ADDRESS: (Street, City & State)

SOCIAL SECURITY NUMBER | DATE OF BIRTH

WORK EXPERIENCE: (Part & Full Time)

Company	Address	Duties

CAREER DESIRES: (List type of position student desires to obtain after graduation along with type of company)

Example: Typist - Law Firm

BUSINESS SUBJECTS TAKEN
(Check Blocks)

- ☐ Bus Math
- ☐ Gen Bus
- ☐ Econ Geog
- ☐ Typing I
- ☐ Typing II
- ☐ Shorthand I
- ☐ Shorthand II
- ☐ Bkkg I
- ☐ Bkkg II
- ☐ Bus Org & Mgt
- ☐ Bus Law
- ☐ Salesmanship
- ☐ Advertising
- ☐ Recordkeeping
- ☐ Clerical Office Practice
- ☐ Secretarial Office Prac

REMARKS
(To be filled in by Job Coordinator & Teachers)

JOB PLACEMENT RECORD
Randolph High School

Name of Company	Phone Number
Address	Description of Business
Name of Personnel Director	Positions Available

Specific Job Requirements--for example: Must be able to type straight copy at 40 wpm for 3 minutes.

RANDOLPH HIGH SCHOOL
EMPLOYER LEAD CARD

ILLUSTRATION "B"

RANDOLPH HIGH SCHOOL

Randolph Township, New Jersey

Office of the Business Job Placement Coordinator

SCHOOL JOB PLACEMENT RECORD FOR _____

BUSINESS SUBJECTS TAKEN	REMARKS AND RECOMMENDATIONS
☐ Business Mathematics	
☐ General Business	
☐ Economic Geography	
☐ Typewriting I	
☐ Typewriting II	
☐ Shorthand I	
☐ Shorthand II	
☐ Bookkeeping I	
☐ Bookkeeping II	
☐ Business Org. & Management	
☐ Business Law	
☐ Salesmanship	
☐ Advertising	
☐ Recordkeeping	
☐ Clerical Office Practice	
☐ Secretarial Office Practice	

ATTENDANCE RECORD:_____

ENGLISH COMMUNICATION:_____

_____
Certifying Official

ILLUSTRATION "C"

ANNEX "E"

DUTIES AND RESPONSIBILITIES

OF A

BUSINESS EDUCATION JOB PLACEMENT COORDINATOR

BUSINESS EDUCATION JOB PLACEMENT COORDINATOR

I. PURPOSE: The primary purpose of the Business Education Job Placement Coordinator at Randolph High School shall be to establish and maintain liaison between potential employers and the school in order to determine and meet the needs of the employing community.

II. DUTIES:

A. To seek out potential full-time employers of our business graduates and part-time employers for business students currently in school and acquaint them with our educational program in Business Education.

B. To arrange for conferences between the business leaders of the employing community and the school in order to keep both parties abreast with the latest developments, trends, and projections in the field of business.

C. To coordinate all job placement activities through the guidance department in order to insure proper student scheduling, counseling, and placement.

D. To conduct periodic surveys and follow-up studies as part of the guidance service regarding our graduates to determine whether or not the Business Education program has provided adequate initial job preparation.

E. To visit former Randolph High School students and graduates on the job to see first hand whether or not their jobs are commensurate with their training in high school.

F. To contribute to the development of a central employers' file in the guidance office.

G. To identify and assist potential Business Education drop-outs and aid them in obtaining employment.

H. To assist Business Education students in arranging for job interviews.

III. ADMINISTRATION:

A. The Business Education Coordinator will have several unassigned periods to carry out his duties and responsibilities.

B. The Business Education Coordinator will develop his own schedule for leaving the high school building and returning.

C. The Business Education Coordinator will submit a monthly report to the Guidance Department regarding the job placement program.

IV. RESPONSIBILITIES:

A. Keeping records of meetings, conferences, surveys, and studies.

B. Contributing to student personnel records in cooperation with the Guidance Department.

C. Making reports to and meeting with the Business Department, Guidance Department, and concerned employers regarding job placement.

D. Talking to students, business groups, clubs, and organizations regarding job placement.

E. Bringing Business Education graduates back to the school to speak about work experiences.

F. Evaluating the job placement program.

V. AUTHORITY:

A. Recommending potential employers to students in cooperation with the Guidance Department.

B. Recommending students to potential employers in cooperation with the Guidance Department.

C. Recommending changes in the curriculum to meet the needs of the employing community.

D. Recommending the use of new and or revised equipment, supplementary materials, and supplies to meet the needs of the employing community.

ANNEX "F"

S A M P L E

EXPLORATORY AND CAREER PROGRAM

Randolph High School

Randolph Township, New Jersey

INTRODUCTION TO BUSINESS AND MATHEMATICS

A G B - 1

A business survey course for all ninth grade vocational students, designed to provide the student with a sampling of business subjects which are offered later in the high school curriculum and to acquaint the student with the various career opportunities available in the fields of business and distributive education. This course is a one semester course to be offered in conjunction with A G B - 2. Students must take both A G B - 1 and A G B - 2 to receive credit--either course may be taken first.

Topics to be offered include:

1. Salesmanship
2. Recordkeeping
3. Bookkeeping
4. Shorthand
5. Business Machines
6. Business Communications
7. Business Organization
8. Notehand
9. Occupational Information

Each unit will be a separate entity lasting approximately two weeks.

Textbook: Dame, Patrick & Grubbs, Exploratory Business, Gregg, 1965 to be supplemented.

Schedule: 1 period per day
5 periods per week
18 weeks
$2\frac{1}{2}$ credits

Randolph High School

Randolph Township, New Jersey

INTRODUCTION TO BUSINESS AND MATHEMATICS

A G B - 2

A survey course for all ninth grade vocational students, designed to develop the student's understanding and appreciation of the various branches of mathematics. Further, the course is designed to provide the students with information regarding careers in trades and industries. This one semester course is to be offered in conjunction with A G B - 1. Each student must take A G B - 1 and A G B - 2 to receive credit -- either course may be taken first.

Topics to be offered include:

1. Career and Occupational Information
2. Properties of number systems
3. Open sentences in one variable
4. Graphs and applications
5. Fractions and decimal fractions
6. Verbal problems
7. Percent with applications
8. Direct and inverse variations
9. Geometrical constructions
10. Experimental Geometry
11. Indirect measurement
12. Empirical probability and statistics
13. Exact and approximate numbers
14. Logical thinking

Each unit will be a separate entity lasting approximately one week.

Textbook: Current text used in Algebra I to be supplemented.

Schedule: 1 period per day
5 periods per week
18 weeks
$2\frac{1}{2}$ credits

The following representatives have volunteered their services for the 1966-1967 Ninth Grade Vocational Career Program to be used in conjunction with A G B - 1 and A G B - 2.

Mr. Frank Mastromano - R.C.A.
Topic: "The World of Accounting"

Mr. Joseph Bell - G.E. Installation at Bell Telephone
Topic: "Careers & Opportunities in Electronic Processing"

Mr. Ralph Fancher - Picatinny Arsenal
Topic: "The Apprentice Program" (Boys)

Mrs. Estelle Sager - Picatinny Arsenal
Topic: "Civil Service Opportunities" (Girls)

Mr. R. Rehm - Mennen Company
Topic: "Production and Clerical Opportunities"

Mr. John Ricci - Hewlitt Packard Company
Topic: "Electronics & You"

Miss Jean Forkel - Bell Laboratories
Topic: "Secretarial and Clerical Opportunities" (Girls)

Mr. John More - Westinghouse
Topic: "The Mechanical Aptitude Student & His Future"

Mrs. Virginia Keener - Research Dept. - Warner-Lambert
Topic: "The Future of Warner-Lambert and You - as a high school graduate" (Girls)

Mr. Edwin Wendlocker, Mr. Donald Allerton - Warner-Lambert
Topic: "The Future at Warner-Lambert and You - a high school graduate" (Boys)

Small Business Panel Discussion
Mr. Kirby Park: Heating and Air Conditioning - Randolph

Mr. Willard Hedden: Hedden Oil - Dover

Mr. Archie Nichols: Baker Real Estate - Randolph

Mr. Rodney Jurist: Job Coordinator - High School - Moderator

A series of speakers from neighboring industries and businesses will address our vocational students in grade nine.

The purpose of this program is to expose these students to current job opportunities after high school graduation, in order that better career planning can take place. It is felt that this first-hand learning will result in immediate meaning in the student's current course of study.

The second purpose of this program is to create more articulation between school and industry and business. Randolph High School vocational teachers feel the need for further communication on this level.

The third purpose of this program is to establish a "starting off" point in which a more intensified program can be continued in each of the additional high school years.

The fourth purpose of this program is to establish more rapport between the vocational student and his teacher - (as seen through the vocational student's eyes.) This will be achieved through teacher-student evaluation of the various programs throughout the school year.

The fifth purpose of this program is to unify the thinking among the vocational teachers in the high school through discussion and exchange of ideas. This is achieved through grade-level meetings with the guidance counselor in addition to their own subject area meetings.

ANNEX "G"

S T A T E M E N T

DISTRIBUTIVE EDUCATION IN NEW JERSEY

State of New Jersey
Department of Education
Vocational Division
Trenton, N.J., 08625

DISTRIBUTIVE EDUCATION IN NEW JERSEY

Robert D. Joy, Director

The growth of the Distributive Education cooperative programs may be attributed to the fact that the program supplies a superior type of training for youths. Such a program, if organized properly, is realistic and provides motivation which encourages learning.

The controlling purpose of the cooperative Distributive Education program is that the vocational training shall be in business of service occupations under actual working conditions for those youths who have selected distribution as their ultimate career. The Distributive Education classes for the high school youth are set up under our State Plan. The practical training and experience are given under an agreement between the employer, the school authorities, and in some cases the parents of the trainees.

This agreement insures that a progressive training program is conducted and that the trainees supplement their practical training with a program of related instruction.

Methods of instruction in the cooperative classes depend for their efficiency upon the motivation and the ability of the teacher-coordinators to adjust themselves to the varying needs of the trainees. The inductive methods of instruction, such as conferences and discussion based on working experiences of the trainees, is preferred to deductive methods based on textbooks and lectures.

We believe that the Distributive Education Work Experience program has many advantages for our school youth.

1. Guidance Values. It offers him an opportunity to get firsthand work experiences and to explore an occupational field.
2. Social Values. The student has personal contacts with co-workers in the field and customers. This gives him practical experience in working with and dealing with people.
3. Educational Values. The student receives a combination of theory and practice, thus relating instruction to life situations.

4. Disciplinary Values. Areas for exhibiting and using responsibility and initiative are ever present.
5. Economic Values. The student has an opportunity to earn while learning and to appreciate the meaning of financial independence.
6. Personal Values. The student has an opportunity for entrance into business a full year before others in his graduating class.

Work experience is a very valuable part of the experience that young people need if they are to mature properly. A great majority of our youth are so constructed that their social, emotional and mental health and growth urgently require work responsibilities. To deny these demands is just as dangerous as to deny the demands of the body for essential minerals and vitamins.

ANNEX "H"

REPORT

REACTIONS TO THE CRITERIA

OF

MODEL BUSINESS EDUCATION PROGRAMS

A REPORT TO THE VOCATIONAL DIVISION

of the

DEPARTMENT OF EDUCATION

New Jersey

REACTIONS TO CRITERIA

Ewing High School

February, 1966

Submitted by Mary Paparone

For the Business Education Department and With Their Approval

1. It is assumed that the general aims of education at the high school level shall be the aims of business education at this level. In view of this criterion, only such further assumptions as apply especially to business education in secondary schools will be hereinafter presented.

Secondary education at Ewing High School attempts to develop in each student the attitudes, understandings, appreciations, and skills necessary for present and future accomplishment. To achieve this, all youth should be considered in the light of their individual differences, interests, aptitudes, capacities, needs and background. Recognized capabilities within the child should be developed toward an eventual true self-realization. The attainment of these goals presumes a staff well versed in subject matter, alert to the nature of adolescence, and aware of methods based on knowledge of the learning process.

Business education in our school truly serves the ideas and attitudes of general education at the high school level. A single curriculum allows ample digression from a traditional approach to education. The curriculum has been designed and developed to meet the individual needs of not only the business student but the needs of the entire school population.

2. Local conditions, not only within a community but often within a single school in that community, must be taken into consideration in setting up and administering a program of business education.

The program of business education has been developed to meet the requirements of Ewing Township and its surrounding areas. The highly diversified businesses located in that area offer varied occupational opportunities. The curriculum of our school offers a sequence of courses leading to absolute skill development for those employment opportunities in the community that demand skill performance at various levels. It also provides for lesser skill development for those students who cannot or are not capable of attaining absolute skills. These students are directed to seek employment in the many clerical positions available in this community. Finally, it offers a general education background enabling all business students to become better citizens and intelligent consumers in our community.

3. Regardless of the type of school organization which prevails in any community there are two distinct, but articulated, periods of training in the field of business education. For purposes of our study one may be called the pre-vocational period, and the other may be called the vocational period. The pre-vocational period should be given over largely to exploration, try-out, personal use, and general education.

Business training I and Business Mathematics I are offered in the ninth grade as the primary pre-vocational subjects in the field of business education. The pre-vocational period is exploratory in the general sense because all potential ninth grade boys and girls may elect Business Training I and/or Business Mathematics I without any prerequisites, formal or informal. They are specifically exploratory in the sense that several major business and economic units are explored throughout the year. For example, the business community, banking services, spending plans, uses of credit, the sharing of economic risks (insurance), savings plans, and other similar units are introduced throughout the year. Try-out is emphasized in opening a checking account, writing checks, preparing budgets, buying on credit, making out insurance applications, opening savings accounts, etc. The personal-use phase is particularly evident in keeping personal records and information such as addresses, gift lists, letters, clippings and photographs, and birthday and anniversary lists. The correct use of the telephone, and mail services also has direct personal application. The travel service unit actually includes plans for auto trips which may be applied for an actual family outing in the Delaware Valley. The units on our business community, successful economic citizenship, and our business and economic world provide a basic understanding of elementary economics which certainly enhance a student's general education.

4. The vocational period should be given over largely to training in preparation for well-defined types of business occupations.

The students in the Ewing High School business department may choose from the curriculum the program best suited to their abilities and goals. He can elect to take courses that will specifically prepare him for proficiency in the following career opportunities:

Typist (including the use of the dictaphone)
Bookkeeper
Stenographer
File Clerk
Key Punch Operator
Verifier Operator
402 Accounting Machine Operator
82 Sorter Operator
Operator of Ten Key Machines
Operator of Calculators
Operator of Burroughs Sensimatic Bookkeeping Machine
Operator of Duplicating Machines

Upon the mastering of these skills, the students are given an opportunity to participate in the Cooperative Office Work Experience Program. In this program, theory and realism are brought together. Students are given an opportunity to assume responsibility and are introduced to requirements of the various business careers.

5. During the pre-vocational period, each pupil should decide under guidance which of the office, store, and other initial-contact occupations he wishes to prepare for.

A unit on planning your future and preparing for employment enables students to investigate particular careers in business. The boys and girls are encouraged to learn about the various office, store, and other initial-contact occupations so that an intelligent career choice can be made. The guidance counselor has several sessions with each student, and tries to help the student to make a realistic career choice. There is frequent exchange of notes between the Business Training teacher and the guidance counselor as well as other subject matter teachers in helping to establish realistic career goals for the student.

6. In the business career of any pupil, the ultimate goal job is more important than the initial-contact job since it has been demonstrated that any type of clerical or other business work may be used as a stepping stone to higher levels of employment.

In Ewing High School we have made every effort to incorporate in the program of studies an adequate theory background coupled with a related work experience to enable the student to take advantage of every opportunity that is presented to him in reaching his highest level of employment.

The business curriculum contains a variety of experiences and the use of many different types and models of equipment. Special stress is given to the personal qualities that lead to promotion plus emphasis on good office procedures, which include working well with others and increasing speed and efficiency in the operation and handling of equipment.

Federal and State Civil Service tests are administered to all seniors in the secretarial and clerical areas. Employment tests are also given to senior business classes. We constantly encourage all of our students to continue with their formal education. There is evidence through follow-up studies made by our Guidance Department that several students have continued their education.

7. In view of the greater importance of ultimate goals, try-out courses in business should be so contructed as to reveal the aptitudes, abilities, and interests of pupils with respect to such goals as well as with respect to the more immediate initial-contact jobs.

The Business Training I and Business Mathematics I courses are constructed to reveal the aptitudes, abilities, and interests of pupils with respect to bookkeeping and clerical careers by providing realistic units on preparation of payrolls, computing interest, discounting notes and drafts, property and income taxes, keeping a petty cash book, preparing purchases and sales records, preparing a profit and loss statement, and preparing a balance sheet. (Simplified bookkeeping forms are used.) Potential success in shorthand can be revealed through an examination of the many reports prepared by students as well as the Turse Shorthand aptitude test. Some of the students also have opportunities to operate business machines in the school office and work in the school store. Some students also volunteer to work in charity organizations during vacation periods.

8. Vocational skill-training should form a part of the training for practically every boy or girl in the business department, but such skill-training should be confined to a single skill or a closely related group of skills--stenographic, bookkeeping, selling, office machine operation, etc., in order to make room for an adequate general education program.

Students may choose one of three areas according to interest and abilities. The areas are: clerical, bookkeeping and stenography. Our single track curriculum allows ample opportunity for business students to develop a salable skill along with a broad, practical background of general education.

9. The largest possible amount of general education consistent with sound vocational training should accompany all business education, but such general education should, wherever possible, be adapted to the needs of business pupils.

In Ewing High School, the curriculum includes many subjects that help to develop the general education that is so necessary to help the student to be well prepared for his place in the business world. In both society and business or professional life a person is often judged by his ability--or lack of it--to handle his native language with fluency and effectiveness. To this end the English courses stress the constant development of the pupil's ability to express himself well orally and in writing, to read with ease and understanding, and to strive for an ever-increasing vocabulary. A great deal of stress is placed on correct spelling, accuracy, and neatness in the preparation of all his work.

In the Social Studies courses, the student develops an understanding of our political institutions, our economic systems, our cultural ideals and our duties and obligations as good citizens--in short, our whole social and economic environment.

In the Practical Science course, emphasis is placed upon the practical application of physical science principles of everyday life, industry and commerce.

In Social Psychology the students learn about themselves and their behavior so that they may better understand and get along with other people.

Our Physical Education program from grades 10 through 12 includes activities for the students which will benefit them physically, mentally, socially, emotionally, and help make them better citizens.

Our curriculum includes the minor subject of Public Speaking. This course is designed to train the student in the development of poise and good speech habits.

The cultural aspect of the students' development is brought out through our many courses in art and music. In the art classes some emphasis is placed on art that can be used in future occupations such as retailing, merchandising and advertising.

10. Since continuity of practice is essential to the development of skills of all sorts, as far as is practicable, short, intensive courses in skill subjects should replace longer courses with intermittent practice on alternate days.

The Business Education Department in its effort to develop skill achievement offers concentrated practice in as short a period of time as is practicable. Our courses offer a continuity of practice in the development of skills by meeting every day of the week. In addition, our students are encouraged to work with tapes and records on their own time.

11. Such skills as are essential to any particular business occupation for which a pupil is training should be developed as nearly as possible to the time when the pupil will leave school and enter upon such employment.

Second-year skill courses (such as Typewriting II, Shorthand II, Bookkeeping II, and Business Math II) are taken in the 11th and 12th grade as close as possible to the date of graduation and subsequent application of these skills. The highly developed skill courses such as Secretarial and Clerical Office Practice are taken in the 12th grade during the semester preceding the Cooperative Work Experience Program.

12. The core of the business curriculum should be general education instead of bookkeeping, shorthand, or any business subject or groups of such subjects.

Although we, as business teachers, are aware of the importance of the skills, we are also cognizant of the fact that in order to have well-rounded business students we must not only help them to develop those personal and vocational traits that are so essential, but we must also provide them with a well-rounded general background.

The core of each business subject in our curriculum stresses general education areas, such as the following: Good English (vocabulary, spelling, grammar, etc.), quality of work (neatness, legibility, and accuracy), and consumer knowledge.

13. Preparation for college cannot be accepted as a major objective of high school business education since the large majority of graduates of a high school business department do not go to college. Preparation for college and training for business positions require different programs.

Our main objective is to prepare students to enter the business world equipped with the necessary skills, basic business knowledge, and an understanding of business to live in an everyday business world which will help them achieve success commensurate with their ability.

Since Ewing offers the single track curriculum, many academic students take beginning business subjects (Typewriting I and Shorthand I). Business students who feel that they want to continue their education after high school are directed toward the necessary elective academic subjects along with their business subjects.

14. Since the aim of vocational business education is to prepare for the performance of specific office or store or other business duties, the tests of achievement in the technical or skill subjects in this field should square with the requirements of occupational life instead of with the usual academic standards.

The business curriculum unlike the academic program cannot be bound by static requirements. Its standards must constantly be reevaluated to keep abreast of current business requirements. It is our responsibility to have a program that is elastic in nature, for it is only by keeping our program up to date that we can have a realistic one.

The business teachers enhance the realism of this program by relating the subject matter and testing program to actual business requirements. These requirements are gathered through employers' reports prepared during our Cooperative Office Work Experience Program. Our business education coordinator is actively engaged in visiting offices and brings back to our department any important information relating to current business standards. In this way we are also able to make our goals realistic in nature.

15. Since the initial-contact positions and promotional opportunities open to boys are likely to be different from those commonly open to girls, the high school program of business education should be so constructed as to meet the apparent needs of both sexes through specialized or differentiated curriculums.

Ewing High School does not have a differentiated curriculum for boys and girls as such. Each business student is helped to construct his business program to meet future needs and goals depending on the type of business work desired after high school.

16. Boys and girls who lack the personal, mental, and physical characteristics which suggest the possibility of advancing beyond the initial-contact job should be encouraged to seek some other form of vocational training since the clerical level of business employment is unsatisfactory as a permanent goal because its financial rewards are inadequate to the needs of adult family life.

As business educators we are well aware that all boys and girls do not have the personal, mental, and physical characteristics that are commensurate with the obtaining and keeping of a good-income job. With this in mind, we do everything possible to guide these students into an area of study where they will receive the best possible education and the one that will best equip them for the outside world.

Beginning with the eighth grade, various tests are administered to the students with the purpose of enabling them to learn more about themselves and their own personal capabilities. Two of these well-known tests are the "Differential Aptitude Test" and the "Kuder Preference Record."

Once it has been established that a student is a slow learner, he is further helped in his selection of a career through intensive guidance. He is given personal guidance by his subject teacher and also his assigned guidance counselor. (We are fortunate in our school inasmuch as we also have a business guidance counselor who assists our students.) A permanent folder is kept on each student which enables the teacher to learn valuable information concerning the background, grades, personal attitude, etc., of the student he is helping.

Of further assistance to the student is the extensive "Career Library" which is maintained by the guidance department and which is available to all interested students.

Throughout the entire junior year, all juniors receive the benefit of a planned career program. The school engages speakers from all professions and businesses who come and speak to the students. In this way, the student can get first-hand information about any job opportunities that appeal to him personally.

17. Since the degree of success in business which may be attained by any individual is dependent upon many factors such as "business ability," "personality," "social qualities," "mental ability," "natural intelligence," "training," "family connections," etc., no pupil should be barred from the business program because his I. Q. is average or even somewhat below average.

No student is barred from the business program at Ewing because his I. Q. is average or below average. Such a student is encouraged to take business courses in which he will see some measure of achievement. Students of average or low I. Q. take Typewriting I and achieve some skill in relationship to their ability. Those not able to master Bookkeeping I principles because of lack of adequate comprehension of the subject matter are directed toward Record Keeping. The students who will never be highly skilled because of ability take Clerical Problems which helps broaden their business knowledge of office procedures.

In all the courses geared for the "slow learner," his personality traits are developed and good work habits stressed. For good citizenship is an integral part of the student's total business education, along with his business skill or knowledge.

18. Since the conventional and traditional subjects of bookkeeping and shorthand require a high degree of "mental ability," or "student ability," or "scholastic ability," it is clear that only students who rate high in this type of ability should be encouraged to pursue training for entrance into business through the medium of a bookkeeping or stenographic position.

The business education student may choose one of three areas of study, namely: Clerical, Bookkeeping, and Stenography. In the ninth grade, the student is first guided into one of these three areas with the help of his business teacher who uses as his guide the results of the Turse Test plus the actual grades received by the student (especially his English grade). These enable the teacher to steer the student into the proper field of study. Only the most capable students are encouraged to take either shorthand or bookkeeping.

Once the student enters the high school and begins to pursue his chosen field, the teacher is constantly alert to the way in which the student is grasping the subject matter. The first "screening" takes place in December at which time the student is required to fill out a tentative subject election schedule for the following year. If the teacher teaching the first-year subject does not feel the student will be able to successfully complete the three-year program he has set

for himself, the teacher will then, with the aid of the guidance department, guide the student into a different area. It can be said, therefore, that the first year of Shorthand, Bookkeeping, and Typing is a "trying-out period."

The subsequent years of study are further controlled by prerequisites which have been set up for the various courses and which must be met before the student is allowed to continue.

19. Since selling (retail or outside) requires what may be called an alert mind and pleasant personality, it is clear that persons who do not possess these qualities should be discouraged from seeking training for selling positions.

Through the channels of our Guidance Department, the primary screening processes are performed. Aptitude tests, interest inventories, personality and behavior descriptions, and individual counseling interviews help the counselor, teacher, and student to recognize the feasibility of selling as a career. If a student erroneously passes these preliminary criteria, he will be detected and redirected through his teachers' thorough screening each year as they give their recommendations at subject election time.

20. The high school business program must contain the best possible provision for such pupils as are not likely to succeed in stenographic, bookkeeping, and selling positions.

Although Ewing's Business Department can boast of its success in training proficient future office employees, its curriculum is not limited to these skills. Key punch training is available in conjunction with other unit record equipment such as the verifier, sorter, and accounting machine. A proficiency is developed in the operation of other office machines, including ten-key adding machines, printing and rotary calculators, full-keyboard adding machines, bookkeeping machines, duplicating machines, and dictating equipment. Another course encompasses areas such as filing, routine typing, a variety of office machines, and other clerical chores. In addition, general business subjects are available for those individuals pursuing positions in which skills are not involved or seeking higher education upon high school graduation.

21. All business courses should be offered with the needs of business pupils in mind and pupils outside the business department should be permitted to elect these courses only when it is clear that they will do the work required exactly as if they were taking such courses with definite vocational intent.

Most courses offered by the Business Department of Ewing High School have a dual objective--vocational and personal use. Vocationally, the student is trained to become an efficient and proficient office employee with a pleasing personality and of sound character. Personally, both the academic and the business student are acquainted with skills, concepts, appreciations, and understandings that will enable them to become upstanding citizens and intelligent consumers in our business world today and tomorrow. Whether they are skills or general business subjects, these courses are taught with the business student in mind.

22. The development of vocational skills and occupational understanding is accomplished most expeditiously and satisfactorily when the trainee has an opportunity to establish contact with actual business during the period of training; hence, it is desirable to make provision for some form of cooperative training whenever feasible.

A cooperative work experience program is in operation at Ewing High School. Participants are engaged in typing, secretarial, bookkeeping, key punch, and clerical duties in the community. Mornings are spent in the classroom and afternoons on the job. Students receive wages comparable to those of employees performing similar duties. Opportunities for vacation and full-time employment are prevalent for students participating in this work experience program. The coordinator works closely with the business community to find for each individual the most meaningful employment situation. With the addition of training on the unit record equipment (made available through funds under the Vocational Act of 1963), the number of students participating in the on-the-job training has more than doubled.

23. The syllabus for each subject in the business curriculum should contain for that subject (a) statement of aims, (b) essential content for use in achieving those aims, (c) suggestive methods for using that content, (d) definite testing procedure for determining whether or not aims have been achieved, and (f) helpful bibliography.

Attached are the courses of study for Ewing's Business Department. The five criteria suggested above are met as can be evidenced by merely reading the subheadings of each subject's course of study.

24. Businessmen should be consulted in the organization of any high school business curriculum which is expected to train boys and girls for employment; hence, an advisory committee should be organized and used freely in consultative capacity.

The suggestions and evaluations of businessmen participating in the Cooperative Work Experience Program are solicited annually. These are thoroughly analyzed and implemented when found to be practical and in conformance with our philosophy. These businessmen are also consulted periodically by the work experience coordinator concerning all phases of our vocational business curriculum. An advisory committee per se is not in existence; however, the close relationship between school and community and particularly between the work experience coordinator and participating employers is sufficient to make our program a successful one.

25. The outcomes of a vocational business education program can be improved by providing (as a joint responsibility with guidance personnel) a placement service and continuous follow-up procedures.

Placement and follow-up are the joint responsibility of the Guidance Department and the business education faculty. One of the four guidance personnel is responsible for the counseling, placement, and follow-up of business students both in and out of school. Employment opportunities are channeled through her office and are made known to interested and qualified students. Periodic follow-up surveys are conducted to determine the whereabouts of business graduates, the role of the Business Education Department, and the importance of guidance and placement services. Through her close contacts with the business community, the Cooperative Work Experience Program coordinator is also in a position to offer placement services. She works in conjunction with the Guidance Department in placing not only students participating in the work experience program but also others who meet the qualifications specified by job descriptions of office vacancies.

26. It must be assumed that instructional staff is competent from the point of training and experience in the business world and is also up-to-date by maintaining professional as well as business contacts.

The instructional staff consists of eight members who are educationally, professionally, and personally qualified in their fields. Educationally, all have a teaching certificate, three hold a masters degree, two are currently in pursuit of it, and three have successfully completed training at IBM institutes. Professionally, members have engaged in various activities to enhance their professional standing: a) all staff members have been employed in office-related occupations, b) active participation in conventions, c) membership in professional organizations, d) attendance at workshops and conventions, and e) in-service activities aimed at the improvement of the business education curriculum.

A. Identify these improvements

1. The most significant improvement resulting from the funds obtained by Ewing High School's Business Department under the Vocational Act of 1963 is the expansion of our Cooperative Office Work Experience program. This year we have been able to more than double the number of students participating in on-the-job training.

   Seniors enrolled in Clerical Office Practice and Clerical Problems were given training in the use of data processing equipment (unit record equipment, wiring panels, Burroughs Sensimatic Bookkeeping machine, and calculating and adding machines.) This training enabled them to be placed in positions operating unit record or closely related equipment.

   Fortunately, plant facilities made it possible to house the unit record equipment in a room which has been wired at school board expense of $1260.00. Supplies for this training was also paid by the school board.

   The Norelco Steno-Trainer equipment, also acquired through the pilot program, has enabled the students of stenography to receive individualized instruction while simultaneously develop additional skill in the taking of dictation.

2. The content of a course entitled data processing developed this school year will be offered to qualified twelfth-grade students beginning in September, 1966. A course of study has been prepared and instructional materials have been selected to satisfy the needs of this subject.

3. Three high school instructors have been trained in the area of data processing. They attended IBM Institutes in New York and Philadelphia during the summer of 1965 at school board expense of $2435.26 and have been enrolled in weekly workshops during the school year. Their training has enabled them to become not only proficient in the operation of unit record equipment, but better able to develop this skill in their students. They are presently making plans for additional training this summer at the IBM Institute.

   Application has been made by the two stenography teachers for enrollment in the State-sponsored course in the use of the Norelco Steno-Trainer equipment.

4. A course for adult training in IBM keypunch is being offered two evenings a week. In addition to keypunch training, this course devotes time to the analyzation of punched cards, introduces the principles underlying automated record keeping, and develops an acquaintanceship with other unit record equipment.

5. In December, the Business Department of Ewing High School sponsored a workshop to acquaint Mercer County Business teachers with its offering in data processing. Lectures were given followed by actual application; i. e., designing card programs, keypunch operation, machine verification, sorting panel wiring, and report preparation on 402 Accounting machine. Our aim was to initiate interest in the development of similar programs in the Mercer County secondary schools.

6. On numerous occasions we have been visited by teachers in the surrounding area. The purpose of these visitations was to observe our program in operation and to seek advice in the establishment of pilot programs in the field of data processing and of Cooperative Office Work Experience programs.

7. We are presently in the process of planning a program to acquaint the other members of our Business Department with the automated equipment acquired through the Vocational Act of 1963. This fall we participated in an in-service program on the operation of the Alpha-Numeric bookkeeping machine by Mr. Jack Shevillo, Burroughs representative.

B. Additional Improvements

1. Our emphasis on improvements has been directed toward the area of data processing. Our experience in this area reveals a strong indication that facilities should be expanded in order to enable more students to take advantage of this training. Because our improvements are based primarily on the availability of rented equipment, we are very much concerned with the continuation of our first-year requests with limited expansion of rental equipment. In addition, we can develop a salable skill in billing machine operation for the slower business students.

2. Our experience also reveals many opportunities for billing machine operators and, therefore, we are proposing the purchase of a second bookkeeping machine. A definite salable skill in billing machine operation can be developed in the slower students.

3. The purchase of an additional five electric typewriters will enable us to bring advanced typewriting courses to full capacity.

4. The installation of a telephone made available to the business education coordinator will enable her to more efficiently perform the tasks of placing students on the job.

C. Priority list of items which would help to implement these additional improvements.

Priority #1

One year rental of following equipment

8 Keypunch 026	$5,760.00
1 Card Verifier 056	600.00
1 Sorter 082	540.00
1 Accounting 402	2,760.00

Purchase equipment

1 Burroughs Automatic form aligning Sensimatic Bookkeeping machine	3,015.00
5 Electric typewriters @$353.20	1,766.00
1 Burroughs Full-Keyboard Adder Style P2208 List 10 Total 10 with credit balance	281.25
Installation of telephone in business wing	75.00
Second year rental of keypunch tapes	100.00
20 Reinforced Learning Systems Operators manuals	40.00
10 Boxes of Continuous Form Stock Paper	154.50
100 Pads Planning Charts & Wiring Diagrams	22.00

2 boxes Carriage Control tapes for 402 accounting machine	6.00
332 M IBM Cards	300.00
Ledger, journal, check supplies for Burroughs Sensimatic Bookkeeping machines	1,011.60
Tapes for Norelco Steno-Trainer	135.00
Training at IBM Institute for 2 instructors	500.00

Priority #2

1 Burroughs Series C1303 Duplex Calculator	648.75
1 Burroughs Series C1203 Simplex Calculator	457.50
1 tape recorder (sony)	125.00
4 F-6-C-N Chairs @ $25.00	100.00
1 Model 3M (Secretary) copier	379.00
TOTAL	$18,776.60

ANNEX "I"

S A M P L E

WORK EXPERIENCE PROGRAM

FOR THE

MENTALLY RETARDED AND SLOW LEARNER

WORK EXPERIENCE PROGRAM

FOR

MENTALLY RETARDED STUDENTS

AT

RANDOLPH HIGH SCHOOL

Although Randolph High School is in a somewhat rural area and is handicapped because of this, our school is attempting to set up a vocational work experience program for the mentally retarded.

This paper is written for laymen and educators to understand the general nature of the employment orientation program for pupils in special education classes in secondary schools.

It must also be recognized by the local Board of Education that the employment orientation program depends upon the willingness of industry to accept such a program.

This work experience program is designed specifically for retarded students and differs greatly from other cooperative education programs both in objectives and operational procedures.

RANDOLPH HIGH SCHOOL
MILLBROOK - MT. FREEDOM ROAD
DOVER, NEW JERSEY

FOXCROFT 1-2400

Dear Employers:

The Randolph School District is currently engaged in a study of job qualifications and curriculum needs for certain of its students. This study will yield information which will make it possible for the schools to provide a program tailored to the needs of these students as indicated by the qualifications required by employers.

The students who are the subject of this study will rank below average in college preparation ability. They can do well in certain types of jobs. In fact, with training and job placement tailored to their capabilities, they have a high potential as hard working, trustworthy employees. It is our hope that this study will make possible training and job placement opportunities to fill the needs of this group. It will be appreciated if you will assist us in this study by completing the following questionnaire and returning it in the enclosed stamped, self-addressed envelope.

Sincerely yours,

David J. Petrosky
Work Experience Supervisor

RANDOLPH HIGH SCHOOL

MILLBROOK - MT. FREEDOM ROAD
DOVER, NEW JERSEY

FOxcroft 1-2400

1. Name of Firm_____ Address_____

2. Type of Business_____ Specific Operations_____

3. Number of employees_____ _____

4. Does your firm make use of part-time help? Yes___ No___

5. Do you require a high school diploma as a condition of employment in your firm? Yes___ No___

6. How many employees are there in your firm with less than a high school diploma? _____

   a. Are any of these employees attempting to complete high school now? Yes___ No___

   b. Have any of them had special training (aside from on-the-job) since dropping from high school? Yes___ No___

7. Does your firm have job descriptions for each classification of position? Yes___ No___

8. Name and position of individual we may contact for personal interview.

_____NAME

_____POSITION

RANDOLPH HIGH SCHOOL
MILLBROOK - MT. FREEDOM ROAD
DOVER, NEW JERSEY

FOxcroft 1-2400

ADVISORY COMMITTEES AND DUTIES

A representative advisory committee composed of outstanding persons from labor and management and representing the major business and industrial establishments to be included in the employment work experience program may be appointed by the supervisor from those returning the questionnaires.

They will meet periodically as long as the program is in operation. This committee can advise in the following areas:

1. Student Qualifications
2. School-Employer Agreements
3. Related Instruction
4. Safety instruction in school and on-the-job.
5. Possible job placement opportunities and the development of sound public relations.

INTERVIEW GUIDES

Normally a survey by mail is sufficient in other work experience areas. However, because we are attempting to provide a curriculum specifically tailored to the needs of these students as indicated by the qualifications required by employers, a personal interview is required.

Your firm has completed a questionnaire which gave us basic information about your business and personnel placement. We would appreciate an hour of your time to explore further your business operations as it relates to our work experience program for mentally retarded students.

To conserve your time and to be certain that important points are covered, we will follow this guide.

1. Review the term non-academic as used in this study.

2. What is your most simple job?

3. How many of your job descriptions do you find suited to the non-academic?

4. What specific qualifications would your firm demand of applicants for jobs suited to non-academic?

5. Do you now have employees with high qualifications on jobs which might be filled by trained non-academics?

6. Have you found that workers with limited academic ability tend to remain satisfied with beginning jobs?

7. What per cent of your workers are (a) men_____? (b) women_____?

8. What is your chief source of supply for employees?

Possible Area Jobs for Educable Pupils from Interviews

Riverside Hospital
Dover Hospital
St. Clair Hospital
St. Francis Hospital
Greystone
Randolph High School
Trim Flex
Resorts

Ward Maid (hospital)
Charwomen (hospital, offices, plant)
Porter or Janitor
Stock Boy (retail trade)
Simple Machine Operator (drill press)
Routine sewing machine operating
Various Restaurants and Resorts - Cafeteria Jobs
Hand and Machine Dishwashing
Cleaning: pots and pans, work space
Preparation of vegetables
Removel of trays of soiled dishes
Laborer - Construction
Mason tender
Landscape - laborer
Farm work
Folding or Packing - Laundry, Manufacturing, Dry Cleaning

Dover Area

American Bottling
241 E. Blackwell St.
Dover, N. J. - FO 6-0217

Carson Gedel Rubber Co.
291 Park Heights Avenue
Dover, N. J. - FO 6-0010

Dover Hosiery Shop
37 N. Essex Street
Dover, N. J. - FO 6-2831

Peerless Handbag Co.
1 West Blackwell St.
Dover, N. J. - FO 6-1966

Reliance Picture Frame
158 W. Clinton Street
Dover, N. J. - FO 6-1130

Standard Printing Co.
Berry St. & Lincoln Ave.
Dover, N J. - FO 6-0006

Swiss Knitting Company
Spruce Street
Dover, N. J. - FO 6-0071

A. M. Walter Co.
264 E. Blackwell St.
Dover, N. J. - FO 6-1905

Denville - Rockaway Area

General Box Co.
30 Estling Road
Denville, N. J.

King Container Corp.
114 Beach Street
Rockaway, N. J.

G. G. Glover Co.
160 Franklin Ave.
Rockaway, N. J.

Rockaway Knitwear Co.
Mt. Pleasant Ave.
Rockaway, N. J.

Hungerford Plastics Corp.
114 Beach Street
Rockaway, N. J.

"WHY" THIS PROGRAM AT RANDOLPH

PURPOSE

Building personal qualifications so that the retarded adolescent can think, feel and act appropriately in the many situations of everyday life is one of the chief responsibilities of the school. Development of such qualities requires more painstaking guidance on the part of those who work with the retarded pupil if he is to achieve status. One real test of the efficiency of a program is its ability to provide opportunities for the mentally retarded to develop socially acceptable behavior.

The high school provides terminal education for mentally retarded students. Consequently, it must concern itself with the important problems of vocational guidance, occupational guidance, occupational orientation, and work experience of a pre-vocational nature.

STAFF

Education of mentally retarded pupils at the secondary level is a team job requiring the understanding and cooperation of several members of the school staff. It is not enough to organize a special class for these youth.

In addition, the special class teacher has to have the solid support of parents, regular classroom teachers, special service personnel such as counselor and school nurse, and the chief administrator of the school.

EMPLOYMENT WORK EXPERIENCE

PROGRAM AGREEMENT

_____
(Name of School)

I The employer _____
(name and address)

agrees to employ _____
(name and address of student-trainee)

on an alternate in-school and on-the-job training program. Not more than forty hours per week shall be spent in employment. If the student devotes time to in-school training during any week, the hours of employment shall be reduced. In no case shall the time at school and the time at work exceed a total of forty hours per week.

II The employer will offer the following work experience during the training period and will follow a rotation plan that provides basic training in each of the experiences listed.

JOB EXPERIENCES

1.	6.
2.	7.
3.	8.
4.	9.
5.	10.

III The employer will assign some member of his organization, a qualified employee, who will have a continuing responsibility for the training and supervision of the student trainee. The person responsible for this training on the job is _____
_____.
(name and title)

IV The schedule of compensation to be paid the employment orientation student while at work will be at least $_____ per hour. If the student is employed in an occupation in which non-handicapped employees in the establishment are paid at piece rates, he shall be paid at least the same piece rates. The named worker or trainee must be paid his full piece rate earnings or the earnings based on the hourly rate specified above, whichever is the greater.

V The employer agrees that where a union or bargaining agency is involved, he will obtain union approval of the program.

VI The student, while in the process of training, will have the status of student-trainee, neither displacing a regular worker now employed, nor substituting for a worker that ordinarily would be needed by the employer.

VII The employment orientation course student will be covered by Workmen's Compensation Insurance and any other benefits to which he is legally entitled as a worker. The student, while working in the employer's establishment shall be subject to all regulations applying to other employees.

VIII Since the employment orientation education program is under school supervision, the teacher-coordinator will be admitted to the employer's premises at such times as the coordinator deems it necessary to observe the student at work and evaluate his progress. The coordinator will conduct his observation in such a way as to cause a minimum of interference with the employer's business.

IX At regular intervals (not less than two weeks) the coordinator will consult with the employer or his representative for the purpose of evaluating the student's progress so that an accurate school record can be maintained.

X The student agrees to report for work punctually and regularly. He also agrees to follow the orders and instructions of his supervisors at all times.

XI The parent or guardian shall be responsible for the personal conduct of the employment orientation course student during his period of training.

XII All complaints shall be made to and adjusted by the teacher-coordinator.

XIII The employment of the employment orientation course student, shall be in accordance with federal, state and local laws and regulations.

XIV This agreement may be terminated by the employer at any time after consultation with the teacher-coordinator. The teacher-coordinator may terminate this agreement at any time after consultation with the employer.

XV Signatures

Teacher-Coordinator	Employer
Parent or Guardian	Representative of Employer
Date	Student-Trainee

CATEGORY OF WORK POSSIBILITIES

CATEGORY OF WORK POSSIBILITIES FOR THE SLOW LEARNER

1. Apprentice painters
2. Barber
3. Bookbinding helpers
4. Box boys (supermarket)
5. Carpenter helpers - apprentices
6. Clean-up and mechanical helpers
7. Common labor
8. Construction helper
9. Cooks helper
10. Cosmetology
11. Delivery and related work
12. Dishwashing
13. Dry cleaning helpers
14. Elementary electricity helpers
15. Fabrication
16. Fire protection work
17. General tire work helpers
18. Greenhouse and plant care
19. Janitorial helpers
20. Loading trucks
21 Machine operators
22. Main service
23. Mechanical work on cars and machinery
24. Nursery assistant
25. Nursing home helper
26. Plumbing helper and apprentice
27. Processing and canning fruit
28. Running electric power
29. Service Station attendant
30. Sheet metal workers
31. Simple filing and general office work
32. Stockroom work
33. Upholstery work
34. Utility floor covering work
35. Waitress
36. Warehousing
37. Yard work

Parents:

Since the nature of the special education program is one that aims at developing the social, emotional, and vocational attitudes of the students, it is important that the parents understand what we are doing. By gaining an understanding, they can better evaluate the program of their children.

It is also necessary that the parents give their written approval before students are placed in a work study or work experience program.

COORDINATOR

EMPLOYMENT ORIENTATION WORK EXPERIENCE TEACHER-COORDINATOR RESPONSIBILITIES

1. Surveying local employment opportunities.
2. Arranging interviews for trainee applicants.
3. Assisting in organizing the advisory board.
4. Publicizing the cooperative aspects of the program.
5. Interviewing and selecting prospective pupils.
6. Approving establishments for employment orientation training. Consult with the N. J. Rehabilitation Commission and arrange for the establishment of cooperative employment planning for each student.
7. Working out training schedules with employers.
8. Certifying the qualifications of employees assigned by employers to train student-trainees.
9. Assisting in the scheduling of classroom programs for pupils.
10. Developing adequate records and reporting systems.
11. Preparing courses of study in related instruction.
12. Teaching the classes in related instruction.
13. Arranging adequate classroom facilities and requisitioning necessary teaching materials.
14. Counseling pupils regarding placement with respect to appropriate employment objectives.
15. Maintaining contacts with local employers.
16. Carrying out follow-up studies of graduates.
17. Assisting pupils to obtain work permits, social security cards, health certificates, and special certificates for employment of handicapped workers.
18. Checking with employer to make sure student has filed all required permits, certificates, etc. before actual placement of student on the job.
19. Visiting pupils working at training establishments to:
    a. Observe the type of work being done.
    b. Arrange with employers for rotation of pupils through a wide range of activities to achieve the training objectives.
    c. Analyzing the jobs of the pupils to secure information for work-theory coordination.
    d. Determining how related instruction within the school effectively supplements the on-the-job training.
    e. Adjusting any problems arising between pupil and employer.

RESPONSIBILITIES AND DUTIES OF THE EMPLOYER

RESPONSIBILITIES AND DUTIES OF THE EMPLOYER

Following are some of the employer qualifications that are evaluated in approving him and his establishment for employment of participating students in the work experience program.

1. He must accept a training responsibility.

2. He must show evidence of safety consciousness and provide properly guarded equipment for his workers.

3. He must be willing to assign a qualified employee who will be responsible for the training function and whose qualifications are certified by the teacher-coordinator.

4. He must be a party to a written agreement with the school indicating the specific nature of the job experiences to be offered and his acceptance of the conditions of the training plan.

5. He must agree to regular supervision of the program by a teacher-coordinator employed by the school, and other details which will safeguard the participating student and insure the orderly progress of the training program.

CURRICULUM

GENERAL SCOPE AND SEQUENCES

A student entering the secondary program for the retarded, will take a curricula that covers four years. Each year is a sequence of cores in order to develop the child's potential and prepare him to meet the world. Students progress through cores on an individual basis.

Core I serves as an orientation period during which the student learns to adjust to his surroundings. At this time he learns to follow the school rules and regulations; to discipline himself and follow a rigid schedule; gain poise and self control; be generally familiar with the "World of Work"; gain more competence in the basic skills; know and accept his problems without shame; know job opportunities available and how to apply for them; know importance of getting along with other students.

Core II serves a dual purpose. It is basically an extension of Core I, but also includes an in-school work program as an introduction to further work experiences. At this time the student will use his basic tools to help him in various job situations. He will receive training so that he will be able to support himself in the "World of Work". Functioning independently is the underlying philosophy of this curricula. Therefore most of the concepts and activities develop from these factors.

Core III moves the student from a school situation into the community for various job experiences. At this time he will also receive classroom experiences coinciding with the community jobs. Also he will be given further training in the tool subjects. Half of the student's time will be spent in school and half in the community. The time in school will be devoted to facing and solving problems met in work experiences. The aim of this core is to prepare the student to gain the proper skills to retain a job after completion of our four year program.

Core IV is the last phase of a four year program. At this time, the student will use all his past experiences to cope with this core. The student will have work experiences outside the community as an extention of Core III. He will learn to solve household chores, take care of his income, and earn money to act independently. Since this is the last phase of a four year program, the student will fill out more job applications and have job interviews. If possible he will have part time employment with a company for which he will eventually work. Problems he meets will be solved in school.

SPECIAL EDUCATION

IN SCHOOL WORK EXPERIENCE PROGRAM

GENERAL STATEMENT AND INTRODUCTION

The basic idea behind our in-school work experience program is to introduce special education students to work situations before they reach the age of 16. This will be accomplished through a program of a part-time nature; from one to three hours a day. The other four school hours will be spent in various subject areas. Since students will be at varying levels of readiness to participate, it is possible that only one or two students will be taking part each semester. We are also limited by the number of in-school work experiences available.

OBJECTIVES

1. To introduce the students to the world of work.

2. To enable students to develop personal responsibilities necessary to hold a job.

3. To provide actual work experiences and simple skills related to positions students might enter after leaving school.

4. To integrate work experience as part of the regular Special Education curriculum.

PROGRAM PLAN

1. The School Work Experience Program should be designed to combine actual job learnings within the school, and on the job discussions and demonstrations to the other members of the class of the skills he has learned.

2. Time Allotment: One to two marking periods per year depending upon the development of the individual student. One to three hours will be spent each day.

3. Areas of Assignment:
   Area A--Work with head custodian.
   Area B--Work with maintenance man.
   Area C--Special Work Assignment.

COMMUNITY WORK EXPERIENCE PROGRAM

COMMUNITY WORK EXPERIENCE PROGRAM

OBJECTIVES

1. To broaden background and preparation for work initiated in the school program.

2. To assist the student prepare for working through part-time experience while still in school.

3. To increase student independence and ability to secure and retain a job after leaving high school.

4. To gain understandings:

   jobs contain many skills; each is important
   characteristics of a good worker
   how to secure a job, to keep it
   job opportunities and requirements

5. To gain through supplementary classroom activities information about the world of work:

   local job families - kind of workers - job requirements
   self-analysis related to jobs
      general picture of abilities
      factors in securing a job
      factors in holding a job

FORMS

PROPOSED JOB ANALYSIS SHEET FOR
POTENTIAL JOB PLACEMENTS

ESTABLISHMENT : JOB TITLE :

WORK PERFORMED	WORKING CONDITIONS	REQUIREMENTS (TRAINING)	REQUIREMENTS (PERFORMANCE)	REQUIREMENTS (PERSONAL)
	WAGES	EXPERIENCE	RESPONSIBILITY	BEGINNING AGE
	HOURS	TRAINING DATA		SEX
	SURROUNDINGS	MANUAL		LICENSE
				BOND
	HAZARDS	NON-MANUAL	MENTAL APPLICATION	UNION
				TESTS TO BE PASSED
	BENEFITS	GENERAL EDUCATION	DEXTERITY & ACCURACY	PHYSICAL DEMANDS

ADDITIONAL COMMENTS :

PERFORMANCE AND ADJUSTMENT RATING

Name_____ Rating for period_____to_____

Rating by_____ Assignment_____

To the rater: Evaluation of a trainee's progress and of the training program depends upon information provided by supervisors. Your careful rating of this trainee will be greatly appreciated.

In making your ratings, consider the descriptions and assign for each a number as follows: using as your basis for comparison, persons at the same level of training:

1. Poor in the characteristic described.
2. Below average in the characteristic described.
3. Average in the characteristic described.
4. Above average in the characteristic described.
5. Very good in the characteristic described.

Characteristic	Rating (Please Circle)
Punctuality Arrives at assignment on time; returns promptly from "breaks"; indicates awareness of, and concern for promptness.	1 2 3 4 5
Work Readiness Settles down to work readily; is interested and does not have to "warm up" to it, or have to be urged or reminded to begin work.	1 2 3 4 5
Appearance Wears clothing suitable for the job, is clean and neat; well-groomed.	1 2 3 4 5
Sanitation and Health Avoids spread of germs or unnecessary exposure to health hazards; uses handkerchief to cover coughs and sneezes; uses washroom facilities; keeps self clean.	1 2 3 4 5

Accepts Directions

Does not resist being told what to do; listens to and attempts to understand directions. 1 2 3 4 5

Able to Follow Directions

Performs tasks as directed; does not need instructions repeated frequently; does not do tasks in ways other than directed; adapts easily to changes in directions. 1 2 3 4 5

Seeks Assistance

Recognizes need for assistance, and asks for it; requests assistance from appropriate person. 1 2 3 4 5

Accepts Assistance

When given assistance, accepts readily; interprets assistance as helpful rather than as adverse criticism. 1 2 3 4 5

Perseverance

Continues with assigned task until completed or until quitting time; does not leave assignment or change from one task to another. 1 2 3 4 5

Effort

Works up to best ability, enthusiastic and takes pride in work; degree of effort is fairly constant and does not vary from task to task or from time to time. 1 2 3 4 5

Concern for Materials

Appreciates value of and conserves materials; avoids unnecessary waste; discards only unusable materials. 1 2 3 4 5

Safety Consciousness

Is aware of and avoids safety hazards; keeps work area clean; uses tools and equipment appropriately. 1 2 3 4 5

Disposition

Even-tempered; pleasant; not disturbed by changes in assignment or work conditions. 1 2 3 4 5

Self-Control

Takes frustrations with little difficulty; controls behavior well; behaves appropriately in the work situation. 1 2 3 4 5

Relation with Co-workers

Friendly with co-workers; not overly dependent upon them; initiates conversation; gets along well; doesn't become involved in arguments. 1 2 3 4 5

Relation with Supervisor

Accepts supervisor's authority; gets along well with supervisor; is not overly dependent upon supervisor or try to be overly friendly; respectful. 1 2 3 4 5

Politeness

Uses expressions "thank you," "please," and so on; is considerate of others; waits turn in conversation; not loud or profane. 1 2 3 4 5

- - - - - - - - - -

Rater's estimate of trainee's general performance and adjustment. 1 2 3 4 5

- - - - - - - - - -

Any additional comments on the trainee will be appreciated.

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

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STATE OF NEW JERSEY
DEPARTMENT OF EDUCATION
DIVISION OF VOCATIONAL EDUCATION

BAKING

RELATED SCIENCE & TRADE INFORMATION

PART 1 - INGREDIENTS

ED013339

Prepared By
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VT003129

State of New Jersey
Department of Education
Division of Vocational Education

BAKING

RELATED SCIENCE AND TRADE INFORMATION

PART I - INGREDIENTS

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Second Printing March, 1967

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(Address) School of Education-Rutgers; 10 Seminary Place, New Brunswick, N J 08903

DATE: July 28, 1967

RE: (Author, Title, Publisher, Date) "Baking - Related Science and Trade Information" ;

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Development Group Author and related instructors
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Method of Design, Testing, and Trial Testing and trial within classroom

(3) Utilization of Material:
Appropriate School Setting Related classroom
Type of Program Vocational - High School
Occupational Focus Baking
Geographic Adaptability Unlimited
Uses of Material Related classroom text
Users of Material Students

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Teacher Competency Certification - science - baking background preferred
Student Selection Criteria Student preference and guidance approval

Time Allotment One year

Supplemental Media -- N/A
Necessary ____) (Check Which)
Desirable ____)

Describe

Source (agency)
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TO THE STUDENT

"The first step in learning
is learning how to learn..."

There are more bakery workers than baking craftsmen because it is easier to learn the HOW of baking than to learn the WHY of baking.

Learning HOW involves learning manual skills, mainly. Learning WHY involves understanding difficult concepts and acquiring many new facts.

This book is more than a collection of baking facts, however. It is part of a method of learning. The method tries to make the process of learning a pleasant experience.

In the first place, the student is not required to struggle through each new unit at home by himself. Instead, all study it together in class. Seated around a large workbench, facing his classmates, a student reads a single paragraph under the leadership of the teacher.

Often, one student's personal experience helps clarify a point for the entire class. The group proceeds together, only as rapidly as each of you understands the new words, new concepts, and new relationships.

In the second place, you know for every topic what is expected of you, for each unit is accompanied by a test, which you grade yourself. You find out for yourself just what your weak points are. The test becomes a learning device, for its only purpose is self-evaluation. Of course, mid-terms and final exams are graded by the teacher, but they are based on the tests you have already taken.

Finally, the most important part of this workbook is the part that you will write yourself. Each page provides a space for your notes. Use it. Don't trust your memory. The good student seldom does. That's what makes him a good student.

Far more will be said in class than I can put down in skeletal paragraphs, so write down each new fact that you learn in class. And build up your fund of information by referring to the recommended readings and references at the beginning of each unit.

In addition, get in the habit of reading trade brochures. Share your new knowledge with your class mates. When they do the same, you will find that you get more than you give. And you will find yourself on the road to craftsmanship.

UNIT I - FLOUR

CHAPTER HEADINGS

I. Introduction
II. A Brief History of the Growth and Milling of Wheat
III. Classifications of Wheat
IV. The Objectives in Milling
V. Extraction and Separation
VI. Chemistry of Wheat Flour
VII. Enrichment
VIII. Vitamins in Flour
IX. Miscellaneous Flours
X. Storage of Flour
Flour Glossary
Test on Flour

REFERENCES AND RECOMMENDED READINGS

Jacob, H. E., Six Thousand Years of Bread, Garden City, N. Y. Doubleday Doran and Company, Inc. 1945

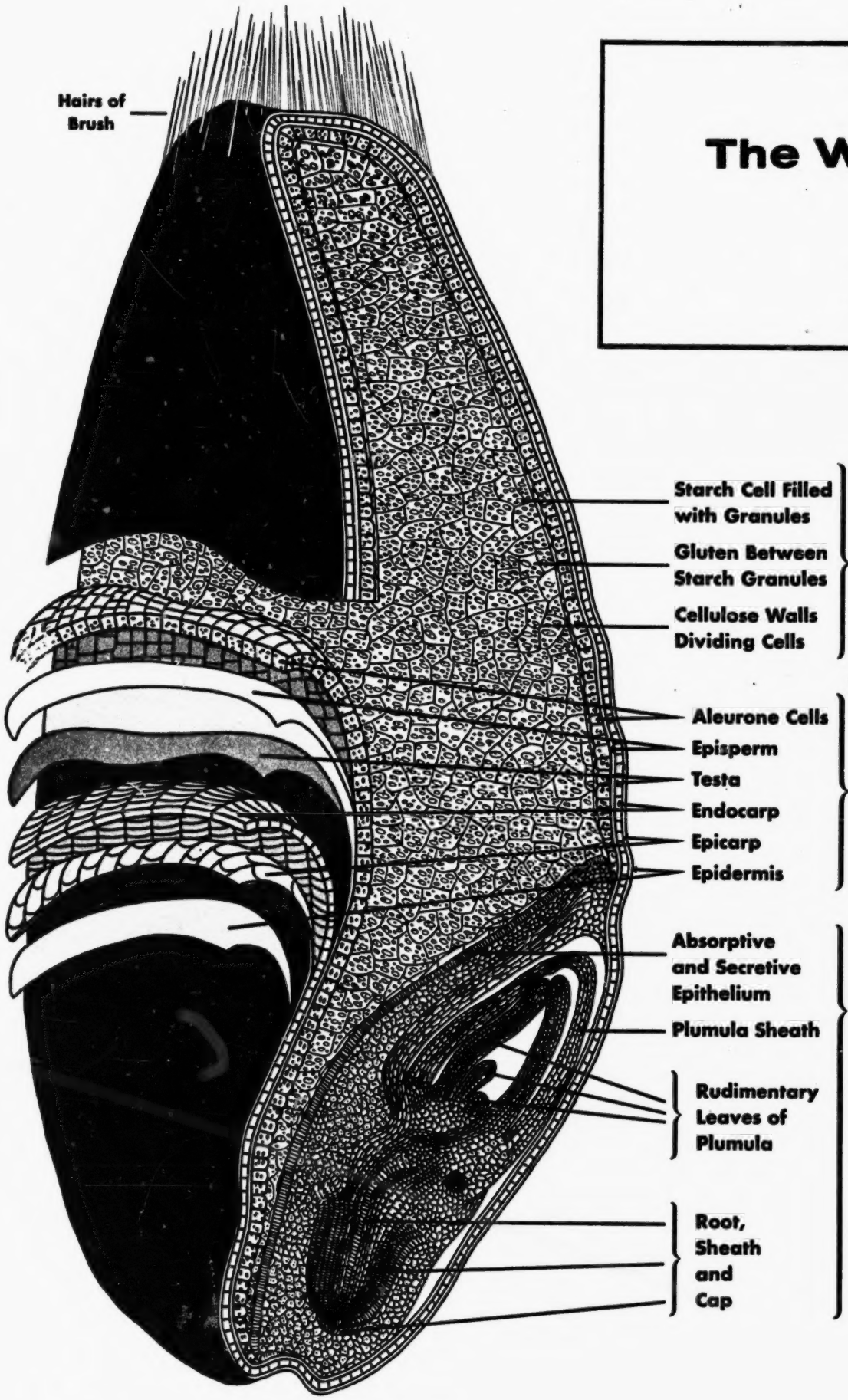
Pyler, E. J., Baking Science and Technology, pp. 191-259

Wihlfahrt, Julius E., A Treatise on Baking, pp. 1-27

From Wheat to Flour, Wheat Flour Institute

The Wheat Kernel

Copyright 1956, Wheat Flour Institute, Chicago 6, Illinois



Longitudinal Section of Grain of Wheat

ENDOSPERM

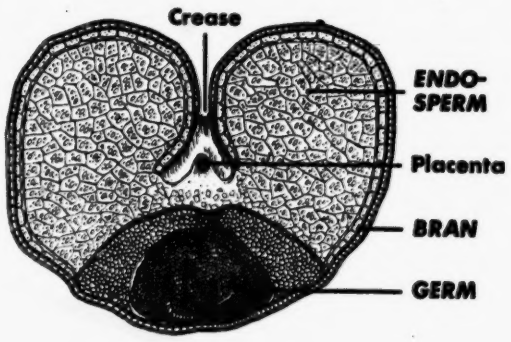
About 83% of the kernel . . . source of white flour. Enrichment adds to white flour approximately the same amounts of thiamine, niacin, riboflavin, and iron contained in 100% whole wheat, but without roughage.

BRAN

About 15% of the kernel . . . used in whole wheat flour, more often as cattle feed. About 98% of all flour consumed is white; less than 2% is whole wheat.

GERM

About 2.5% of the kernel . . . removed to improve the baking and storage qualities. High in fat and protein, it is of value in cattle feed.



Cross Section View

FLOUR

I. INTRODUCTION

NOTES

Flour is the most important ingredient in baking. It is logical that you should want to know as much as possible about it. When you have completed this unit, you will know a great deal about (1) the growth of wheat, (2) the milling of flour, and (3) the different characteristics of various types of flour.

Let's begin with a kernel of wheat. On the opposite page is an enlarged drawing of a cross-section of a single wheat kernel. The actual size of a wheat kernel is about $\frac{3}{8}$ of an inch.

It is not necessary to know all of the technical terms to be a good baker. But in order to understand the chemical process called GROWTH, and the physical process called MILLING, you will find that some knowledge of the vocabulary related to the processes is helpful. Make it a point to underline any new words in the text, and use the "Notes" section on the right-hand side of each page to fill in meanings and definitions as soon as they become clear to you.

II. A BRIEF HISTORY OF THE GROWTH AND MILLING OF WHEAT

NOTES

Historians have expressed the opinion that the dawn of civilization began with the cultivation of grain -- for when primitive man learned that wild grains were edible and that they grew each season in the same place, he stopped roaming in search of food.

Among the early peoples who knew the use of grain as food were the Swiss Lake Dwellers, who lived during the late stone age, some 8,000 years ago. Millet, a form of grain, was probably the first used, but barley and early varieties of wheat were also used. When it occurred to some cave man to grind the grain between stones to separate the more tender inner portion from the branny outer covering, milling was invented. Perhaps by accident, it was discovered that wheat was more palatable when first moistened. Later, it was discovered that it tasted even better when heated by fire.

For some 3,000 years, hard sheets of baked meal served as man's primary food. This was the only type of "bread" known to the Assyrians, Babylonians, and early Egyptians. In the valley of the Nile, where the land was rich and well watered, the cultivation of grain was practiced extensively as an affair of the state. All the grain belonged to the Pharoahs. Planting was administered by the priests. Part of the crop was turned over to the royal household, and the remainder went to the public granaries. There it was crudely ground into flour in a "saddlestone," something like a mortar and pestle.

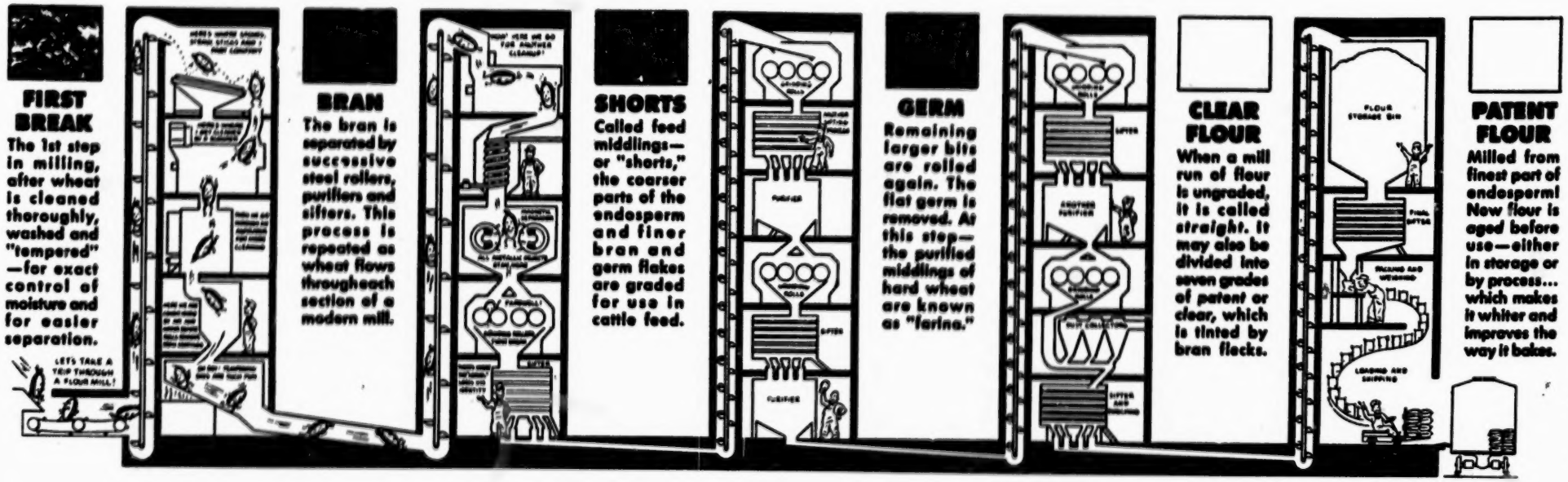
The first real step forward in milling was made by the Greeks, who developed quern mills, in which wheat was milled by a continuous motion. The quern was made by fitting two large, flat stones together. Wheat was poured through a hole in the upper stone to sift down between the upper and lower stones. A stick served as a lever to turn the upper stone against the lower one, grinding the grain. Until the development of water power to turn the millstones, there was no other important development in milling.

The next great step forward came with the invention of the steam engine in 1789, which made possible the development of the roller mill. The steps in the milling of flour in a modern mill are described in the chart on the next page.

HOW WHEAT IS MILLED INTO FLOUR

Wheat, like many products of nature, has an outer protective coat. Milling breaks away this husk, separates the endosperm, and divides wheat into different grades of flour and various products.

A series of corrugated and smooth rollers, with sieves and sifters of increasing fineness, crush and separate parts of clean wheat until 72% is finely ground into white flour, and 28% is made into by-products.



FIRST BREAK
The 1st step in milling, after wheat is cleaned thoroughly, washed and "tempered" —for exact control of moisture and for easier separation.

BRAN
The bran is separated by successive steel rollers, purifiers and sifters. This process is repeated as wheat flows through each section of a modern mill.

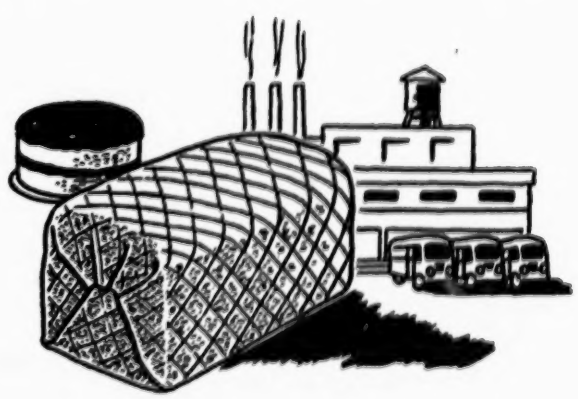
SHORTS
Called feed middlings—or "shorts," the coarser parts of the endosperm and finer bran and germ flakes are graded for use in cattle feed.

GERM
Remaining larger bits are rolled again. The flat germ is removed. At this step—the purified middlings of hard wheat are known as "farina."

CLEAR FLOUR
When a mill run of flour is ungraded, it is called *straight*. It may also be divided into seven grades of *patent* or *clear*, which is tinted by bran flecks.

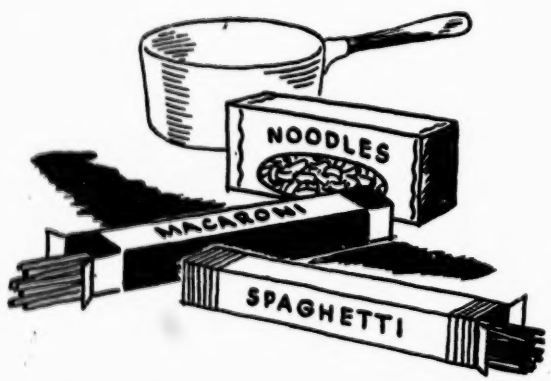
PATENT FLOUR
Milled from finest part of endosperm! New flour is aged before use—either in storage or by process... which makes it whiter and improves the way it bakes.

HOW FLOUR IS DISTRIBUTED AND USED



COMMERCIAL 68%
(approximate)

HOUSEHOLD 27%
(approximate)



DURUM PRODUCTS 5%
(approximate)

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III. CLASSIFICATIONS OF WHEAT

NOTES

Although there are more than 200 varieties of wheat grown in the United States, most of them can be grouped into five main classifications:

Hard Red Spring Wheat
Durum Wheat
Hard Red Winter Wheat
White Wheat
Soft Red Winter Wheat

Hard wheat and white wheat varieties are used mainly for making high-quality, yeast-leavened bread.

Soft wheats are best for chemically leavened baked products such as cakes, pastries, cookies, etc.

Durum wheats are used for noodles, macaroni, spaghetti.

Note that the five classifications above refer to two things -- a season and relative hardness or softness. When wheat is planted in the spring and harvested during the summer, it is called spring wheat. When wheat is planted in the winter and harvested in the spring, as it is in sections of the country where winters are mild, it is called winter wheat.

Winter wheat kernels have a softer outer covering. The flour milled from such wheat is called soft winter wheat. Most cake flours are milled from soft wheat. That's why cake flours have a characterisitically soft feel to the touch.

Spring wheat kernels have a hard outer covering. The flour milled from such wheat is called hard spring wheat.

Most bread flours and all-purpose flours are milled from these hard kernels. That's why all-purpose flour is called hard flour. It is also called strong flour because the hard kernels contribute qualities of "strength" to the dough. (See the glossary for the definition of "strength" in flour.)

As in all living processes, the final product is affected by everything that contributes to its growth. For example, how strong your teeth are depends to a great extent on the kind of food you ate as a child. Heredity also enters into the picture. If your parents had strong teeth, you are also likely to have strong teeth.

Similarly, the amount of nourishment wheat gets during the growth process determines the quality and quantity of wheat that an acre will yield. There is also a direct relationship between the amount of rainfall and the wheat yield. Even wind velocity influences yield.

IV. THE OBJECTIVES IN MILLING

After wheat is grown and harvested, it is ready to be processed into flour. This process is called milling.

Not all wheat is the same. Wheat grown in the west -- even though grown from the same seed -- will be different from wheat grown in the east because the climate, soil, and all other conditions concerned with growth are different. If you were the miller and you found that the bread baked from a particular type of flour was too white, and the bread baked from another type of flour was too creamy-colored, how would you correct the condition? You would blend both flours, of course, just as a painter might blend two shades of a color to get the exact shade he wants.

This may be an over-simplified illustration, but it tells what the miller's function is in the baking industry.

The machinery the miller uses is costly and complicated. But the process of milling is basically the same as it was thousands of years ago when the caveman crushed grains of wheat between stones to extract the white "dust" that lay hidden beneath the outer covering of the wheat grains that grew wild in the fields.

By blending a "hard" flour with a "soft" flour, the miller produces a flour with just the right characteristics for a specific product. In bread baking for example, these are the most important characteristics that the baker looks for in a flour:

1. Color (whiteness)
2. Strength
3. Absorption
4. Tolerance
5. Uniformity

NOTES

In other words, the five qualities listed above are the objectives in milling flour that is to be used for white bread. The objectives in milling flour for cake making are different.

Color

While all flours appear white at first glance, there are really a number of different shades of flour. In white bread, the color of the flour is important because it affects the brilliancy of the finished loaf. To get this color it is important that the miller select the right variety of wheat. It is also important that he extract only the center portion of the wheat kernel because the "heart of the wheat" contains none of the coloring matter that is present in the outer portion of the kernel.

Most flour has a naturally creamy color, rather than pure whiteness. Flour can be whitened by bleaching however. It is also possible to whiten flour by aging it. In fact, that's the way it used to be done before chemistry speeded up the process. Now, the bleaching process is usually performed by mixing the flour with a gas (nitrogen peroxide, nitrogen trichloride, or chlorine with nitrosyl) in an agitator.

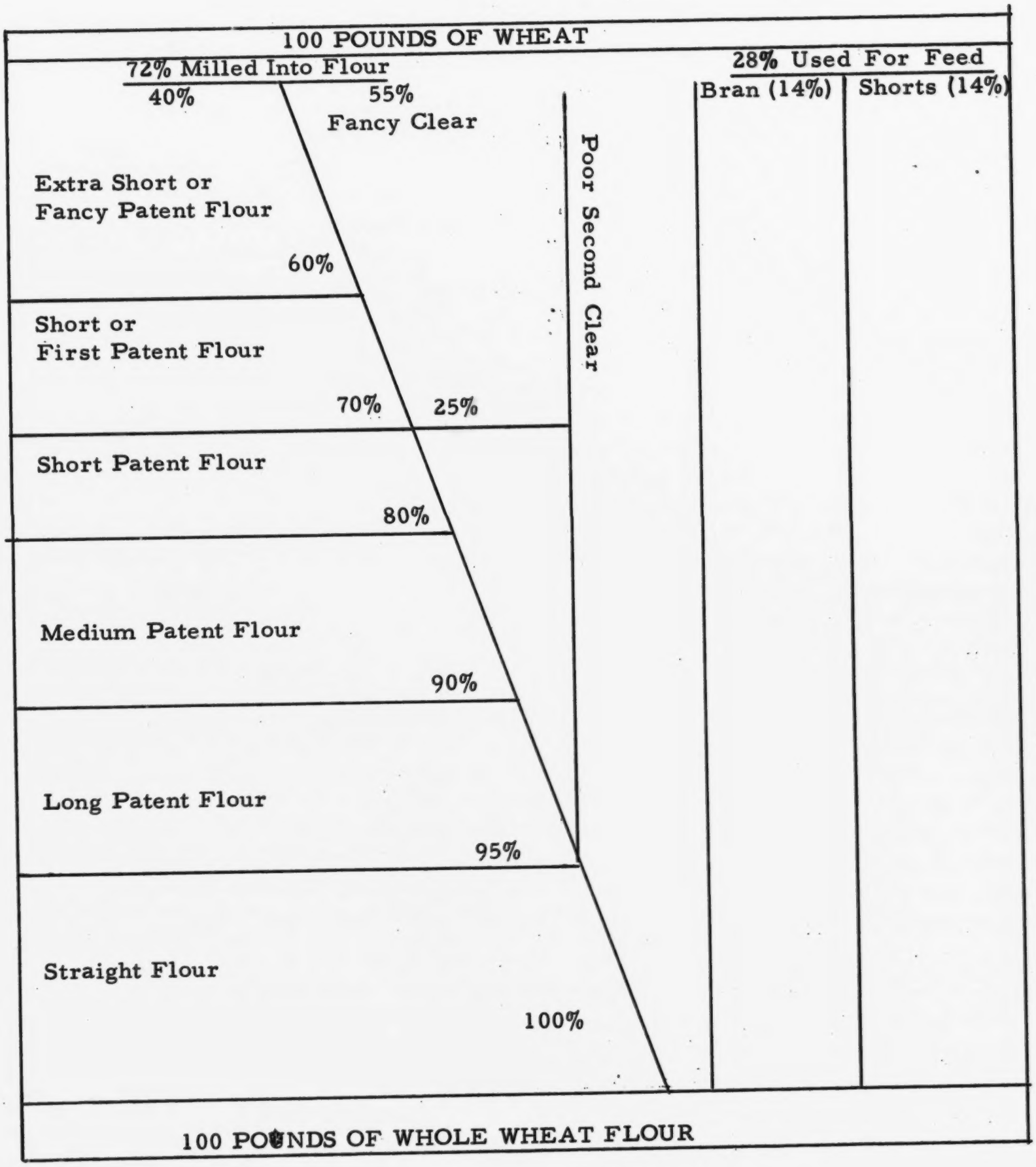
Strength

Strength in a flour means the ability to be made into large, well-piled loaves. Strength also means the ability to hold in the gas that is created during fermentation.

High Absorption

To understand the idea of absorption, think of flour as a sponge. Some types of sponges will take up more water than others. Some flours, when mixed into a dough, will absorb more water than others. When 100 pounds of flour can absorb 56 pounds of water, that flour is said to have 56% absorption. However, "true" absorption means the total of all liquids, such as eggs, milk, etc., that can be taken up by all floury ingredients, such as milk powder, dry malt, etc.

SCHEMATIC BREAKDOWN SHOWING EXTRACTION AND SEPARATION FROM 100 POUNDS OF CLEANED WHEAT



The more moisture contained in a dough, the more moisture will be retained in the baked product--and the longer it will stay fresh. Also, it will be cheaper to produce bread from high-absorption flour. Absorption is defined as the ability of a flour to carry the maximum amount of moisture in the dough and still produce a quality loaf. Absorption is higher in strong flours than in weak flours because strong flours contain more of the outer covering, the absorbent portion, of the wheat kernel.

Tolerance

Tolerance in a bread flour means the ability to produce satisfactory results over an extended fermentation period. This does not mean total fermentation period. It means that time after the normal fermentation period for the best bread has passed, but in which a satisfactory product can still be produced.

Uniformity

Not only must the baker be able to depend on the strength, absorption, and other qualities of the flour; he must also be able to depend on specific flours' having the same strength, absorption and other qualities from season to season. In other words, even though wheat differs from crop to crop, the miller must rectify the difference so that each year's supply of flour will be as much like the previous year's flour as possible.

V. EXTRACTION AND SEPARATION

It is important to understand the difference between extraction and separation if the student is to understand the milling process. On the opposite page is a chart in which the difference is graphically shown.

Extraction

When a load of wheat (let's say 100 pounds) comes to the mill, it is cleaned and a certain portion taken off for feed. If 28 pounds are taken off for feed, 72 pounds are left to be milled into flour. This is called 72% extraction flour. The chart shows the breakdown of the various kinds of flour milled from the 72 pounds of wheat.

You should understand this: The higher the extraction, the lower the quality of the flour. Look at the chart a moment. Suppose instead of 72% extraction, the miller got 80% extraction. To do so he would have to use part of the wheat that is normally used for feed. Since this is the branny outer hull, he would be lowering the quality of the flour from the standpoint of color and other baking characteristics. This was done during World War II when it was necessary to stretch our supply of wheat to help feed our allies.

Separation

Separation is concerned with that portion of the chart in the dotted box. After the flour is extracted from the wheat, the miller separates it into various types of flour. For example, when he divides the 72 pounds of flour (that he extracted from the 100 pounds of cleaned wheat) into patent flour and clear flour, this process is called separation. As you can see by referring again to the chart, there are various grades of patent and clear flours. In other words, separation means first dividing the flour into two kinds of flour (patent and clear) and then dividing the two kinds of flour into various grades. Each kind of flour is suited to a different purpose, but on the whole, patent flour is of a higher quality than clear flour.

Note that, in processing whole wheat flour, the entire 100 pounds of wheat is used. There is no extraction and no separation. The entire kernel is ground up to make a flour that has all the portions of the wheat kernel and therefore all the nutrients of the wheat. That is why whole wheat flour is more healthful than white flour.

VI. THE CHEMISTRY OF WHEAT FLOUR

NOTES

The composition of almost every strain of wheat differs from that of every other strain; naturally, this results from the fact that the conditions that went into their growth differed. On the whole, this is the approximate composition of the average of all types of wheat:

Protein	12.6%
Fat	1.9%
Ash	1.6%
Carbohydrates	70.4%
Moisture	13.5%

Protein in Flour

If there were no proteins there could be no animal life, for proteins make living tissue. Proteins are found in all substances in greater or lesser degree. Proteins cannot be stored up (as fats can) in the human body, and therefore a daily supply of proteins should be included in the diet.

Just as proteins form tissue in humans, they also form structure in leavened bread. The cell walls hold in CO_2 created during fermentation are built of protein. But the baker seldom uses the term protein. Instead he speaks of GLUTEN, a substance formed out of the constitutents of protein when water is added to the dough. The quantity and quality of gluten determine how well a bread will rise and keep its shape in baking.

Fat in Flour

Although fat constitutes about 2% of the flour, cereal chemists have shown in laboratory experiments that its presence can have noticeable effect. For one thing, wheat fat is subject to rancidity. Therefore, in milling, an effort is made to reduce the fat content of flour and thereby increase the period of storage during which flour will remain sound.

Because certain chemical reactions take place in fats at high temperature and moisture levels, flour stored for long periods under these conditions deteriorates and loses its baking quality.

Doughs made from such deteriorated flours lack extensibility and tear easily.

It has been shown in laboratory tests that such doughs will not handle satisfactorily and that their gas retention is poor. It has also been proven that the volume, flavor, and palatability of the bread made from flours with excessive fat are inferior.

Ash in Flour

Ash indicates the quantity of mineral matter in wheat. We find out how much ash a flour contains by heating a small sample of flour until all organic matter, such as the starch, sugar, proteins, etc., is burned away, leaving white ASH as a residue.

It has been found that the minerals of wheat are not evenly distributed throughout the kernel. Higher concentrations occur in the bran portion than in the endosperm portion.

Whole wheat bread, which is known to be more healthful than white bread, contains more of the bran than bread made from white flour. One can easily draw the conclusion as to where in the wheat kernel the most healthful constituents are.

Unfortunately the health-giving constituents are not necessarily those most sought after in the production of popular white bread. It is WHITENESS and MACHINEABILITY that are more important to the automatic-production bakers. However, with enrichment, the baker can return to the flour the nutrients that have been taken out in the milling process.

It is important to remember that the bran portions of wheat contain approximately 20 times as much ash as does the endosperm. Thus, a high ash content usually indicates a high proportion of bran, such as occurs in low-grade flours. It is also important to remember, however, that low grade flour doesn't necessarily mean low in nutritional value; it means low in tolerance, or strength, or color, etc.

NOTES

Many bakers believe that the quantity of ash present in flour is an inverse guide to flour quality - the lower the ash, the higher the quality of the flour. However, it has been found that ash content alone is not a reliable guide to baking quality. In general, soft-wheat flours contain a lower ash content than hard-wheat flours, yet hard-wheat flours possess superior baking characteristics for bread baking.

Carbohydrates in Flour

CARBOHYDRATES constitute one of nature's three great classes of organic compounds. The other two are FATS and PROTEINS.

You will recall that flour contains about 70% carbohydrates; this is in the form of STARCH. Starch is involved in the process of fermentation. It forms the structure, with gluten fibers of other protein, in all baked products.

In the mixing process, the starch in flour combines with about one-third its weight of water. Since there is so much more starch than gluten, the combined water in the dough is held equally by the starch and the gluten.

In the baking process, as the temperature rises, gluten gradually loses its ability to hold water, and begins to lose the water it combined within the dough. At the same time starch gains in ability to absorb water, and the granules gelatinize, taking up the water released by the gluten.

The change that takes place when starch is heated with water is called gelatinization. The starch granules absorb the available water and swell to several times their own size. This water is retained in the starch granules, so that the the baked loaves contain a structure consisting of a concentrated starch gel bound together by gluten fibers.

Moisture in Flour

As you probably know, water constitutes a large portion of all foods. The legal limit for moisture in flour is 15%.

One of the disadvantages of having too high a moisture content in flour is that moist conditions make for infestation by weevils and other insects.

Another disadvantage is that the higher the moisture content when the flour arrives at the plant, the lower the absorption the baker can expect in mixing the dough.

VII. ENRICHMENT

During the 1930's, surveys showed that 33% of American families had poor diets. Although we were the best fed nation in the world, malnutrition was evident.

Recognizing the need for correcting the condition, the Food and Nutrition Board of the National Research Council proposed in 1936 that the nutritional elements most lacking in the diet be restored through the addition of thiamine, riboflavin, niacin, and iron to white flour.

To some extent, these are the nutrients lost in the milling process. The baker restores these nutrients by enriching his bread in one of three ways:

1. By using ENRICHED flour.

2. By adding a powdered mixture of vitamins and iron to the dough during mixing.

3. By dissolving an enrichment wafer in water and adding it to the dough during mixing.

During World War II, War Food Order No. 1 made the enrichment of white flour and bread mandatory. This order was withdrawn in 1946, but most of the states have enacted enrichment laws of their own.

VIII. VITAMINS IN FLOUR

NOTES

The flour of wheat is rich in vitamins of the B group. But what are vitamins?

We can best approach understanding the answer to this question by first understanding that foods may be divided into two classes: energy foods and non-energy foods.

There are three classes of energy foods:

1. Carbohydrates
2. Fats
3. Proteins

The energy stored in these foods is changed in the body to other forms of energy, such as body heat and motion.

The non-energy foods:

1. Water
2. Vitamins
3. Minerals

supply no energy but are as necessary to life as those that do.

Vitamins are complex chemical compounds found in nature or manufactured chemically. Each functions in one or more of the following ways:

To prevent or cure some particular disease, such as rickets or scurvy.

To cause the digestive organs and other structures to function effectively.

To promote good health, usually in one or more ways in addition to those mentioned.

Vitaminc B_1 is called Thiamine. This is one of the vitamins replaced in flour by the process of enrichment. It is necessary for a healthy nervous system, for good appetite and digestion, and to help the body convert energy foods into energy and heat.

Riboflavin (B_2) and Niacin (K), two other vitamins necessary to maintain good health and prevent such diseases as pellagra, are also added to flour -- in some cases, in larger quantities than are considered adequate.

Iron (a mineral rather than a vitamin) is the fourth nutrient added to flour. It is needed by the body in the formation of hemoglobin, the red substance in the blood that carries oxygen to the cells.

IX. MISCELLANEOUS FLOURS

Rye Flour

While most flour is milled from wheat, it is important for the baking student to know that there are other types of flour besides wheat flour.

Although only 2.5 percent of the world rye crop is grown in the United States, rye is the second most popular type of flour consumed in America.

Rye is grown principally in colder regions, where it will thrive under climatic and soil conditions which are unsuitable for wheat.

There is practically no difference between rye and wheat flour from a nutritional viewpoint. Contrary to the opinion of some people, there is very little difference in digestibility.

One of the chief differences between wheat and rye is the difference in gluten. Rye flour cannot form a definite gluten structure during mixing. Very small, compact loaves result when the baker makes bread from pure rye flour. In "rye" bread as we know it, about 60% wheat flour is used as the structure builder.

Soybean Flour

Although the soybean, or soyabean, is one of the oldest agricultural crops cultivated by man, very little of this flour is used in American bakeshops.

The soya crop is grown extensively here, but its principal uses are for the production of oil and meal rather than for baked foods.

Soya is exceptionally rich in oil and protein -- but the protein is of a somewhat different type and produces a gluten that lacks elasticity.

While soya can produce a superior bread from a nutritional standpoint, the crumb color would be noticed and probably objected to by many consumers.

Adding soya to white flour for bread making provides certain advantages. It

1. Prolongs shelf life
2. Cuts down rancidity
3. Provides a more even crumb structure
4. Improves evenness of browning in toast
5. Improves nutritional qualities

Potato Flour

Potato flour, which is different from potato-starch flour, is sometimes used in the production of white bread because it helps bring about some of the characteristics sought by white-bread bakers. For one thing, potato flour helps retard staling.

Potato flour also adds to the flavor of white bread. True, it adds a distinctive flavor, but it is flavor, which is something many white breads do not seem to have.

From a nutritional standpoint, potato flour is superior to white flour in thiamine, riboflavin, and niacin.

From a production standpoint, fermentation is speeded up by the addition of potato flour.

Potato flour is also widely used in the production of yeast-raised doughnuts.

NOTES

Wheat Germ Flour

Although there is no doubt about the nutritional value of wheat germ, it has been found that the addition of more than 3 percent wheat germ to dough has a harmful effect on both the dough and the bread. Dough will be sticky and hard to handle. Bread will have an open grain and poor volume.

Self-Rising Flour and Prepared Cake Mixes

Self-rising flour is different from prepared cake mixes in that the former contains only baking powder and salt in addition to regular white flour; the latter may contain milk powder, dried eggs, shortening, and other baking ingredients.

In preparing self-rising flour, the miller doesn't add baking powder as such. Instead, he adds those chemicals which make up baking powder, namely, sodium bicarbonate and an acid reactant. Self-rising flour is a household flour and is not used in commercial bakeries.

X. STORAGE OF FLOUR

The flour storage room should be well ventilated, clean, rodent-proof, and odorless. The temperature should be about 65°-75° F., with a relative humidity of 55-65%.

Flour should never be stacked directly on the floor, but should be placed on skids, far enough from the walls to permit free circulation of air.

Bleached flour will improve steadily in quality and keep well up to approximately five months from the time it is milled. Unbleached flour will keep up to about eight months. Rye flour, corn meal, whole wheat flour are subject to more rapid deterioration and should be bought in the smallest quantities practical.

FLOUR GLOSSARY

NOTES

Ash -
The mineral residue left after complete burning of a substance. In the milling and baking industries, the substance is burned under certain specified conditions.

Aging -
A natural process of oxidation which flour undergoes during storage and which results in improved baking characteristics and whiter color.

Absorption -
The amount of liquid that a flour will absorb or take up. "True absorption" is the amount of water and other liquids that a flour will take up. The percent of absorption is found by dividing the total amount of flour into the total amount of water.

Bran -
The coarse outer covering of the wheat kernel, as separated from cleaned and scoured wheat in the usual process of commercial milling. Essentially, the epidermis and other outer coverings of the wheat kernel.

Bleaching -
A process of treating flour with certain chemicals to remove yellow pigments. The effect of bleaching is similar to the effect of aging.

Bucky -
A dough condition usually resulting from too much CO_2 in the dough, which makes it too elastic to machine or roll out by hand.

Baking test -
An actual baking in shop or laboratory under controlled conditions to determine the baking qualities of a new shipment or a new crop of flour.

Bromated flour -
White flour to which potassium bromate has been added, in a quantity not exceeding 50 parts to each million parts of the finished bromated flour. This chemical is added only to flours whose baking qualities can be improved by such addition.

The addition of bromate to a flour has a strengthening action on the gluten quality of the dough and improves gas retention. Baked products produced from doughs with such an oxidizing agent normally have a close and silkier interior, in addition to a whiter crumb color and larger loaf volume.

Climate -
One of the important factors determining what strains of wheat to plant. That is, winter wheat will be planted only in those areas where winters are relatively mild. Seed planted prior to the onset of cold weather germinates in the fall, becomes dormant during winter, resumes growth in the spring, and is harvested in early summer.

Classification -
Usually a reference to the hardness, softness, or time of planting. There are five major time-hardness classifications of wheat used for bread and cake making: hard red spring wheat, hard red winter, soft red winter, winter white, and spring white wheat. Wheat may also be classified according to a color and botanical variety, e. g., common or durum wheat.

Clear flour -
The flour remaining after the patent portion has been removed. It is darker in color, but higher in ash and protein than the lower ash flours, such as short and fancy flours made from the same wheat.

Color -
Usually determined by Pekar Test, in which samples are pressed smooth and dried in a special oven to bring out color differences more clearly. Natural color of unbleached flour is creamy in appearance, due to presence of color pigments. These are usually decolorized by bleaching.

Durum -
A type of hard wheat consisting of grains that are particularly long, rather transparent, and very yellow. It is used chiefly for the production of semolina. There are several varieties of durum wheat which are characterized by color names, such as red durum, amber durum, etc.

Endosperm -
Nutritive tissue formed within the embryo sac in a seed plant. It is that part of the cereal grain that goes to make up flour.

Enriched flour -
White flour which contains the following amounts of ingredients per pound of flour: not less than 2 mg. thiamin, 1.2 mg. riboflavin, 16 mg. niacin, 13 mg. iron. It may also contain 250 - 1,000 U. S. P. units of vitamin D and/or 500 - 625 mg. calcium, and/or not more than 5% by weight of wheat germ or partially defatted wheat germ.

Enrichment -
In bread, enrichment means the addition of enough vitamin B complex (thiamine, riboflavin, and niacin) and iron to bring the level of these nutrients in the bread to at least the level they would have had if 100 percent whole wheat had been used as the only flour in the bread formula.

Enzyme -
A biological catalyst of a protein nature elaborated by living tissue. There are great varieties of enzymes and they are essential to the functions of living organisms.

Extensograph.
Baking volume depends on a balance between the extensibility and the resistance to extension of dough. The extensograph is a device used to measure this balance. In baking laboratories it helps to determine fermentation tolerance of the dough as well as relative fermentation time.

Extraction -
The percentage of wheat that is to be milled into flour, after a fixed percentage is taken off for feed.

Family flour -
Also known as blend flour and all-purpose flour. It is frequently produced by blending flours made from both hard and soft wheat. It is milled with a view to serving all-round household uses.

Fancy clear -
Portion of flour remaining after removal of fancy and first patents. Clear flours are darker in color, but higher in ash and protein than the lower-ash flours, such as short and fancy patent flours made from the same wheat mix.

Fancy patent -
Flour made from purified endosperm millings; 40-60% separation.

First patent -
Portion remaining after separation of short or medium patents.

Farinograph -
A dough-testing machine that incorporates a high speed mixer and is designed so that the force required to turn the mixing blades is measured with a dynamometer system connected to a recording mechanism which produces a graph showing a record of the mixing process. It is used to check the uniformity of flour, as far as mixing strength and tolerance are concerned; to determine absorption and mixing requirements of a flour before it goes into one uniform blend of desired characteristics; to check the dough consistency at various stages of production.

Grain.
In reference to flour, grain refers to the wheat kernel itself, which is differentiated from other grains such as rye or oats.

Grinding -
One of the basic processes in the milling of flour from wheat grains, i.e., the grinding of the grain between rollers to separate the endosperm - the internal, floury portion of the grain - from the branny outer covering.

Granulation -
The degree to which flour particles have been broken down, as sugar is granulated, to various degrees of fineness. Flour that has been finely granulated will be softer to the touch and appear to be whiter than flour that is not finely granulated in the milling process.

Gluten -
The protein fraction of wheat flour obtained by separating the starch and protein. This separation is accomplished by gentle washing of a flour-water dough. The gluten itself is that portion which forms the elastic, rubbery substance which results when flour is mixed with water.

Hard flour -
An actual feeling of hardness of the flour to the touch. The hardness is in proportion to the portion of wheat kernel, besides the endosperm, that has gone into the flour. The baking characteristics of hard flour will incorporate the characteristics of this outer portion of the wheat kernel.

Humidity.
Flour is sensitive to humidity, i. e., the amount of water vapor contained in the air. Flour is a hydroscopic substance. In a very moist atmosphere it will pick up moisture and gain weight; under average conditions it loses weight, and this loss is due to loss in moisture.

Iron -
A silver-black, lustrous, magnetic, metallic element. The presence of an adequate amount of iron, along with copper, in the diet prevents nutritional anemia. The iron content of flour is increased by the addition of reduced iron and iron salts, such as sodium iron pyrophosphate and ferric phytate.

Kernel -
The individual wheat grain itself, as illustrated at the beginning of this unit.

Niacin -
Also known as nicotinic acid. Occurs in all living cells in small amounts. Is necessary for growth, normal functioning of the gastro-intestinal tract and skin, and for normal cell respiration. Niacin is not destroyed during baking or cooking.

In wheat, most of it is located in the germ. About 85% is destroyed in milling; this is replaced when flour is enriched.

Patent -
The term was first used to refer to any flour milled on certain patented equipment. There are actually various grades of patent flour, the finest being extra short or fancy patent, in which up to 55% of the wheat is taken off for clear flour -- and only the remainder is milled into extra fancy patent. When all of the extracted wheat is milled into flour (with little or none taken off for clear flour), the lowest grade of patent flour is produced. It is called straight flour.

Protein -
A complex nitrogenous substance made up of different amino acids. Proteins are found in all animal and vegetable matter. Of all cereals, wheat flour alone has the unique quality of being able to be formed into a dough that will retain the gas evolved during fermentation. This quality is imparted to wheat by its proteins which, on combining with water, result in gluten, the actual substance that confers on dough the property of gas retention.
A difference may exist between the quality of protein contained in two flours having the same percent of protein.

Riboflavin -
Also known as vitamin G or vitamin B_{12}. It promotes growth and general health and is essential to nerve functioning. Lack of riboflavin causes cell weakness, loss of weight, nervous disorders, loss of hair. Riboflavin is found in many foods, including bran.

Screening -
Part of the milling process in which bran is separated from flour by passing the flour through a series of screens and bolting cloths in order to obtain flour of finer granulation.

Seed covering -
The outer covering of the wheat kernel, which is structurally differentiated into three parts: the outer branny covering, or seed covering, the germ or embryo, and the endosperm.

Semolina -
A flour prepared by grinding and bolting clean duram wheat to such fineness that it passes through a No. 20 sieve; but not more than 3 percent passes through a No. 100 sieve. It is almost entirely free from bran-coat and germ. Its moisture content is not more than 15%.

Separators -
Machines to remove foreign matter (seed, etc.) from wheat.

Sieving -
A method of separating different sized particles by sifting through screens of a certain mesh.

Soft flour -
A type of flour low in protein and used for cake and pastry, as differentiated from that which is used for bread baking. It is made from a type of wheat with mealy and opaque endosperm. There are many varieties of soft wheat. For example, there are at least 66 varieties of soft and red winter wheats alone. Soft flours are soft to the touch.

Soft wheat -
A type of wheat with mealy and opaque endosperm.

Spring wheat -
Wheat that is planted in the spring. It may be hard or soft and is usually grown in the northwestern and northern parts of the United States.

Strength -
A quality of flour made from "a wheat which yields flour capable of making large, well-piled loaves." The resultant loaves must therefore not only be large, but possess also a smooth, silky texture as implied by the world "pile" - a term borrowed from the textile industry. A flour giving a large volume but coarse texture would, according to this definition, not be considered a strong flour. Thus, strength refers to the quality of flour as well as to other characteristics.

Separation -
The process that begins after extraction is completed, i.e., after the greatest portion of the branny covering has been removed. The remaining flour is separated into various portions of patents and clears.

Straight flour -
Flour milled without separation. All of the wheat remaining after extraction.

Starch -
Comprises about 70% of wheat flour. It is a white, odorless, tasteless material, insoluble in cold water, alcohol, and other liquids. It is considered that the loaf potentialities are determined by the gluten quality and quantity, and that these potentialities are set in the loaf by the starch during the baking process.

Tolerance -
In bread flour, tolerance means the ability to produce satisfactory results over an extended fermentation time - the period after the best bread can be produced during which the dough will still yield a satisfactory product. Tolerance is bound up with the quality of the gluten.

Thiamine -
Also known as vitamin B. Essential for normal metabolism of carbohydrates in the animal body. It promotes growth, stimulates appetites, and aids digestion. It is present in many foods, including bran.

Uniformity -
One of the important characteristics of flour, sought after in the production of quality bread. Shipments from the same mill are expected to be uniform in quality.

Winter wheat -
Wheat planted in the fall. This may be either hard or soft wheat and is typical of the wheat planted in the south central and southwest regions, where winters are generally mild.

Whole wheat -
Flour made from the entire wheat kernel without extraction. Standards are set as to how coarse and how fine it may be.

UNIT II - YEAST AND FERMENTATION

CHAPTER HEADINGS

I. Introduction
II. A Short History of Fermentation
III. The Manufacture of Yeast
IV. The Importance of Yeast to Fermentation
V. Some Additional Information About Yeast
VI. Sponge Doughs Versus Straight Yeast Doughs
VII. Punching a Yeast Dough
VIII. The Effect of Certain Ingredients on Fermentation
Glossary
Test on Yeast and Fermentation

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YEAST AND FERMENTATION

I. INTRODUCTION

NOTES

The study of yeast as an ingredient of baking is important only in its relation to an understanding of the process of fermentation. For that reason, the emphasis in this unit will be more on fermentation than on the ingredient yeast itself.

Fermentation is part of an even larger subject--leavening. Leavening is defined as a process of producing gas in a dough or batter. This may be done in one of four ways:

1. By micro-organisms, as in bread, by the action of yeast.

2. By the action of chemical leavening agents, such as baking powder, used in cakes, and ammonium carbonate, used in certain types of cookies.

3. By mechanical means, that is, by aerating a batter by beating or whipping, as is done in the production of pound cakes and sponge cakes.

4. By the use of heat, to produce steam in breads and cakes, in which case moisture is changed in vapor, which expands and causes products to rise.

In this unit we will study only the first of these leavening with yeast.

II. A SHORT HISTORY OF FERMENTATION

NOTES

Although wheat and other grains have been used as food since the days of the cave man, it was not until the time of the Egyptians that the first kinds of leavened bread as we know it today, came into existence. Perhaps some Egyptian baker allowed a dough to stand overnight and yeast cells in the air caused the dough to ferment. In some way, perhaps part of this fermented dough was used in another dough, and it was discovered that this caused the bread to rise and become lighter and tastier. Thus leavened bread became a staple of the Egyptian diet.

Not until more than a thousand years had passed, did scientists come to understand exactly what was happening during the leavening process. Yeast cells were first made visible to the human eye when Leeuwenhoek constructed the first microscope in 1630. However, he failed to recognize them as living organisms associated with fermentation.

In 1803, Thenard claimed that yeast caused fermentation but his claims were not universally recognized. Not until Louis Pasteur demonstrated positively that yeast was a living organism, capable of growth and reproduction, was the true nature of yeast recognized. Since then, Pasteur has been called the Father of Fermentology.

III. THE MANUFACTURE OF YEAST

The growth of yeast is exponential. That is, each time it reproduces, the entire batch doubles in the progression of 1, 2, 4, 8, 16, 32, 64, etc. Its growth depends, of course, on ideal conditions, namely, the right temperature and the right food.

The production of yeast begins in a test tube in which there are a number of strains of yeast. Each of these strains has been found to have some desirable quality, such as the ability to produce a maximum quantity of yeast in a given time. Another quality might be fermentation strength, that is, the ability to produce gas for leavening.

NOTES

These test tubes are kept in a refrigerator under sterile conditions to prevent propagation and prevent the strains from becoming contaminated.

When it is decided to make a batch of yeast, few yeast cells from the pure culture stock are added to a test tube containing sterile molasses. In a short time, the yeast cells multiply and are transferred to a flask; there they continue to multiply and are transferred to a jug. Molasses provides carbon and sugar as food for the yeast and supplies calcium, potash, and other elements also.

The jug of budding yeast cells is then used to seed a small tank.

After the yeast has grown to a quantity large enough for starting growth in a bigger tank, it is transferred to a 20,000-gallon fermenting tank.

At the same time that the process of growing stock yeast is going on, yeast food is being continuously mixed for the continued growth of the yeast. This food is called wort. Wort consists mainly of molasses. This is delivered simultaneously with water and the stock yeast to the fermenting tank. Nitrogen and phosphorous are also added at this time.

For about 10 hours this mixture is aerated continuously while it is being fed into the fermenting tank. From time to time the foam which is created is cut back by the addition of vegetable oil defoamers, such as soy bean oil.

The temperature of the fermenting tanks is maintained at 85°F. Because fermentation is exothermic (releases heat), a cooling system is used to maintain the proper temperature. Near the end of the cycle, the temperature is lowered to slow the yeast reproduction rate and allow yeast cells to mature fully.

At this point (about 9 days have elapsed from the time the first yeast cells were removed from the refrigerator), the yeast is ready for harvesting. The first thing to be done is to separate the yeast from the used wort. This is done in centrifuges, after which the yeast is diluted in a cold-water washing process and re-separated. The resulting yeast slurry is cooled in a refrigerated tank.

From the refrigerated tank, it is pumped into hydraulic presses where water is forced out.

From the hydraulic presses, it is scraped into huge troughs and then wheeled to a mixing machine where it is plasticized - that is, made into an even mass similar in consistency to soft shortening. Shaved ice is added to the mass in the plasticizer, in order to improve its handling qualities and adjust its moisture level.

From there, it is compressed and extruded in a continuous square "ribbon" and cut off into the one-pound cakes with which we are familiar.

After that, compressed yeast is wrapped, boxed and stored under 40°F. refrigeration, ready for shipment to the baker.

Active Dry Yeast

In the preparation of ACTIVE DRY YEAST, the process is identical up to the point where the yeast is pressed in the hydraulic presses. From there it is extruded into thin ribbons and fed into a huge revolving barrel, called a Roto-Louvre, where for 12 hours it is tumbled as warm air is passed through. The resulting dry granular material is then packaged for shipment.

To rehydrate active dry yeast (ADY), use water having a temperature of 100-110°F. The amount of water should be at least 4 times the weight of the ADY. Time required: 3-5 minutes. In substituting ADY for compressed yeast, the only formula adjustment necessary is that an extra 2 pounds of water should be added for each pound of ADY, to compensate for the water contained in compressed yeast but missing from the dry product.

IV. THE IMPORTANCE OF YEAST TO FERMENTATION

NOTES

Fermentation is a highly complex process, involving many chemical and bilogical actions and reactions. Many of the reactions that take place during fermentation are not fully understood even by scientists. Yet, even though the good baker is capable of turning out good bread without being able to explain why certain changes come about or are necessary, it is desirable to have some knowledge beyond that of the "feel" of a good dough.

We know, for example, that as fermentation progresses and a dough rises to several times its original size, certain changes are taking place in the gluten. Outwardly, it becomes more elastic and springy. This happens because it is being acted upon by enzymes, particularly a yeast enzyme called zymase.

Like any other living organism, yeast requires food and favorable conditions before it can function properly. The favorable conditions required by yeast are:

1. Moisture.
2. Moderate temperature.
3. Proper degree of acidity.
4. Adequate supply of fermentable carbohydrates.
5. Other basic mineral foods.

When yeast has all of the above foods and conditions, fermentation will progress and the dough will develop. Proper dough maturity is that point in fermentation at which the dough will yield the best bread that the flour is capable of producing.

The two main end products of yeast fermentation are alcohol and carbon dioxide. Most of the alcohol is volatilized and driven off during baking, yet it is interesting that a very small portion of alcohol has been found in freshly baked bread.

The carbon dioxide created by the yeast does not all remain in a gas state. Some of it combines with water to form carbonic acid, which contributes to lowering the pH of the dough. Also, enzyme action contributes toward lowering the pH of the dough.

Thus, the pH of a freshly mixed dough has an approximate value of 6, which may be reduced to as low as 5 at the end of fermentation, as a result of the various reactions whose end products are acids of various kinds and strengths.

Correct mixing of a balanced dough is the key to proper fermentation. This means that we cannot set a definite mixing time for each dough, for each flour is different and requires its own definite time for best development.

When a balanced dough is allowed to ferment, two forces begin to operate: gas production and gas retention.

Gas production is principally the result of enzymes at work in flour and yeast. The following factors can result in increased gas production:

1. More yeast.
2. Addition of sugar or diastatic malt to flour which is deficient in these.
3. The use of yeast food (in the proper amounts).
4. High temperature (up to 95°F.)

Gas retention is governed by the action of enzymes too. Other factors, such as the presence of minerals, the amount of moisture in the dough, the presence of bleaching agents, and other chemical factors also influence gas retention.

In addition, mechanical factors govern gas retention. In fact, anything that has to do with the stretching of the dough affects its ability to hold in gas. Among these factors are punching, dividing, rounding, and molding.

The student should have in mind the fact that just as there are factors that increase gas production, there are also factors that can decrease gas production. Among them are:

1. Additional salt.
2. Too much yeast food.
3. High temperature (over 95°F.)
4. Too much diastase.

The above is only an outline and gives only a suggestion of the activity that goes on during fermentation. However, it should serve to indicate to the student how really involved and complicated the fermentation process is.

V. SOME ADDITIONAL INFORMATION ABOUT YEAST FERMENTATION AND DOUGH

Yeast can be frozen without killing it. Cell walls, however, will be weakened and fermentation action decreased. Frozen yeast should be thawed before using. The amount used should be increased about 10% to compensate for loss in strength due to freezing.

The following statistics are approximate and indicate the reaction of yeast to temperature changes:

45-65°F.	No activity
65-94°F.	Some activity
95-98°F.	Optimal fermentation
99-140°F.	Fermentation weakened
140°F.	Thermal death point. Enzymes killed. Production of CO_2 stops.

Characteristics of a "Young" Dough

Feels sticky. Breaks short with resistance.
Has tendency to stick to divider.
Will flatten in pan during proof. Will require more time to proof.
Bread colors quickly in oven and takes on reddish-brown color.
Small oven spring.
Crust will be thick but will have good, sweetish taste.
Loaf will be heavy.
Bread will have sharp corners with smooth, glassy sides.
Crumb will be dark, coarse, open.

Characteristics of an "Old" Dough:

Breaks short without resistance.
Has strong odor.
During proofing, surface of dough will start to break.
Bread colors slowly and is usually very pale.
Grain is open, cell walls thick, bread crumbles easily.
Odor of bread is sour.
Requires long proof, has poor oven spring.

Yeast Foods

Yeast food is also known as dough improver. The need for a dough improver was recognized when it was found that even when doughs were made with identical ingredients under similar conditions, identical results were not always obtained. It was found that the water used in various localities contained different amounts of mineral salts, and this was a cause of the different results noted. It was also found that even in the same locality, the water contained different amounts of mineral salts at different times of the year. Dough improvers were developed to correct such conditions.

Yeast foods stimulate desirable enzymatic activity. They provide the mineral and nitrogen necessary for proper yeast activity and help bring about the pH necessary for good fermentation.

These are some of the advantages of using yeast foods in dough:

1. Better flavor.
2. Greater volume and oven spring.
3. Better bloom, or crust color.
4. Finer grain.
5. Silky texture.
6. Improved crumb color.
7. Greater uniformity.
8. Increased yield.

VI. SPONGE DOUGHS VERSUS STRAIGHT YEAST DOUGHS

NOTES

At this point, some information about the difference between sponge doughs and straight doughs is in order.

Most students are familiar with straight doughs: these are doughs in which all of the ingredients are blended together, more or less at the same time, and then mixed to the desired consistency and temperature. Although fermentation is known to begin at once, full "proof" may take about two hours, more or less, depending on the amount of yeast, temperature of dough, etc. Shortly after full proof, the dough is ready to be taken to the bench for make-up.

Sponge dough is quite different. Sponges are used very little in the handcraft shop but they are used almost exclusively in the production of white bread in wholesale bread bakeries.

A sponge dough is a two-stage dough in which all of the yeast and most of the flour and water are first mixed into a soft dough, which is then allowed to ferment, usually about four hours. This is the first or "sponge" stage of the dough. In the second, or "dough" stage, the sponge is returned to the mixer, where it is combined with all of the remaining ingredients, including salt, milk, sugar, shortening, additional flour, water, and any other ingredients that the particular recipe calls for. After mixing, the completed dough is then allowed final proof, after which time it is ready for make-up.

The advantages of a straight dough are:

1. Because it is a one-stage process, it requires less labor.

2. Because the total fermentation time is shorter, fermentation loss is less.

3. Many bakers believe that better flavour can be developed in straight-dough products.

The advantages of the sponge dough are:

1. Sponge doughs require about 20% less yeast.

2. Bread produced from sponge dough tends to have greater volume and a more desirable texture and grain.

3. The sponge method is more flexible. Sponges can be held longer without noticeable deterioration of the final product, in contrast to straight doughs, which must be "taken" when ready.

VII. PUNCHING A YEAST DOUGH

The student should learn why, how, and when to "punch" a dough. The first thing to understand is that while we use the word "punch" we don't really punch the dough at all. We merely fold the sides well into the center, then turn the entire dough over.

Here's the why of "punching" a dough: Remember, our aim is maximum gas production and maximum gas retention. Laboratory experiments show that gas production is not constant. It starts fast and then slows down. Gas retention varies too.

In the beginning, the dough can hold in all the gas that is being produced. After a while, the dough becomes "weaker" and much of the gas that is being produced is allowed to escape. However, if the dough is folded back at the right time, the ability to retain gas is increased, and practically no gas loss occurs.

When we observe a dough that has been punched, we notice that it now begins to rise more rapidly. This gives the impression that the yeast is now working better and is producing more carbon dioxide. This is actually not the case. What is happening instead, is that, after being punched the dough is strengthened and is retaining the gas better.

A good baker knows when to turn a dough. All he does is touch the dough with the tips of his fingers, withdraw them quickly, and observe the dough's behavior. If the dough is firm and springs back immediately and does not show the finger marks, it is not yet ready to be turned. However, if it recedes slightly, it is ready. If it falls in completely, then the dough is overproofed. In this case, there is nothing to do but "take" the dough and make it up at once and try to prevent it from becoming further overproofed.

How long a dough should be given this primary proof is something else the student should understand. As a rule, the point at which the dough is first ready to be folded over constitutes 60% of the total fermentation time. In other words, if a dough is ready for the first "punch" in an hour, it will be ready for the second "punch" in about another half hour. Ten minutes after that it will be ready to be taken to the bench for make-up - a total of 100 minutes in this particular case.

All of the above information deals only with the fermentation aspects of doughs that are to be mixed, proofed, and made up for baking when ready. This information does not apply to doughs that are to be retarded or refrigerated.

VIII. THE EFFECT OF CERTAIN INGREDIENTS ON FERMENTATION

YEAST: Good yeast begins its action slowly and speeds up in vigor toward the end of the fermentation period.

FLOUR: Much of the nutrition for the yeast is in the flour. Stronger flours require more vigorous fermentation. Different flours require different fermentation periods, to be determined only by baking test.

SALT: In a dough, salt works in two ways to control fermentation: (1) it checks the growth of undesirable yeast, and, (2) it strengthens the gluten. By this latter action, it counteracts the natural softening of the gluten by fermentation.

WATER: In the ordinary sense, water is not considered a food for the yeast, but since the other nutrients for yeast must be supplied in solution, water is indispensable for the activity of yeast.

SUGARY AGENTS: Sugary agents furnish yeast with the necessary carbohydrate food. At the same time it is the sugar which is broken up into CO_2.

There is not sufficient sugar in flour for the production of good white bread. Sugary agents must be added. Malt sugar is excellent, because it also furnishes proteins and mineral salts, which further stimulate yeast activity.

Too great an amount of sugary agents will retard fermentation. Six percent is recommended for bread. Over 10% will retard fermentation.

Doughs Containing Little or No Sugar Must Be Given a Shorter Fermentation Period so That There Will Be Sufficient Sugar Left at the End of the Fermentation Period to Support Vigorous Yeast Activity and to Impart Crust Color and Caramelization of Loaf During Baking.

SHORTENING: Exerts no influence on yeast activity.

MILK: The presence of milk in dough favors the development of a small amount of acidity, which softens the gluten. Slightly more fermentation is required in milk dough - hence more yeast will be required.

EGGS: The effect of eggs on fermentation is not significant, although their presence does add to the ability of the dough to rise.

NOTES

Budding -
The process of reproduction in yeast. In this process, the mature yeast cell forms a small bud, similar to a small bubble growing out of a larger bubble. Cytoplasm and nuclear material migrate from the original cell, called the mother cell, into the bud. The bud continues to increase in size, forms a wall between it and the mother cell, and breaks off. Then the process repeats.

Catalyst -
A substance which initiates or speeds up a chemical reaction without undergoing change itself.

Diastase -
An enzyme found in flour and malt products. Its action is to liquefy starch and convert it into fermentable sugar (maltose).

Diastatic extract - (Malt flour)
which has been dried or kilned at low temperature. It is pale in color and is used chiefly for white doughs. When it is kiln dried at high temperature, the sugars in the malt are caramelized and the enzymes killed. Non-diastatic malt flour or extract is dark brown in color and is used widely in dark breads.

Enzyme -
A biological catalyst of a protein nature elaborated by living tissue. Enzymes are usually specific, that is, they perform a single step and act upon a specific ingredient. They are sensitive to high temperatures. The enzymes in yeast are:

Invertase, which converts sugar into dextrose and levulose. In the form of these simple sugars, sucrose can be assimilated by yeast as food.

Maltase, which converts malt sugar (maltose) into available dextrose.

Zymase, which changes dextrose and levulose into carbon dioxide gas and alcohol.

Proteolitic enzymes, which act upon complex proteins, converting them into simpler, more soluble forms, thus aiding in conditioning the gluten.

Exothermic -
Having the ability to generate and give off heat. In the process of fermentation, heat is generated and given off.

Extrude -
To force out steadily, as compressed yeast is extruded from the mass of yeast in a long bar or ribbon.

Fermentable -
Capable of being fermented. Fermentable sugars are invert sugars. Although sucrose can be fermented by yeast, it is not a fermentable sugar in the strict sense of the term. It must first be inverted before it can be fermented to alcohol and carbon dioxide. This is done outside the yeast cells by the enzyme invertase, the sucrose being changed to dextrose and levulose.

Fermentation -
The chemical changes of an organic compound due to action of living organisms (as yeast), resulting in the formation of the leavening gas, carbon dioxide.

Fermentation loss -
A term used to describe the loss in weight of the dough during the fermentation period. In other words, a piece of dough weighs less at the end of a period of fermentation than the total weight of the ingredients used in its manufacture. Some of the loss is the result of the conversion by yeast of some of the flour solids to carbon dioxide, which is kneaded out of the dough. Other losses are due to evaporation. In the production of bread from sponge doughs, an allowance of about 7 pounds per 100-pound sack is made during a six-hour fermentation period.

Fermentation room -
A room in which humidity and temperature are carefully controlled so that fermenting sponges or doughs will be uniformly fermented.

Fermentation tolerance -
A term used to describe the ability of a dough to handle well and make a good product even though the fermentation period is extended beyond the normal time.

Fermenting tank -
A large tank used in the manufacture of compressed yeast, usually about 20,000 gallons in capacity. After yeast has been started, it is transferred from the small seeding tank to the fermenting tank, where it is fed and aerated.

Gluten -
A mixture of proteins characteristic of wheat flour. It is gluten that makes the framework for a bread dough. The gas-retention qualities of a dough are largely dependent on its gluten development.

Hydraulic presses.
In the manufacture of yeast, hydraulic presses are used to press out spent wort after the yeast leaves the fermenting tank.

Leaven -
A noun meaning a portion of dough reserved from one day's baking and used to aerate the next day's dough. During waiting, the dough becomes very sour. A certain amount of yeast is produced in the dough. This is able to initiate fermentation when mixed with fresh flour and water. The term is often used synonymously with "sour" or "sponge."

Leavening -
The process of producing gas in a dough or batter. This may be done (1) by micro-organisms, or (2) through the action of chemical agents to produce carbon dioxide, or (3) through the use of heat to produce steam in baking breads, cakes, etc., or (4) by mechanical means.

Leavening agents -
Substances used to raise a dough by producing carbon dioxide. Yeast is a form of bilogical leavening. Baking powder is a form of chemical leavening.

Malt -
The name given to barley, wheat, or other cereal grains that have been induced to germinate and commence growing by being moistened and slightly heated. Malt has a high diastatic activity and thus finds use in baking.

Maltase -
An enzyme that can change maltose into glucose by hydrolysis.

Maltose -
A colorless, crystalline disaccharide, soluble in water and alcohol. It may be obtained from the interaction of malt and starch.

Micro-organism -
An organism (living animal or plant) of microscopic size, applied especially to bacteria.

Plasticizer -
A machine used in the manufacture of compressed yeast. After yeast is drawn off from the fermenting tank and separated from the spent wort, it is mixed in the plasticizer until it comes together in a plastic mass.

Proof -
The degree of aeration imparted by the action of yeast before baking. Most yeast products require proof at each stage of production. First, a dough requires proof, (aeration by yeast action) immediately after mixing. After the dough is scaled into small units, short proof is required. Finally, after the units are made into specific products, final proof before baking is required.

Sour (or sough dough)
A dough that has fermented for a sufficient period to enable acetic, lactic, or other acids to be developed. Fermentation of a sour usually is allowed to take place without the addition of yeast. The resulting fermentation imparts desirable flavors to the final product. Rye and pumpernickel breads are usually made with sour dough.

Sponge dough -
A two-stage dough in which, in the first stage, most of the flour and water and all of the yeast and yeast food are allowed to ferment for about three hours. After that, the dough is returned to the mixer with the remaining ingredients and mixed at a temperature of 72-75°F. It is used largely in the production of white bread in large bakeries.

Straight dough -
A dough mixed by a single-step process in which all of the ingredients are incorporated at nearly the same time.

Trough -
Large, rather shallow containers, usually on wheels, used for holding large masses of rising dough.

Wort -
A fermenting liquid, thus, a mixture of sugars and yeast.

Yeast -
A microscopic, one-celled plant belonging to the fungi group, which multiplies mainly by budding, and under suitable conditions carries out fermentation. The types used in baking are:

Active dry yeast (ADY) is prepared from yeast-press cake by controlled drying at moderate temperatures. When suspended in warm water it will reconstitute into a material whose fermentation activity is the same as the original press cake from which it was made. Contains only 8% moisture (compared with 70% moisture for compressed yeast).

Compressed yeast - moist, living cells of the yeast plant combined with a filler, which may be a starch or other absorbent base, and pressed into a cake. This is the yeast commonly used in most bakeshops where delivery is not a problem.

Yeast food -
A term applied to a mixture of inorganic salts which are necessary for best yeast growth. It serves to speed fermentation and helps to achieve maximum gas production from a given quantity of yeast.

UNIT III - CHEMICAL LEAVENING

CHAPTER HEADINGS

I. Introduction
II. Four Important Leaveners
III. Use of Starch in Baking Powder
IV. Slow-Acting, Fast-Acting, and Double-Acting Baking Powders
V. Amount of Baking Powder to Use
VI. Storage of Baking Powder

Glossary
Test

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CHEMICAL LEAVENING

NOTES

I. INTRODUCTION

Most people prefer leavened to unleavened baked products. The advantages of leavening in baked products are:

1. Good volume.
2. Improved eating quality as a result of a tender crust.
3. Better appearance due to uniform cell structure, brilliance of crumb color, softness of texture.

You may recall that, in the chapter on yeast, we defined leavening as a process by which dough is raised or lightened. It was pointed out that this may be accomplished in a number of ways:

1. by micro-organisms, as in yeast-raised bread,
2. by mechanical means, as in pound case that is creamed to incorporate air,
3. by heat, as all products are caused to rise by the vaporization of moisture when exposed to oven heat, and
4. by chemical means, i. e., baking powder.

In this unit we are concerned only with leavening by chemical means.

II. FOUR IMPORTANT LEAVENERS

The four most important chemical leaveners that we shall study are:

1. Baking soda
2. Baking powder
3. Baking cream
4. Ammonium carbonate

Baking Soda

Baking soda is known chemically as sodium bicarbonate and has the formula $NaHCO_3$. This is the "bicarbonate of soda" with which you are all familiar.

When heated, baking soda liberates carbon dioxide. It can also liberate carbon dioxide when it is mixed with an acid, at either hot or cold temperatures.

When used alone, baking soda will not only produce CO_2, but it will also leave a residue of sodium carbonate (or washing soda) as a result of the chemical action involved. When present, this gives cake a dark color and unpleasant taste. This taste is actually the taste of soap, which is formed when the sodium carbonate acts on the shortening in the cake.

It is for the above reason that when the baker uses baking soda, he also uses an acid to produce an edible residue in addition to the CO_2. The acid need not be a chemical, as such. It may also be an acid ingredient such as :

1. sour milk
2. honey
3. molasses
4. invert sugar
5. sorghum
6. lemon juice
7. buttermilk

While all of the above acid ingredients are excellent "neutralizers" of soda, they have been found to be impractical to use in commercial production because they vary in their acidity. For example, sour milk may have a certain degree of "sourness" on one day and, after standing for a time, become considerably more sour. Can you see how it would be impossible to work out dependable formulas under such circumstances? It was as a result of the search for a dependable neutralizer or reactant of the baking soda that baking powder was developed.

Baking Powder

Baking powder was first produced in this country in 1865. According to government definition, baking powder must conform to the following standards:

> "Baking powder is the leavening agent produced by the mixing of an acid-reacting material and sodium bicarbonate, with or without starch or flour. It yields not less than 12% available carbon dioxide. The acid-reacting materials in baking powder are: (1) tartaric acid or its acid salts; (2) acid salts of phosphoric acid; (3) compounds of aluminum, or (4) any combination in substantial proportions of the foregoing."

Note that sodium bicarbonate is the only alkaline ingredient permitted. In classifying the various types of baking powders, classification is made according to the acid-reacting ingredient. Thus, we have:

1. Tartrate baking powders (made of tartaric acid, cream of tartar, baking soda, corn starch).

2. Phosphate baking powders (made of calcium acid phosphate or sodium acid phosphate, baking soda, corn starch).

3. Sulphate baking powders (made of sodium aluminum sulphate, calcium acid phosphate, baking soda, corn starch).

Baking Cream

In some baking powders sodium pyrophosphate is used as the acid reactant. Normally, this product is used in what is known as 72% strength. However, it is also available on the market in a weaker strength: 50% strength. In this form it is called baking cream.

The chief advantage of baking cream is that it can be combined by the baker, in the proportion of two parts baking cream to one part sodium bicarbonate, to form a slow-acting baking powder.

Its chief disadvantage is that it has a tendency to leave a residue of sodium pyrophosphate in the cake, which produces an unpleasant aftertaste.

Ammonium Carbonate

The advantage of this leavening is that it decomposes into two gasses and does not leave a residue.

Ammonium carbonate is usually called baker's ammonia. While it does not leave a solid residue, it does leave a slight excess of ammonia gas, which imparts a disagreeable taste and odor.

The use of ammonium carbonate is usually restricted to small or porous products so that the ammonia fumes can bake out.

III. USE OF STARCH IN BAKING POWDER

In the earlier paragraphs of this unit, it was pointed out that baking powder consists of three parts:

1. sodium bicarbonate (baking soda)
2. an acid salt
3. a filler (starch or flour)

The filler is necessary for the following reasons:

1. To keep the baking soda particles and the acid particles from intimate contact and thus help avoid premature action.

2. To act as a medium to absorb free moisture incorporated during manufacture or in storage.

3. To improve handling and measuring.

NOTES

IV. SLOW-ACTING, FAST-ACTING, AND DOUBLE-ACTING BAKING POWDERS

Not all baking powders act with the same speed. Their speed depends on the acid-reacting ingredient, not on the bicarbonate of soda. If the acid ingredient is soluble in cold water, the baking powder will be fast acting; if the acid ingredient is not soluble in cold water and requires heat to release carbon dioxide, it will be a slow-acting baking powder.

"Double action" powders use two acid reacting ingredients in addition to the bicarbonate of soda: one is cold-water soluble and the other is soluble only at high temperatures. This type of baking powder offers the combined advantages of aerating the batter during mixing and handling, thus facilitating handling, and in addition, its greatest leavening action takes place in the oven.

Examples of acid salts that are used in slow-acting powders are:

1. Calcium pyrophosphate
2. Sodium pyrophosphate

Examples of acid salts that are used in fast-acting powders are:

1. Tartrate (This type is too fast for use in commercial bakeries.)

2. Calcium acid phosphate (This type will release about half of the gas at room temperature. It is often used as the fast-acting member of a double-acting team.)

Action During Panning

Bakers are inclined to overlook a function of baking powder that has little to do with its power to raise a batter during baking: that is, its power to make the batter easier to handle before baking. A heavy batter is difficult to handle. A proper amount of carbon dioxide gas set free in the batter makes it smooth flowing and helps in scaling, depositing, and panning.

V. AMOUNT OF BAKING POWDER TO USE

NOTES

It is important that baking powder be very carefully scaled. Too much or too little results in lack of volume, poor grain and texture, and poor eating quality.

Some types of cake, such as sponge cake, angel food cake, and pound cake may require little or no baking powder, perhaps $\frac{1}{4}$ of 1% of the weight of flour is sufficient. In other types of cakes, the amount of baking powder used may be from 1% to 5%.

A word may be said about the change necessary in the quantity of baking powder to be used at higher altitudes, although for practical purposes bakers on the eastern seaboard are not concerned with the problem. At higher altitudes, atmospheric pressure is reduced, that is, less pressure is pushing down on the cake as it is rising; thus, less leavening power is required to raise the cake to a desired height.

When too much leavening is used in a cake mix, any or all of the following may happen:

1. Cell walls will become over-extended and the cake will have a coarse grain.
2. Cake will dry out quickly because of the above.
3. Cell walls may be ruptured and cause the cake to shrink and collapse after rising in the oven.
4. Crumb will be dark.
5. Taste will be salty.

When too little leavening is used, any or all of the following may result:

1. Cake will be heavy and lack volume.
2. Cake may pull away from sides of pan.
3. Poor eating quality.

NOTES

There is a relationship between the amount of baking powder and the other ingredients in the cake. For example, in a cheaper cake, where the minimum quantity of eggs is used, more baking powder will be needed than in a cake that has a high quantity of eggs. Also, if the eggs are beaten before being added to the mix, a slightly smaller amount of baking powder will be required than when the eggs are creamed in without preliminary beating.

With harder flours or more milk, an additional quantity of baking powder is required.

A shortening that has a high creaming value carries more air into the cake and often makes it necessary to reduce the amount of baking powder slightly -- not to save the cost of the baking powder -- but to obtain the best results in the finished cake.

VI. STORAGE OF BAKING POWDER

All baking powders deteriorate with age. When they stand for any length of time, they absorb moisture from the air and slowly give off gas, dissipating their strength.

Baking powder should be purchased in the smallest practical quantity. It should be stored in a clean, dry room and kept in a tightly covered can.

Acid -
Organic compound which is sour and has the property of neutralizing alkalis.

Acid reacting component -
The salt part of baking powder, which causes sodium bicarbonate to react.

Aeration -
The act of incorporating air, as by beating or whipping. Charging with carbon dioxide.

Aerator -
A substance such as baking powder, capable of inducing aeration.

Baking cream -
Sodium pyrophosphate, reduced in strength to 50% and often used to make baking powder by combining two parts baking cream with one part baking soda. Although not identical with cream of tartar, it is often used in place of it in recipes that call for cream of tartar.

Baking powder -
A leavening agent produced by mixing an acid-reacting material and sodium bicarbonate, with or without starch or flour as a filler. By government standards baking powder should yield not less than 12% of available carbon dioxide.

Bicarbonate of soda - Baking soda -
A sodium salt of carbonic acid having the ability to combine with acid to produce carbon dioxide. It is alkaline in nature. In cold water it is slightly alkaline and on standing or as the temperature rises, it attains a pH of 8. 2.

Biological leavening -
Leavening which takes place a s a result of the activity of micro-organisms. Leavening resulting from the fermentation of yeast is biological leavening.

Carbon dioxide -
A colorless, tasteless, edible gas obtained during fermentation or from a combination of soda and acid.

Chemical leavening -
Leavening which takes place as a result of the reaction of various chemicals on each other, as the reaction of sodium acid pyrophosphate with sodium bicarbonate in baking powder, to produce carbon dioxide.

Cream of tartar -
A chemical substance (potassium bitartrate) which, when used as the acid-reacting component in baking powder, results in a fast-acting baking powder. The reaction between the components occurs at low temperatures, in the presence of moisture, to liberate carbon dioxide.

Creaming process -
A form of mechanical leavening in which aeration results from the action of the beater on the various ingredients of the batter.

Double action -
Referring to the liberation of carbon dioxide in a batter in both the early stages of mixing (when moisture is added) and the later stages (during baking - when subjected to heat).

Fast acting -
Referring to baking powder that begins to liberate carbon dioxide as soon as subjected to moisture as tartaric acid powders. A typical formula of this type of baking powder contains 26. 73 percent sodium bicarbonate, 5. 97 percent tartaric acid, 44. 90 percent sodium bitartrate (cream of tartar), and 22. 40 percent corn starch.

Inert filler -
A substance such as flour or special starch, added to baking powder. While the filler does not contribute directly to leavening, it serves to keep the acid and soda particles apart and thus improves leavening by preventing them from reacting on each other before being incorporated into the batter.

Leavening -
The process of producing gas in a dough or batter by chemical or other means.

Slow acting -
Referring to a baking powder that does not liberate carbon dioxide until the temperature of the batter is increased. Sodium acid pyrophosphate as the acid-reacting component in baking powder makes a slow-acting baking powder because it is relatively insoluble in cold water. A typical formula for such a baking powder

contains 30.59 percent bicarbonate of soda, 40.38 percent sodium acid pyrophosphate, and 29.03 percent corn starch.

Soda - Sodium carbonate, Na_2CO_3.
Not sodium bicarbonate (baking soda). Sodium carbonate is common washing soda, and is the residual salt produced when sodium bicarbonate is heated in water.

Sodium bicarbonate - $NaHCO_3$.
The acid salt produced by passing carbon dioxide under pressure into brine saturated with ammonia gas. On heating it decomposes to sodium carbonate, liberating carbon dioxide.

Tartaric acid -
An acid that occurs in vegetable or fruit juices. The potassium salt of this acid is known as cream of tartar.

UNIT IV - SALT

CHAPTER HEADINGS

I. Introduction
II. Effect of Fermentation
III. Effect on Flavor
IV. Effect on Color and Texture
V. Amount of Salt to be Used in Bakery Products

Test

REFERENCES AND RECOMMENDED READINGS

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World Book, Chapter on Salt

NOTES

I. INTRODUCTION

Although there are many salts in nature, the baker is concerned only with the use of common table salt, which is chemically known as sodium chloride. The chemical symbol for salt is NaCl. An aqueous solution of salt has a pH of 6. 7 - 7. 3. In addition to its function to make all foods palatable, salt also provides the human body with sodium and chlorine, ingredients essential to life itself.

This aspect of the use of salt becomes clear in the study of biology. How salt is formed and processed for our use is part of the study of chemistry. How it functions as a bakery ingredient, however, is our chief concern here.

II. EFFECT ON FERMENTATION

The baker who forgets to put the salt into a yeast dough learns very quickly what its effect is on fermentation when he sees the dough "running wild." Salt retards fermentation by keeping the growth of yeast under control.

Salt also has a strengthening effect on the gluten. The baker who forgets salt in the dough will also notice that the loaves are considerably larger. Only in part is this growth the result of yeast activity.

III. EFFECT ON FLAVOR

The taste of salt is not in itself the reason for its use. It has the ability to bring out the flavor of other ingredients. You might even say that it is salt that makes vanilla custard taste like vanilla custard.

In bread, salt not only has an effect on fermentation, it also brings out the wheat flavor. In cake, salt brings out the flavor of the eggs, milk, butter, etc.

NOTES

Indeed, "the best flavored bread is obtained by the maintenance of cool dough temperatures, the liberal use of salt, and sufficient yeast to bring about the necessary softening of the dough and the production of a light loaf in a reasonably short fermentation time."

IV. EFFECT ON COLOR AND TEXTURE

Salt has an indirectly beneficial effect on the color of baked products in this way: by controlling the activity of yeast (which feeds on sugar in the dough), sufficient sugar is retained in the dough to promote crust color.

Although salt does not have a direct bleaching action, as some bakers believe, it does help promote a fine grain and thin cell walls. This results in a texture (feel to the fingertips) that is smoother. It also seems to give the crumb a whiter appearance.

V. AMOUNT OF SALT TO BE USED IN BAKERY PRODUCTS

In the small bake shop, the amount of salt used is one of the most haphazard judgments the baker makes. In many mixes, he merely takes a pinch or a handful of salt without knowing exactly how much he has used or how much he should have used.

The quantity of any ingredient used is usually figured in relation to the flour weight or to the number of quarts to be mixed. But to be correct, the quantity of salt used should be figured in relation to the total weight of the dough.

The reason for this is that the quantity of enriching ingredients (sugar, eggs, milk, shortening, etc.) has a bearing on how much flour will be required. It also has a bearing on what ingredients need to have their flavors brought out.

NOTES

According to a laboratory study, these are the recommended average amounts of salt to be used in various products:

Sweet dough	$1\frac{1}{4}$ ozs. per qt. of water
Danish pastry	$1\frac{1}{2}$ ozs. per qt. of water
Cookies	1 oz. per 10 lbs. dough
Rich icing	$\frac{1}{2}$ oz. per 10 lbs. sugar
Lean icing	$\frac{1}{4}$ oz. per 10 lbs. sugar
Pie dough	$\frac{1}{2}$ oz. per pound of flour

UNIT V - WATER

CHAPTER HEADINGS

I. Introduction
II. How Water is Formed
III. The Purity of Water
IV. The Effect of Water on Dough
V. Absorption of Water in Dough
VI. Classes of Water
VII. Some Additional Facts About Water
VIII. The Effect of the Three Classes of Water on Bread Baking
IX. Use of Water to Control Temperature

Water Glossary
Test

REFERENCES AND RECOMMENDED READINGS

Pyler, E. J., Baking Science and Technology, pp. 353-368

Wihlfahrt, Julius E., A Treatise on Baking, pp. 30-33

World Book, Chapter on Water

NOTES

I. INTRODUCTION

The average baker takes water for granted. He knows it is an essential ingredient in bread and cake making. He knows that if it is pure enough to drink it is pure enough to use in mixing. He knows that the temperature at which he uses it makes a difference in the finished product. He also knows that the quantity of water he uses in a dough or in a batter affects its quality. But he knows little else. He knows little about the quality of the water itself.

The baker whose knowledge of his trade is better than that of the average baker does know something about the quality of the water he uses. He also knows something about how water is formed and how the presence of minerals in it can affect the quality of his finished products.

In this unit you will learn something about how water is formed, and about the different kinds of water. And while the emphasis is on the everyday use of water in baking, you will also learn something about the chemistry of water.

II. HOW WATER IS FORMED

About three-fourths of the surface of the earth is covered with water. Most of it is in the ocean; this is not purewater but contains a great deal of dissolved material, mostly common salt. This salt comes from the minerals in the earth, which are picked up by the rainwater as it filters through the earth on its way back to the ocean.

About $\frac{1}{3,000}$ of all the water on the surface of the globe is evaporated each year. This seems to disappear into constantly moving air as water vapor. Later, this vapor forms into clouds and eventually falls back to earth as rain.

Some of the rain water runs into streams, lakes, ponds, and rivers. This is known as <u>surface water</u> and contains considerable amounts of organic, inorganic, and microbiological impurities.

The rest of the rain (and melted snow) is soaked up by the ground. It may stay locked up in the ground for thousands of years. Eventually, it filters through the rock and forms wells and springs. This is known as ground water. It is usually practically free from organic impurities but it is high in mineral matter.

This entire movement of water from the earth, up into the clouds, then down to earth again as rain or snow, and finally into the waters of rivers and oceans is known as the natural water cycle.

III. THE PURITY OF WATER

For normal baking use, it can be taken for granted that the water that comes from the tap is pure. It usually comes from a dependable source, has been filtered by the local water system, and has been treated to kill harmful bacteria when necessary. But in a chemical sense, natural waters are never "pure." They contain dissolved impurities of the earth itself. Although the water that comes out of the tap is pure enough to drink and use in the preparation of foods, we must remember that the minerals remaining in the water may cause a chemical reaction with some of the other ingredients used in the manufacture of bread and cakes.

IV. THE EFFECT OF WATER ON DOUGH

The formation of yeast dough would be impossible without water.

In a yeast dough, water works mainly in two ways:

1. When water is mixed with wheat flour, it combines with the proteins to form the elastic product called gluten. This is known as hydration of the gluten.

2. Water also combines with the starch of flour, wetting and swelling it to make it soluble. When wetted starch is incorporated into the gluten and thoroughly mixed, the result is dough.

Both of the above combinations are thus responsible for the formation of dough.

Such dough properties as consistency, pliability, extensibility, and stickiness are all controlled by the quantity of water used. To some extent, they are also controlled by the quality of the water too.

The quantity of water used in a dough also affects fermentation. Slack doughs ferment faster than stiff doughs. However, slack doughs cannot be handled at the bench or machined properly. Doughs that contain too little water and are therefore stiff will ferment very slowly and will be difficult to make up, either by hand or by machine.

Within reasonable limits, the keeping quality of bakery products depends on the quantity of water that is incorporated into a dough or batter. For all practical purposes, freshness is moisture. In other words, the more water the baker can get into a dough, the longer the baked products will stay fresh.

There is a legal limit as to how much water may be incorporated into a dough, however. According to government standards, the maximum amount of moisture that may be contained in a bread one hour after baking is 38%. As for the practical limit, a dough should only contain as much water as it can hold without adversely affecting the other desirable characteristics of the dough.

V. ABSORPTION OF WATER IN DOUGH

NOTES

How much water a given type of flour will absorb depends largely on the age and strength of the flour. Total absorption also depends on some of the other ingredients in the dough. For example, according to studies by the Milk Institute, each pound of non-fat milk solids will absorb an additional pound of water without affecting the dough consistency.

According to literature distributed by the American Sugar Company, the addition of Nulomoline (their trade name for invert sugar) will make possible the addition of more water than a dough would normally take.

The reason invert sugar makes possible the absorption of additional water into a dough, is that invert sugar is hydroscopic -- that is, it has the ability to attract and hold water. It even pulls moisture from the air after the product is baked.

The percentage of absorption is figured by finding the percentage of water that can be taken up by a given flour. Thus, if 100 pounds of a flour can absorb 56 pounds of water, that flour is said to have an absorption of 56%.

VI. CLASSES OF WATER

Water -- other than salt water -- is generally classified in three categories: hard, soft, and alkaline.

Hard water is water that contains considerable amounts of carbonate or sulphate of magnesium or calcium. Hard water is difficult to form into a lather. When it is hard because it contains carbonates (rather than sulphates) it is called "temporary" hard water because it can be made into soft water by boiling.

When water is hard because it contains sulphates, it is called "permanently" hard water, since the sulphates do not boil out when the water is boiled.

NOTES

Soft water is water that is relatively free of carbonates and sulphates of magnesium or calcium. It forms a lather freely with soap.

Alkaline water is water that contains substances such as sodium carbonate. Alkaline waters also possess a degree of hardness.

VII. SOME ADDITIONAL FACTS ABOUT WATER

The degree of hardness is expressed by a numerical value representing the hardness-forming minerals present in the water. Since the amounts of dissolved substances in water are very small, the results of a water analysis are expressed in parts per million (p. p. m.) On this basis, water is classified as follows:

Hardness	Classificiation
0 to 15 p. p. m.	Very soft water
15 to 50 p. p. m.	Soft water
50 to 100 p. p. m.	Medium hard water
100 to 200 p. p. m.	Hard water
Greater than 200 p. p. m.	Very hard water

Listed below are some of the substances that commonly occur in natural water. The student is not expected to learn them. They are listed only to give him some idea of how complex simple-looking water really is:

Acids:	carbonic, sulfuric, and others
Aluminum:	oxide and sulphate
Calcium:	carbonate, chloride, and others
Iron:	carbonate, oxide, sulphate, others
Lithium:	carbonate, sulphate, others
Magnesium:	sulphate, nitrate, others
Potassium:	carbonate, chloride, others
Silicon:	as silica or silicon dioxide
Sodium:	chloride, carbonate, nitrate

VIII. THE EFFECT OF THE THREE CLASSES OF WATER ON BREAD MAKING

NOTES

Hard water is generally best for dough making. Hard water contains mineral salts which tend to strengthen the gluten. However, excessively hard waters may contain so many minerals that they toughen the gluten to the point where fermentation is retarded. In such cases, it becomes necessary to use considerably more yeast.

Soft water has a tendency to soften the gluten. The result is a very sticky dough. The solution in this case is to use a yeast food to supply the minerals lacking in the water. Additional salt is also helpful.

Alkaline waters reduce the desirable dough acidity brought about by fermentation. By doing so, fermentation is retarded and gluten weakened. To overcome the harmful effect of alkaline water, a small amount of vinegar may be used in the dough batch.

Sometimes water is found to contain large amounts of chlorine. Doughs made with such water often do not develop properly -- but the reason is not the presence of chlorine but the presence of excessive impurities that made the use of chlorine necessary.

IX. USE OF WATER TO CONTROL TEMPERATURE

Because it has been found that for the most part, cool doughs and cake batters yield the best bakery products, every effort should be made to keep ingredients cool. Sometimes this is difficult during the summer months, when flour and other ingredients are at room temperature.

Since the temperature of water can be more easily controlled by the addition of ice or by refrigeration, it is this means that the baker most often uses to keep dough down to around 78°F. after mixing. This is known as the optimum dough temperature.

In large bakeries, dough mixers are often water-jacketed. That is, coils containing water at about 35°F. surround the mixing bowls to counteract the heat generated by the action of the revolving mixing arms.

WATER GLOSSARY

NOTES

Absorption -
Refers to the amount of water that can be taken up by flour. Usually expressed as a percentage of the flour by weight.

Alkaline water -
Water that contains in solution basic substances such as sodium carbonate. Alkaline water may also possess some degree of hardness.

Carbonate hardness -
Temporary hardness of water caused by the presence of carbonates that decompose upon heating to form insoluble carbonates that can then be precipitated out.

Evaporation -
Although water appears to be static, it is actually in a very active state. Water molecules are constantly leaving the surface of the water and going into the surrounding atmosphere. These molecules become water vapor as they change from a liquid to a gaseous state. This process of losing molecules from the liquid is called evaporation.

Filtering -
The process of purifying water by allowing it to trickle through some material such as sand or charcoal. In some baking plants, special filtering tanks filter all of the water that is to be used in baking.

Ground water -
Water from springs and wells. This water is usually purified by passage through layers of porous rock, so it is practically free from organic impurities. Ground waters are high in mineral matter.

Hard water -
Water that contains considerable amounts of carbonate or sulphate of magnesium or calcium. In hard water it is very difficult to form a lather with soap. Some hard waters can be made soft by boiling; others are "permanently" hard.

Hydration of gluten -
Taking up of water by the proteins in flour.

Hydroscopic -
The ability of a product to attract and hold water.

H_2O -
The chemical formula for water. Each molecule of water contains two atoms of hydrogen and one atom of oxygen.

Permanent hardness -
Hardness of water caused by salts or sulphates that will not boil out but, instead, will remain in solution. Permanent hardness is also known as noncarbonate hardness.

Pure water -
In a chemical sense, natural waters are never "pure," since they contain some dissolved impurities. Even snow which has not yet fallen to the ground and therefore contains no dissolved salts or minerals, contains some dissolved gasses from the atmosphere.

p.p.m. -
Part per million of dissolved hardness - forming minerals present in water. In our context, it is a means of classifying water as to hardness, based on the number of p.p.m. of calcium carbonate as a standard.

Solution -
The mixture that results when a substance is dissolved in water, as yeast dissolved in water is called a "yeast solution."

Soft water -
Water that is relatively free of the carbonates of calcium or magnesium. Soft water forms a lather freely with soap.

Surface water -
Water from streams, ponds, lakes, and reservoirs are the principal sources of surface water. Such water may contain considerable amounts of organic, inorganic, and microbiological impurities.

Temporary hardness -
Hardness of water caused by the presence of carbonates of magnesium or calcium, that can be removed by boiling. Also known as "carbonate hardness."

UNIT VI - SUGAR AND OTHER SWEETENERS

CHAPTER HEADINGS

I. Introduction
II. The Manufacture of Sugar
III. The Refining of Sugar
IV. Sugar in Bread Baking
V. Sugar in Cake Baking
VI. Formula Balance
VII. Invert Sugar in Cake Baking
VIII. Corn Syrup in Cake Baking

Glossary
Test

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Sugar, An Illustrated Story, Sugar Information Inc., 52 Wall Street, N. Y.

Corn Syrups and Sugars, Corn Industries Research Foundation, 1956, Washington, D. C.

Wihlfahrt, Julius E., A Treatise on Baking, pp. 55-64

NOTES

I. INTRODUCTION

Sugar is one of man's most important foods. It acts in the body the way gas acts in an auto. It provides man with heat and energy. Table sugar has a fuel value of 1,800 calories per pound. According to statistics, Americanslike sugar so well that they eat their weight in sugar yearly.

Sugar is classified as a 100% carbohydrate food, which means that it contains the chemical elements carbon, hydrogen, and oxygen. Its chemical formula is $C_{12}H_{22}O_{11}$.

In this unit we shall not go deeply into the chemistry of sugar. However, it will be necessary for the student to become acquainted with a number of new terms in order to better understand how sugar works in baking.

For the most part we shall be concerned with how sugar works in bread and cake baking. To some extent we will consider its use in confectionery work. But first let's find out something about the manufacture and refining of sugar.

II. THE MANUFACTURE OF SUGAR

The most important of commercial sugars is sucrose. It is obtained principally from sugar cane and sugar beet. While the methods are similar for extracting and processing sugar from the different plants, there are naturally certain differences due to the nature of the plants. In order to simplify our study, we shall deal here only with cane sugar. There is actually no significant difference in the two sugars.

At harvest time, cane sugar contains from 16 to 20 percent sucrose, in addition to small amounts of other types of sugar, mineral and organic matter, and coloring and flavoring substances.

The woody stalks of the sugar cane are delivered to the sugar mill, where they are cut into small pieces, crushed, and their juice extracted.

The liquid obtained is then passed through strainers and run into settling tanks, where the coarser materials settle out. The juice is then transferred to mixing tanks, where more of the impurities are removed.

From there the clear juice is run into evaporators, where it is concentrated into a thick and viscous syrup.

The thick syrup is then further thickened by evaporation in vacuum pans until the syrup is saturated with sugar and crystallization sets in.

The crystal-syrup mass is then transferred into centrifugal baskets, which separate the crystals from the mother liquor, yielding raw sugar and first molasses. The raw sugar obtained at this stage is a brown, coarse-textured product containing 97 percent sucrose and other minerals and impurities. At this point it is sent to the refinery, where the raw sugar is converted into pure sucrose and the many varieties of sugar are produced to suit the needs of industry.

The molasses is treated further to remove the remaining sugar. After all sugar is removed, the remaining molasses is called "blackstrap" molasses, which is a non-edible product. Blackstrap molasses is used mainly by industries other than the food industry.

III. THE REFINING OF SUGAR

Although the processing of cane sugar and of beet sugar are different up to the time the raw sugar reaches the refinery, there is very little difference from this point on. The raw sugar is first purified by a series of treatments which remove the molasses adhering to the raw sugar crystals. This results in a water-clear syrup, from which a huge variety of sugars, varying mainly in their grain sizes, is obtained after careful processing. The most common varieties offered to industrial sugar users include the following.

NOTES

Granulated Sugars

"Coating Sugar" -- an extremely finely granulated sugar used principally for coating pan goods in the production of confectioneries.

"Bakers Special" -- a sugar of very fine grain consisting of whole crystals and therefore better suited for cake making than powdered sugar.

"Fruit Granulated" -- a very finely granulated sugar designed for dry mixing with finely dispersed substances. It is also highly suitable for cake making.

"Extra Fine Granulated" -- a general purpose industrial sugar, intermediate in fineness of grain between fruit-granulated and fine-granulated sugars.

"Fine Granulated" -- a sugar of uniformly fine crystal size. It is the type used primarily by bakers and confectioners as a sweetening agent.

"Standing Sugar" -- a sugar of unusually uniform grain size and brilliant luster, suited especially for sprinkling on cookies and sweet goods.

"Medium Fine Granulated" -- a sugar of somewhat larger grain size than fine-granulated sugar, It is preferred by many as a general purpose sugar.

"Medium Granulated" -- a sugar of exceptionally pure color, having a grain size larger than medium-fine granulated sugar but smaller than standard-granulated sugar.

"Standard Granulated" -- a sugar which is readily soluble, especially where heat can be applied to the solution. It is also used for grinding purposes.

"Coarse Granulated" -- a sugar of very large grain, used in specialty products in which the original sugar crystals contribute th the special effect of the finished item, such as sugar-sprinkled cookies and cakes.

NOTES

Confectioner's Sugar

"Confectioner's XXXXXX" -- a pulverized sugar of extremely fine texture, especially suited for sugar fillings.

"Confectioner's XXXX" -- a fine textured, pulverized sugar used principally for uncooked icings and for dusting purposes on pies, pastries, and similar products.

"Standard Powdered" -- a sugar less finely ground than confectioner's XXXX and suitable for use where extreme fineness is not essential.

"Coarse Powdered" -- a sugar of coarser texture than standard powdered and used when too fine a texture is undesirable as, for instance, in coating doughnuts.

Soft Sugars

The so-called soft sugars are brown sugars, which can range in color from white to dark brown. They readily absorb and retain moisture and possess a very pleasant flavor. They are graded according to color, #1 being nearly pure white and #15 having the color of roasted coffee.

The grades used in baking range from #6, which has a light yellow shade and is used in lighter colored bakery products, to #13, a dark brown sugar used in such products as gingerbread, etc. Unless a bakery produces large quantities of products requiring the different soft sugars, it usually uses a single grade -- usually #8 - for all its brown sugar items.

IV. SUGAR IN BREAD BAKING

In bread baking, sugar performs six major functions, each of which will be considered here separately:

1. It supplies food for yeast during fermentation.
2. It increases fermentation tolerance.
3. It develops an appetizing crust color.
4. It provides sweetness and flavor.
5. It contributes to initial softness.
6. It controls baking time and yield.

1. Sugar Supplies Food for Yeast During Fermentation

Yeast feeds on sugar to produce the carbon dioxide necessary for leavening. In bread making, the basic ingredients are flour, salt, yeast, and water. Notice that sugar is not listed as a basic ingredient, and indeed many breads, such as Italian and French breads often contain no added sugar. Yet fermentation is possible because yeast feeds on the small amount of sugar contained in the flour.

In the baking industry, fermentation refers specifically to alcoholic fermentation -- the conversion of sugars into carbon dioxide and alcohol by the action of the yeast. During fermentation, the carbon dioxide produced by yeast action is trapped in the gluten and raises the dough.

Of course, this action is not so simple as it is made to sound. Actually, a number of almost instantaneous activities are taking place. One of these activities that must take place before even the carbon dioxide is formed is one called inversion.

Inversion is the result of breaking down sugar ($C_{12}H_{22}O_{11}$), a complex disaccharide, into a simple carbohydrate ($C_6H_{12}O_6$).

The break-down process is called inversion, or hydrolysis. It results from the action of a powerful enzyme in yeast called invertase, which is a complex carbohydrate.

When sugar is inverted, each sugar molecule splits to form two simple sugars -- dextrose and levulose, each with the same formula, $C_6H_{12}O_6$. It is only after this action has taken place that fermentation can begin, for it is these simple sugars -- dextrose and levulose -- that are directly fermentable by yeast.

The student should bear in mind that inversion does not take place only in bread making. In fact, the product called Nulomoline is a ready-made invert sugar for use in baking and confectionery where the sugar is not naturally inverted (as in bread baking) but where the advantages of an inverted sugar are desirable.

Students who have seen and used Nulomoline know that it has a tendency to separate into two parts: a clear, liquid substance which rises to the top and a thick, fondant-like substance which settles on the bottom. The top part is the dextrose and the bottom part is the levulose.

Although both have the same molecular formula, they differ in structural formula and properties. Levulose is sweeter than sugar and roughly twice as sweet as dextrose. When both are present, the dextrose portion is fermented more rapidly than the levulose portion. Since not all of the sugars are consumed in fermentation, it is the levulose, the sweeter portion, which remains to give sweetness to the baked bread. It is this that accounts for the fact that when products are baked with commercial dextrose (made from corn sugar) they are less sweet than when made with sugar. This is referred to as the residual effect of the sugar.

2. Sugar Increases Fermentation Tolerance

Fermentation tolerance is the range of time during which a properly developed and fermented dough will produce bread of good quality. It is affected by two factors: a) depletion of sugars, and b) physical condition of the dough resulting from mechanical, chemical, and enzymatic action.

In other words, the first factor that influences fermentation tolerance is whether or not the yeast consumes all of the fermentable sugars. Naturally, when all of the food is consumed which makes possible the production of carbon dioxide, which in turn makes possible the continued rising of the bread, fermentation simply stops.

The other factors are grouped together in the above definition. They refer to how much or how little the dough is mixed, what other ingredients go into the dough besides the basic ingredients, and the conditions that make possible or impede enzyme action in the dough.

3. Sugar Develops Appetizing Crust Color

To a baker, a rich crust color is evidence of a properly fermented dough baked into a loaf of pleasing flavor. Crust color is largely due to the caramelization of sugars present in the dough at the time of baking. In other words, it is not enough that sugar be present at the time of mixing; in an over-fermented dough most of the sugars may be consumed by the yeast before the time of baking, with the result that the crust color will be pale, no matter how long the loaf remains in the oven.

While bread can be made with commercial dextrose (dextrose hydrate) as a sweetener in place of sugar, and commercial dextrose will caramelize at a lower temperature than sugar, here's why bread baked with sugar will give better crust color than bread baked with commercial dextrose:

You will recall that the yeast enzyme invertase acts on sugar and splits it into two simple sugars -- dextrose and levulose. The levulose portion of the sugar is even more heat sensitive than the dextrose portion. Furthermore, yeast consumes these simple sugars in sequence; first it consumes the dextrose, then it consumes the levulose. Since considerable levulose remains in the loaf at the time it goes into the oven, caramelization results. On the other hand, where only commercial dextrose is used as the sweetening agent, no levulose is present in the sweetening agent, with the result that the same degree of caramelization is not possible.

It is also a fact that caramelization and browning reactions contribute important flavoring substances. Baking laboratory experiments in which bread was baked with no crust, show that such bread is also without flavor, so it is clear that, to a great extent, the flavor depends on the crust and the crust depends on the sugar.

4. Sugar Provides Sweetness and Flavor

There are two aspects of the use of sugar in bread baking: first, there is the aspect of improved palatability that the sweetness of sugar itself gives to bread, and second, there is the improvement in flavor that results from the reaction of sugar with other ingredients. The following chart shows the relative sweetness of table sugar compared with various other sugars. Following the general practice of baking authorities, sugar is given a value of 100.

RELATIVE SWEETNESS RATING

Ingredient	Relative Sweetness
Sugar (cane or beet)	100
Levulose	175
Invert sugar	130
Dextrose hydrate	70
Corn syrup (enzyme)	60
Corn syrup (acid)	30

In addition to the sweetness it contributes of itself, sugar also acts as a vehicle or carrier of other flavors, such as butter aroma and other volatile aromas. These volatile aromas are absorbed in the bread when it cools. Hence, a well-mixed dough will have a richer crust color and more flavor than an undermixed dough. And a short-baked bread baked at a proper temperature will retain more flavor because it will retain more moisture (to hold in the volatile flavors) than an over-baked or slow-baked loaf in which the volatile flavors are given a chance to become dissipated.

The important thing to remember is that it is the generous use of sugar which makes possible the type of oven heat which results in the retention of more moisture.

5. Sugar Contributes to Initial Softness

Sugar is not a miracle ingredient and the student must be careful not to attribute to it qualities it does not possess. For example, it is generally believed that the increased use of sugar in bread contributes to its softness, but since sugar is not in itself a softening agent, there must be another explanation why sugar seems to contribute softness.

The explanation lies in the previous paragraphs, in which it is pointed out that sugar makes possible the use of an oven heat that contributes to the retention of moisture in the loaf.

Tests have shown that increasing the sugars in bread from 4 percent to 12 percent has little effect on the rate of change in crumb firmness. Tests have also shown that, as sugar content is increased, baking time is decreased. Rapid baking results in softer crumb and higher moisture content. This, of course, is reflected in longer shelf life. Thus, it is because sugar contributes to initial softness that its value in bread baking is increased.

6. Sugar Controls Baking Time and Yield

It should be clear to the student from the above that there is a direct relationship between the quantity of sugar used and the baking time. Indeed, in many bakeries, where there is continuous production, and a faster bake becomes necessary, the dough mixer continually adjusts the quantity of sugar used to meet the need.

V. SUGAR IN CAKE BAKING

In cake baking, sugar performs these functions:

It increases tenderness.
It contributes volume.
It improves texture and reduces the danger of tunneling.
It develops a pleasing crust color.
It creates a balance between liquids and solids, thus forming a stable structure.
It acts as a vehicle for other flavors.
It assists in the retention of moisture.
It gives cake its attractive finish and sales appeal.

Although there are many similarities between the functions of sugar in cake baking and in bread baking, there are also many differences. The chief difference is that in bread baking, CO_2 is produced by the action of yeast on sugar; in caking baking, CO_2 is produced by one of three other ways. These are three ways in which CO_2 is produced in cake baking:

1. By chemical means, i. e., by the action of baking powder or other leavening agents.

2. By the production of steam from the moisture in the cake.

3. By mechanical means, i. e., by the incorporation of air by mixing.

At this point in our study of the use of sugar in cake baking, it becomes necessary to understand something about the relationship of sugar to other ingredients. This is part of a larger study called Formula Balance. We shall deal with formula balance only to the extent that it involves sugar.

You will recall that in bread baking, the basic ingredients are flour, salt, water, and yeast. The basic ingredients in cake baking are sugar, flour, water and/or milk, salt, eggs, and/or shortening. Notice that leavening is not listed as a basic ingredient because it is possible to leaven a product by incorporating air in the mix.

VI. FORMULA BALANCE

The basis of formula balance is the idea that each ingredient in cake making is either a tenderizer, a toughener, a moistener, or a dryer. To obtain a stable structure, therefore, each ingredient must be balanced against all the other ingredients. By "stable structure" we mean that the cake structure formed by combining the various ingredients must be capable of retaining the gas formed in the leavening process.

Here are the formula-balance rules for the use of sugar in cake baking:

In Pound Cakes and Layer Cakes

1. The weight of the sugar should exceed the weight of the flour.

2. The weight of the eggs and other liquefying agents should exceed the weight of the sugar.

In Angel Food Cakes

1. The weight of the sugar should equal the weight of the egg whites.

2. The weight of the flour should be approximately one-third the weight of the sugar or of the egg whites.

In Sponge Cakes

1. The weight of the sugar should equal or exceed the weight of the eggs.

2. The total weight of liquids (including eggs) should exceed the weight of the sugar.

3. The weight of sugar or of eggs should exceed the weight of the flour.

4. The total weight of eggs and flour should exceed the weight of sugar and liquids.

Notice that in every one of the above rules, the use of sugar is involved. It should be evident that the correct use of sugar in cake baking is more critical than in bread baking.

VII. INVERT SUGAR IN CAKE BAKING

Just as benefits accrue to bread when sugar becomes inverted in the fermentation process, benefits also come to cake if part of the sugar is inverted. In cake baking, however, the sugar must be inverted before it is even incorporated into the product.

You may recall that invert sugar consists of two simple sugars. These simple sugars result when the complex disaccharide sucrose is split into almost equal parts of levulose and dextrose.

One of the important properties of invert sugar is that it attracts and holds moisture. This is called a hydroscopic property. Because of this hydroscopic property, cakes made with invert sugar stay fresh longer.

Although the retail baker seldom prepares his own invert, the formula is given below to show how simple it is:

70 lbs. sugar
30 lbs. water
1 oz. tartaric acid

Dissolve all ingredients, bring to a gentle boil in steam kettle, hold at low boil for 30 minutes, shut off steam and run cold water through jacket while cooling is in progress.

VIII. CORN SYRUP IN CAKE BAKING

Corn syrups are used in cake and confectionery making, not primarily as a sweetener, but to introduce bodying effects which act to retard crystallization of sugars. It is called corn syrup because it is prepared from maize, commonly known as Indian corn. It is also commonly (but incorrectly) referred to as glucose.

Corn syrup is defined as "a thick, syrupy, colorless product made by incompletely hydrolyzing starch, or a starch-containing substance, and decolorizing and evaporating the product. It contains, on a basis of 41 degrees Baume, not more than one percent of ash, consisting chiefly of chlorides and sulphates."

Baumé -
A unit of measure for the density of cooked sugar syrup. The word is derived from the name of the man who invented the Baumé Saccharometer, an instrument similar to a hydrometer. Accurate readings are secured at 60°F.

Decolorize -
A process involved in the manufacture of sugar whereby the natural, dark-molasses shade of sugar is eliminated, so that the final product is seemingly pure white.

Dextrose -
A white, powdery substance derived from corn, somewhat similar in appearance to confectioner's sugar. It is used in baking as a supplement to or replacement for sugar.

Dextrose is not so sweet as cane sugar, having a relative sweetness of 66. It crystallizes more slowly than sugar and is less soluble in water. It is directly fermentable by yeast. It caramelizes at a lower temperature and pH than sugar and thereby contributes to good toasting qualities and crust color.

In chemistry, dextrose is also known as glucose. It is one of the simple sugars into which sucrose is split by inversion.

Disaccharide -
A complex sugar formed from the condensation of two molecules of a monosaccharide with the elimination of one molecule of water. Disaccharides are converted into monosaccharides during the process of digestion. Table sugar is a disaccharide.

Caramel color -
The black, soluble material obtained by heating sugar or molasses to about 392°F., or from starch conversion to glucose and then heating the syrup. This product is used as a food coloring in pumpernickel and other dark bakery products.

Caramelization -
The process by which sugar components are caused to color, particularly at the crust, on exposure to heat. Different sugars will caramelize at different temperatures.

Carbohydrate -
One of nature's three great classes of organic compounds, the other two being fats and proteins. No matter what their complexity, carbohydrates contain only carbon, hydrogen, and oxygen, the latter two in the proportion in which they exist in water, that is two to one (as in H_2O). Starch and sugar are examples of carbohydrates.

Corn syrup -
Also known as glucose among bakers, although by correct definition the two terms are not synonymous. According to the Pure Food and Drug Administration, corn syrup is "a thick, syrupy, colorless product made by incompletely hydrolizing starch, or a starch-containing substance, and decolorizing and evaporating the product. It contains, on a basis of 41° Baumé, not more than one percent of ash, consisting chiefly of chlorides and sulphates."

Crystallization -
The change from a dissolved, molten, liquid, or gaseous state to a solid state of definite ordered and characteristic shape. In the refining of sugar, crystallization takes place immediately after the syrup is placed in evaporating pans, that is, when moisture is evaporated from a saturated solution. Crystals grow in size depending on temperature, rate of cooling, and amount of stirring. Also, syrup can be "seeded" with crystals of a definite size so that similar crystals will be developed out of the sugar in the syrup.

Enzyme -
An organic catalyst, generally a protein, which is capable of bringing about a specific chemical reaction, Each enzyme has its own name and can generally be recognized by the ending ase. Thus, the enzyme which converts sucrose into dextrose and levulose is called invertase.

Perhaps because of their complexity, efforts to isolate enzymes have not been very successful; thus, their structure is not well known.

Evaporation -
The process of withdrawing moisture from a given substance.

Fermentable sugar -
Although sucrose can be fermented by yeast, it is not a fermentable sugar in the strict sense of the term because it cannot be directly fermented by yeast. Before sucrose can be absorbed into yeast cells and fermented to alcohol and carbon dioxide, it must first be inverted. This is done outside the yeast cells by the enzyme invertase and the resulting invert sugar is the fermentable sugar. In other words, invert sugars are sugars which are capable of being directly fermented.

Fondant -
Fondant is made when 80% sugar is cooked with 20% water to a definite temperature (238-248°F.). It is stirred before boiling to prevent the formation of crystals, but is not stirred again until it has cooled to a desired temperature -- the exact temperature depending on the size of the crystals desired.

Because special equipment is needed and particular care must be taken to control temperature, this product is almost always purchased by the baker. According to accepted standards, fondant should be snowy white, the crystals so small that they are imperceptible. Fondant should not be gritty to the palate but soft and plastic.

Glucose -
A solution of dextrose made from corn by conversion of the starch into sugar. Has approximately two-thirds the sweetening power of cane sugar. Has a lower caramelization point than cane sugar.

Inversion -
The changing of sucrose to invert sugar. The reason for the name is that, before the change occurs, a solution of sucrose is dextra-rotatory -- that is, it has the power to twist or rotate a ray of polarized light to the right. Invert sugar, however, twists the ray of polarized light to the left. Actually, dextrose bends the ray to the right and levulose bends it to the left; the levulose being more powerful, the mixture bends the ray to the left.

Invertase -
The enzyme naturally present in yeast which acts on sugar and splits it into two simple sugars, levulose and dextrose.

Invert sugar -
A simple sugar; a combination of both dextrose and levulose. It is produced when sugar is subjected to prolonged heating or when sugar is heated in solution with acids or mineral salts. It is also produced by the action of an enzyme naturally present in yeast. "Nulomoline" is the trade name for such a sugar manufactured by the American Molasses Company. Other companies produce similar invert sugars under their own trade names. See the word "inversion" above for further explanation.

Hydrolysis -
A chemical process of decomposition involving the elements of water. In many cases it is induced by the presence of a small amount of an enzyme, a dilute acid, or other agent. Thus, cane sugar boiled with dilute hydrochloric acid yields a mixture of dextrose and levulose. Similarly, diastase hydrolyzes starch into maltose and dextrine.

Levulose -
Also known as fructose or fruit sugar. A monosaccharide or simple sugar, found naturally in company with dextrose in honey and in the juice of many sweet fruits. It can be prepared from cane sugar in association with dextrose by hydrolysis, that is, by boiling with a small quantity of acid, the mixture being known as invert sugar. Levulose is a fermentable sugar.

Maltose -
The chemical name for malt sugar. It is not so sweet as cane sugar. It is produced by enzyme action on starch and is thus the principal sugar in bread fermentation. Maltose is changed into dextrose by the action of malt<u>ase</u> - an enzyme found in yeast.

Molecular -
Pertaining to, consisting of, or connected with molecules. A molecule is one of the minute particles of which material substances consist. It is the smallest portion into which a substance can be divided without losing its chemical identity.

Monosaccharide -
A simple sugar such as levulose, dextrose, galactose. All monosaccharides are soluble, crystallizable, diffusible substances, unaffected by digestive enzymes.

Nulomoline -
An invert sugar manufactured by the American Molasses Company. It is a simple sugar consisting of equal parts of levulose and dextrose. Used in bakery products, it has the ability to promote better browning, because invert sugar has a lower caramelization point than sucrose. It also promotes moisture retention because of its hydroscopic properties, that is, its ability to attract and hold moisture.

Stable structure -
Not a barn for horses, but a mixture with a proper balance of liquids and solids, which when baked produce a cake of good contour, proper tenderness, and good handling qualities.

Syrup -
According to official specifications, "sugar syrup" is a product made by dissolving sugar to the consistency of a syrup and contains not more than 35% of water. Note that syrup is made from sucrose and is different from "corn syrup" which is made by incompletely hydrolizing starch.

Sugar -
A term applied to carbohydrates having a sweet taste. They are generally of vegetable origin, from such materials as barley, beets, sugar cane, corn, fruits, etc. Brown sugar is cane sugar which has received little or no refining. The caramelization of sugar in a dough during baking accounts in large part for the brown color of the crust.

Viscous -
Said of substances having a thick or gluey character. Resistant to stirring.

Volatility -
The quality of being susceptible to evaporation and diffusion at ordinary temperatures.

UNIT VII - EGGS AND EGG PRODUCTS

CHAPTER HEADINGS

I. Introduction
II. Structure of an Egg
III. Bacteriology of Eggs
IV. Functions of Eggs in Bakery Products
V. Fresh Eggs Versus Frozen Eggs
VI. Dried Eggs
VII. Reconstituting Dried Eggs
VIII. Handling Frozen Eggs
IX. General Information Regarding Eggs in Baking

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Test

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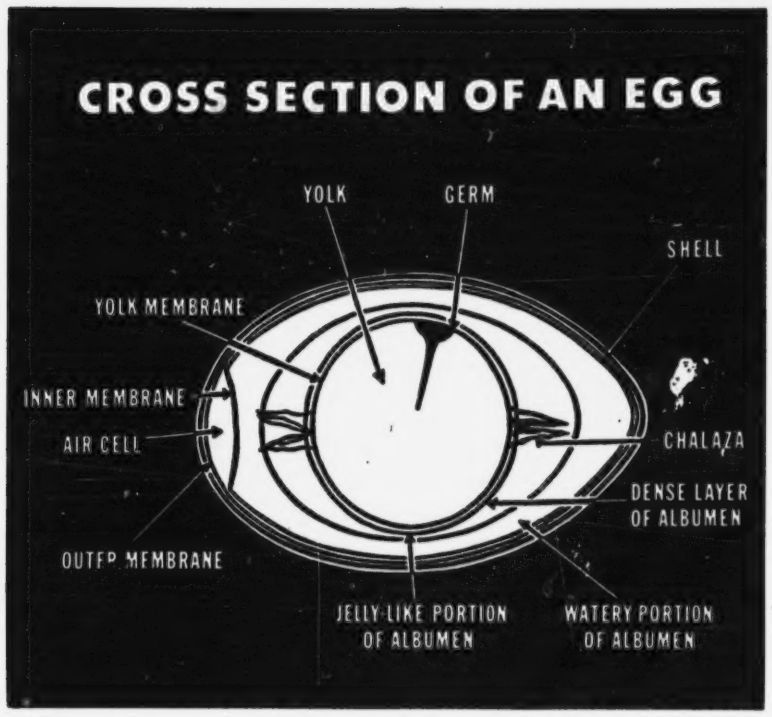
I. INTRODUCTION

NOTES

Eggs are one of the most important baking ingredients from the standpoint of quality, nutrition, and cost. In many cakes, the cost of the eggs alone comprise about half the total cost of ingredients. In sponge cakes, the cost of eggs may amount to as much as 70% of the total ingredient cost.

Eggs are available to the baker in four forms: shell eggs, liquid eggs, frozen eggs, and dried eggs. At present, dried eggs are not as important as the other forms, so they shall be dealt with only summarily here. Regardless of which form of eggs the baker buys, the egg is the same. We shall therefore first learn something about the egg itself.



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II. STRUCTURE OF AN EGG

The shell constitutes about 10% of the egg by weight. This, of course, serves only as a protective container for the edible egg material. When the egg is newly laid, it is covered with a gelatinous coating which serves to seal the pores. If eggs are washed, this coating is washed away, and bacteria can enter.

The outer shell membrane is next to the shell.

The inner shell membrane is next to the white and holds it in.

An air space exists between the inner and outer shell membranes, but is most noticeable at the top. This air space increases in size as the egg cools and ages.

The watery portion of albumen is the thin, white fluid, next to the inner shell membrane. This portion is just as nutritious and important to the baker for its cell-building qualities as the thicker portion of the white.. The total white portion constitutes about 65% of the edible egg.

The dense layer of albumen is the somewhat smaller portion of the white surrounding the yolk between the watery portion and the jelly-like portion.

The jelly-like portion of albumen is a thin layer immediately surrounding the yolk.

Chalaza is the name for either of the pair of rope-like masses of thickened albumen at each end of the yolk. These provide anchorage for the yolk in the white.

The yolk is the yellow portion of the egg. It is enclosed in a sac called the vitelline membrane, which holds the yolk in its normal ball-like shape. The yolk constitutes about 35% of the edible egg.

Germ. This appears on the surface of the yolk. It is a small disk of protoplasmic material from which the embryo develops.

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III. BACTERIOLOGY OF EGGS

Eggs are highly perishable and should be kept under refrigeration to prevent the growth of bacteria and molds. To some extent, eggs have certain built-in sanitation factors.

One of the built-in sanitation factors is the change in pH that takes place within 24 hours after the egg is laid. Newly laid eggs have a pH of 7. 6. Ordinarily, within 24 hours this changes to 9. 0 -- a level which is beyond the tolerance of many bacteria.

Another built-in sanitation factor is the presence of a substance called lysozyme in the white. This substance has been found to prevent the development of a number of types of microorganisms which gain access into the egg liquids. However, lysozyme loses its strength when eggs are stored for long periods. That is one reason why ideal storage conditions are essential.

When shell eggs are held in commercial storage for six months or more, the temperature is usually maintained at about 30°F., which is slightly above the freezing point of the egg liquids. In the bakery they should be kept at 40°F. and, most important, they should be kept dry at all times.

A common defect in eggs is the appearance of blood spots in the yolk. The small blood clot usually is a blood vessel fragment that has become detached from the hen's ovary. Although this does not affect the edibility of the egg, it is unpleasant and affects salability. However, the large blood ring that results from germ development is definitely inedible.

Eggs are a potential source of two types of food poisoning: salmonella and staphylococcus.

Salmonella infections cause acute gastro-intestinal disorders. The symptomsare generally abdominal cramps, diarrhea, and, in some instances, vomiting. The period of incubation, that is, the period which elapses before the onset of illness, ranges from a minimum of 7 to 8 hours to a maximum of 72 hours, with the average being 12 to 24 hours.

Staphylococcus is the more common type of food poisoning. This disease is of short duration and usually results in rapid recovery. Symptoms usually appear within 3 or 4 hours after the food is eaten. Increased salivation is usually the first symptom, followed by nausea, vomiting, cramps, and diarrhea. In mild cases, no treatment is necessary since the poisons are thrown off in the vomiting and diarrhea.

In order to prevent outbreaks of staphylococcus food poisoning, perishable foods should be refrigerated. People who have sinus infections, continual colds, or boils, should not handle custards, meringues, or other foods subject to bacteria growth.

IV. FUNCTIONS OF EGGS IN BAKERY PRODUCTS

Binding Action. You may recall that in the study of flour, we learned that protein was the structure-building material that made leavened bread possible. To some extent, the presence of protein in eggs performs the same function, for egg proteins form the skeleton capable of acting as a framework for the support of other ingredients.

Leavening Action. Eggs provide a leavening action not only in sponge cakes and angel food cakes where the foam provides a skeleton for air cells, but also in heavier types of cakes where their protein films, distributed throughout the batter, help to retain the gas liberated by baking powder. While eggs do not help create any gas as does baking powder, they do contribute toward leavening in this indirect way.

Emulsifying Action. Egg yolk contains lecithin, which is an emulsifying agent. Not only does the emulsifying property of the yolk balance the toughening quality of the whites, but the overall effect of the whole egg is that of tenderizing rather than toughening.

Flavor. Fresh and frozen eggs have a desirable flavor which improves the eating qualities of cakes.

Color. While there is no difference in the food value of eggs with deep-colored yolks and eggs with a light-yellow-colored yolks, bakery products are, for the most part, more attractive when eggs with deep-colored yolks are used.

Food Value. Eggs are rich in proteins, fats, minerals, and vitamins essential to growth, particularly vitamins A and D. There is no difference in the food value of brown-shelled and white-shelled eggs.

V. FRESH EGGS VERSUS FROZEN EGGS

Before frozen eggs were introduced, bakers used mostly shell eggs. There are many advantages of frozen eggs over fresh eggs, however:

Easier handling
Higher and more uniform quality
No waste
Less price fluctuation

The amount of time saved by using frozen eggs instead of fresh eggs is a most important factor to the baker. But time alone is not the only factor. No matter how carefully the baker cracks fresh eggs, about 3% of good egg material is lost.

In general, the quality of frozen eggs is higher than the quality of fresh eggs, provided, of course, that the eggs are purchased from a reliable packer. Better packing plants confine their packing season to the cool spring months, since eggs laid from February through May are superior to those laid during the summer.

Many bakers contract for their total yearly supply of frozen eggs when prices are lowest, thus insuring themselves against any price rise due to a fluctuating market. This cannot be done with fresh eggs.

VI. DRIED EGGS

Although dried eggs are not widely used in small-bakery production, their use is increasing in packaged mixes and in large-scale production. In some products, such as meringues, the use of dried egg whites has been found to be superior to fresh whites.

Dried eggs are prepared by breaking high quality eggs, mixing them in a churn, screening to eliminate shells and membranes, spraying them under high pressure into a drying chamber (temperature 160° - 170°F.), where they are dried almost instantly. The resulting product is an egg powder known as whole dried eggs.

Dried egg whites are handled somewhat differently. Since the whites consist of thick and thin matter, this must first be made into a mass of uniform consistency. This is done because the thin part possesses superior whipping qualities to the thick part. Thus, the whites are first allowed to ferment for about 72 hours. Then they are dried and powdered and are ready for packaging.

Whites can also be dried without first being fermented. In this case, the thick portion of egg whites is liquefied by pumping and straining and by acid or enzyme hydrolysis.

VII. RECONSTITUTING DRIED EGGS

Whole dried eggs. Whip 1 pound of dried eggs on top of 3 pounds of water. Allow mixture to stand 4 to 5 hours, or until normal liquid egg consistency is obtained.

Dried yolks. Whip 1 pound of egg yolks on top of 3 pounds of water. Allow mixture to stand 1 hour.

Unfermented albumen. Whip 1 pound whites on top of 6 to 7 pounds of water. Allow mixture to stand 3 hours.

Fermented albumen. Whip 1 pound of whites on top of 10 pounds of water. Allow mixture to stand for 3 hours.

VIII. HANDLING FROZEN EGGS

Frozen eggs stored at 0°F. can be held for about two years. At -10°F to -15°F. they can be held almost indefinitely.

The best method for defrosting eggs is to set the can in a tank of running water at 50° - 60°F.

The next best method is to transfer the eggs to a refrigerator at about 35°F., but this requires at least a couple of days for defrosting a 30-pound can.

The least satisfactory method of defrosting eggs is to allow them to stand at room temperature (usually about 70° - 80°). It takes 18-24 hours for a 30-pound can to defrost in this manner. Although the result is seemingly satisfactory to the naked eye, the fact is that the eggs at the outer edge of the can will approach room temperature while those at the center of the can will be considerably cooler.

Eggs are very perishable and should not be refrozen after thawing, since this impairs the effectiveness of the eggs in a batter.

When eggs are frozen, there is a migration of solids toward the center of the can. Therefore, after the can has been defrosted, the entire contents should be thoroughly mixed before any is used.

Thawed eggs should be used promptly. As a rule, it is best if they are not held in the refrigerator longer than 24 hours.

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IX. GENERAL INFORMATION REGARDING EGGS IN BAKING

Good quality frozen eggs are every bit as good for baking as fresh eggs. In most cases, frozen eggs are better than fresh for bakery use.

Eggs are capable of leavening five to six times their weight of other ingredients.

Egg yolks have high emulsifying power which helps impart a definite shortening action.

Eggs improve the cell structure of the product, maintaining it during baking, and reduce the evaporation of moisture from the baked product, thereby extending freshness.

Egg whites lend little flavor but produce a mellowing effect.

The whipping quality of egg whites is harmed by even the least bit of egg yolk or any kind of fat.

The thin portion of whites can be whipped more readily to the proper consistency and can thus make a better cake than the thick portion. Thick egg whites can be improved for angel food cake by the addition of water.

Spring-laid eggs produce larger cake volume than summer-laid eggs.

Egg whites can be whipped better at room temperature than when whipped directly from the refrigerator, because the surface tension of egg whites is lowered when the temperature is raised.

GLOSSARY ON EGGS

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Acid stabilizer -
Certain acids, such as cream of tartar, calcium acid phosphate, lemon juice,-and even salt- which improve the ability of egg whites to form into a foam. This happens because the protein coagulates more rapidly upon addition of limited amounts of certain acids at the foaming stage of the whites.

Albumen -
The white of an egg.

Check -
An egg with an open crack or break in the shell but with the shell membrane unbroken and with no leakage.

Coagulation -
The process by which liquid egg materials solidify and form structure in a product. This is accomplished by the yolks as well as by egg whites. On baking to 126°F., yolks coagulate to a more stable structure than the whites. They also form thinner cell walls.

Cohesiveness -
One of the properties of eggs, that of holding together various ingredients in a mix.

Chalaza -
A rope-like mass at each end of the egg which anchors the yolk in the egg white.

Curdle -
To form into a curd. (A curd is the coagulated substance formed from milk by the action of acids.) When eggs are added to a mix in too large a proportion, a curdling action takes place.

Elasticity -
One of the properties of eggs, that of being able to stretch and form into cell walls that can hold air. This property is impaired when eggs are stored at too high a temperature and become "thin."

Emulsifier -
A compound which allows a relatively permanent suspension of oils and fats to be mixed with water. For example, egg yolks contain lecithin and cholesterol, which give it its characteristic emulsifying value.

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Yolk is the most stable emulsion known in nature.

Foam -
A dispersion of air or other gas into a medium stabilized by a suitable agent. For example, the foam in beer consists of CO_2 in a liquid stabilized by protein materials.

Gas Retention -
The ability of a substance to hold CO_2 within the cell walls developed by mixing or creaming.

Lecithin -
A yellowish-brown, waxy solid occurring in various animal and vegetable tissues, especially brain, egg yolk, soy bean, and wheat-germ oil. It is insoluble in water and is used as a fat extender, emulsifier, and stabilizer.

Leavening -
As applied to eggs, it is the ability of eggs to hold in air created during mixing and creaming and thus help to raise the product.

Leaker -
A grade of eggs that has an open break or crack in the shell membrane so that the contents are flowing or free to flow.

Low surface tension -
The relative "softness" of the surface of egg matter. For example, one of the reasons older egg whites can be whipped to a foam more easily than fresh, firm whites is because they have lower surface tension. (That older whites may not be able to retain the air that is whipped into them is another matter.)

pH -
The relative acid-base relationship in organic matter, 7 indicating neutral, above 7 indicating base or alkaline, and below 7, acid. The pH value of newly laid eggs is 7.6. At normal room temperature this will rise to 9.0.

Porous -
Full of pores or tiny holes. Describes the surface of egg shells. That is, there are tiny holes in the surface, through which bacteria may enter.

Protein -
Complex substance found in the cells of plants and animals and necessary to life. Eggs contain approximately 13% protein.

Salmonella -
Food poisoning that may result from certain bacteria grown in eggs that are subject to high temperatures. and unsanitary conditions.

Staphylococci -
All micro-organisms having a spherical shape are called cocci. Those that exist in pairs are classed as diplococci. Those that exist in clusters are classed as staphylococci.

Shell membranes -
Two membranes directly next to the shell of the egg. The outer membrane is next to the shell; the inner shell membrane is next to the egg liquids.

Yolk -
The rich, yellow portion of a shell egg. It is enclosed in a membrane and floats in the whites. It consists of approximately 50.9% water, 16.2% protein, 31.75% fat, and 1.09% ash.

UNIT VIII - SHORTENING AND OTHER BAKING FATS

CHAPTER HEADINGS

I. Introduction
II. The Manufacture of Shortening
III. The Function of Shortening
IV. Proper Storage of Shortening
V. The Composition of Fats
VI. Nutritive Value of Shortening
VII. Creaming Power of Shortening
VIII. Shortening Power
IX. Butter and Margarine
X. Frying Fats

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NOTES

I. INTRODUCTION

Of the various fats used in baking, shortening is the most important. Shortening is defined as "an edible fat from plant or animal sources, which may or may not be hydrogenated, used in baked products to produce tenderness and enhance flavor and texture."

When shortening is made from the fatty tissue of hogs it is called lard. When shortening is made from the fatty tissue of other animals it is simply called animal shortening. When it is made from oils which are extracted from such plant sources as cotton seed or peanuts or soya beans, it is called vegetable shortening.

Corn oil is seldom used in the manufacture of shortening because it is difficult to process into a plastic form. Until very recently, all shortenings were in a plastic form, that is, they were solid at room temperature. However, shortenings have now been developed that are semiliquid.

II. THE MANUFACTURE OF SHORTENING

The difference between an oil and a fat is merely the difference in the physical state of the same substance at room temperature. An oil is liquid at room temperature; a fat is solid at the same temperature.

When oil is heated and combined with hydrogen in the presence of a catalyst such as nickel, it becomes solid and turns white. It is then known as a "plastic" shortening.

When all the oils or fats are hydrogenated, the resulting shortening is called all hydrogenated shortening. When only part of the shortening is hydrogenated, the resulting product is known as compound. Compounds may be either all vegetable, all animal, or a combination of both.

Compound shortening is HARD shortening in which the degree of desired hardness is obtained by varying the amount of either oleostearine or edible tallow, which are two of the constituents of vegetable and animal fats. Hardness is also achieved by additional hydrogenation. Hard fats are desirable in the production of puff pastry.

Originally "lard compounds" were merely 80 percent cottonseed oil and 20 percent oleostearine and were designed as lard substitutes. When the process of hydrogenation was developed about 1910, it became possible to harden vegetable oils completely without the use of oleostearine.

When an emulsifier is added to a hydrogenated shortening, it is called an emulsified shortening. Emulsified shortenings are necessary for the production of "high ratio" cakes, that is, cakes which have a high ratio of sugar and liquids to flour. The addition of the emulsifier to the shortening makes it possible for the shortening to be more widely dispersed through the batter.

The entire process of shortening manufacture is called refining. In the manufacture of shortening, almost all of the impurities are refined out of the raw materials - just as in the refining of sugar, - almost all of the impurities are removed and the finished product is called refined sugar.

In the refining processes by which edible fats and oils are made from the crude oils and fats taken from animals or plants, the first step is to treat the raw oil with an alkali. When this combines with the free fatty acid, a soft soap is formed. The soap particles, on settling, carry down with them the various impurities. This results in a clean, light-colored, and practically neutral oil on top.

If a high-grade shortening is to be produced from this oil, a bleaching process follows. After that, the oil is again filtered to remove further impurities.

This purified oil is now ready for hydrogenation. The oil is treated with purified hydrogen gas under pressure. Because of the presence of the catalyst nickel, the liquid oil changes into solid form.

After the oil is hydrogenated, it is deodorized. This is done by blowing it with superheated steam under a high vacuum.

Finally, it is solidified by chilling and forcing through valves to give it a smooth consistency.

In summary, the steps in the manufacture of shortening are:

1. In animal shortenings, the fat from fatty tissues is rendered. In vegetable shortening, the raw oil is obtained by pressing or other means.

2. The raw fat or oil is treated with an alkali to separate impurities.

3. The purified oil is hydrogenated to convert it into a plastic form.

4. The hydrogenated shortening is then deodorized.

5. Finally, the plastic white shortening is chilled and smoothed.

III. THE FUNCTION OF SHORTENING

Why use shortening in baked foods?

1. To improve eating qualities.
2. To improve appearance.
3. To improve keeping qualities.
4. To improve food value.
5. To improve volume (except in sponge and angel cakes).

Fats do not blend chemically with other bakery ingredients; instead, they are dispersed throughout the entire mix. Thus, the addition of shortening serves to tenderize the finished product, and eating qualities are improved.

Eating qualities are also improved because the films of fat break down gluten structure and starch structure to some extent and prevent the formation of a hard, tough mass.

The dispersion of fats may also be increased by the addition of emulsifiers. Greater quantities of air are more evenly entrapped. The result is greater volume.

Because the creaming ability of shortening serves to trap air into the mix in the form of tiny cells or bubbles, and because these bubbles hold the air that is later generated by baking heat and leavening, tenderness is also improved.

Although most shortenings are bland-- that is, they have no taste in themselves-- the use of emulsified shortening can improve the sweetness and keeping quality of cake indirectly. Here's how it does it.

Remember, sugar and liquids help keep cakes tasty and moist. Now, with regular shortening, the most milk and sugar that a mix will take and still remain in balance is 40%. But with emulsified shortening, milk and sugar can be increased to 55%. Thus, sweeter (and more tasty) cakes can be made with emulsified shortening. And since more liquid can be added to the mix if emulsified shortening is used, the cake will remain moist longer.

There are three types of emulsifiers: lecithins, monoglycerides and diglycerides, and polyoxyethylenes. You will probably learn about these in your chemistry class.

IV. PROPER STORAGE OF SHORTENING

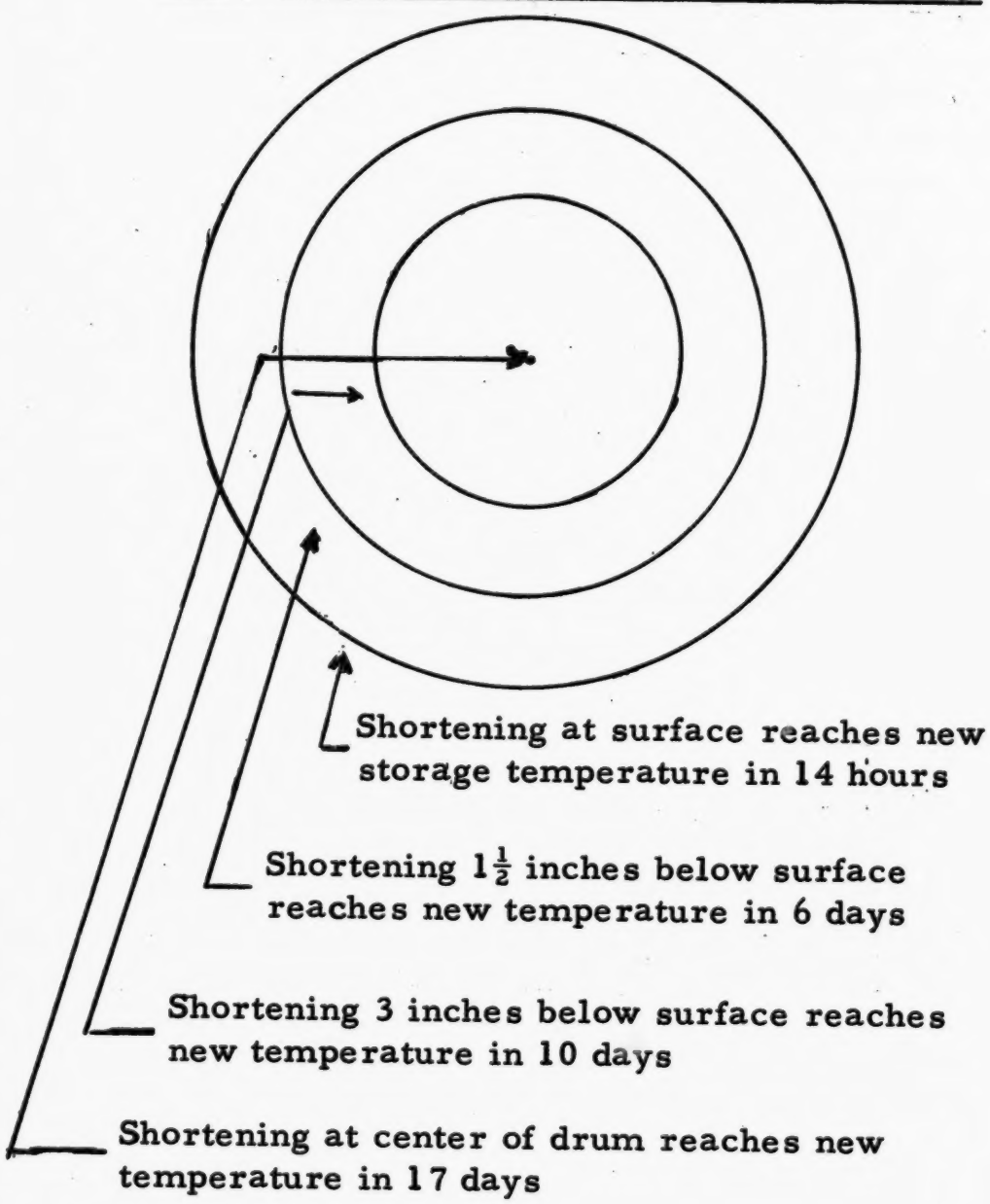
All conditions connected with the production of baked foods are important, and storage is just as much a part of production as the actual baking of a product. That is why it is as important to know how to store raw materials properly as it is to know how to bake the finished product.

It is simple enough to understand that the quality of baked foods is directly related to dough or batter temperature. Therefore, it should not be difficult to understand that the temperature of the finished product can be controlled, to a great extent, by controlling the temperature of the ingredients that go into it.

Experience has shown that for most bakery products, shortening gives best results when used within a temperature range of 60-80°F.

In studies conducted by Proctor & Gamble, it was found that it takes 17 days for the center of a 400-pound drum of shortening to effect a 27-degree temperature change. This is shown graphically below:

Top View of a 400-Pound Drum of Shortening



The time required for shortening to come to the new temperature would be the same regardless of whether the shortening in the drum cooled down 27° or warmed up 27°F.

The baker who buys in quantity in order to obtain the best possible price and take advantage of seasonal price fluctuations, is faced with a serious storage problem. Improper storage can result in a quality loss that would more than offset any price advantage he might gain by quantity buying.

Shortening refiners change their formula with the seasons. In the summer they process "summer shortening" -- that is, the shortening is harder and will hold up better under warm storage conditions. In the winter they do the opposite: they process the shortening so that it will not become too hard if exposed to cold for long periods of time. They do this either by varying the amount of oleostearine or the degree of hydrogenation.

V. THE COMPOSITION OF FATS

You will recall that there are three large classes of organic compounds: carbohydrates, minerals, and fats. Although fats, like carbohydrates, are composed solely of carbon, hydrogen, and oxygen, their molecular structure is different and their properties are different.

In comparison with carbohydrates, fats have a very low oxygen content. One of the fat molecules is glycerol (commonly known as glycerin), which has the ability to take up moisture. To some extent, this is one reason why fats will keep bakery products from drying out.

Besides the glycerol molecule, fats contain molecules of the fatty acid known as palmitic acid. This is a so-called saturated fatty acid. Generally, natural fats are classed as glycerides containing three fatty acid radicals, or tryglycerides.

Fats differ from each other because they have different quantities of the various fatty acids of which they are composed.

Among these fatty acids are:

Butyric acid
Palmitic acid
Oleic acid
Lauric acid
Myristic acid
Stearic acid
Linoleic acid

Of course, these are pretty frightening names, but fortunately, only the chemist is required to know and understand them. It is enough for the baking student to understand that the different qualities of the different fats are determined by the quantities of the various fatty acids that different fats contain. For example, the more stearic acid a fat contains, the harder it will be. Since most of these acids can be separated out of the fat, it is possible to add stearic acid to a fat to make it harder than it is in nature, or to remove some and make it softer if the occasion or the product demands.

VI. NUTRITIVE VALUE OF SHORTENING

Shortening, as one of the three major food substances (fats), represents the most valuable of the energy-producing substances known to man. Fats contribute more than 40% of the total food energy to the American diet, according to a government report.

Of all the natural foods, fats represent the most concentrated of all food materials.

From a caloric standpoint, fats contain more than twice the quantity of energy contained in the second most concentrated food -- sugar. Fats contain more than three times the energy contained in such staples as rice and bread.

The chart on the following page shows the average caloric value of some common foods. Note particularly the relative value of fats to bread.

NOTES

Food	Caloric Value per pound
Lard	4,000 cal.
Vegetable shortening	4,000 cal.
Butter (80% butter fat)	3,250 cal.
Sugar	1,800 cal.
Cake	1,550 cal.
Bread	1,200 cal.
Potato (boiled)	375 cal.

The vitamins A, D, and E occur only in fatty foods. Without these essential vitamins, human health would not be possible. To the extent that baked foods contain these fats so necessary for health, they contribute to the well-being of the nation.

VII. CREAMING POWER OF SHORTENING

Creaming power is the ability of a shortening, when mixed, to entrap and retain air cells.

When the solid fat content of the shortening is too high, shortening loses its ability to cream. When the solid fat content is too low, shortening also loses its ability to cream. In the latter case, however, creaming ability is lost because the shortening itself becomes too soft; more than the quantity of solid fats in a shortening is involved in creaming power.

Temperature is another of the factors involved in creaming power. The best creaming temperature for shortening is between 65° - 75°F. However, shortening that has been exposed to extremely high temperatures and then brought back to 65-75°F. will not cream well because certain changes in crystal arrangement have taken place.

The opposite is not true however: shortening that has been chilled but which is brought back to room temperature before use, will cream perfectly. In other words, no change in crystal arrangement takes place during chilling, but a harmful rearrangement of the crystals does take place when shortening is exposed to heat.

Emulsified shortenings are more sensitive to heat than regular hydrogenated shortenings. This is because emulsified shortenings contain monoglycerides which cause a thinning out of the batter, thus lowering creaming peak.

VIII. SHORTENING POWER

The ability of a fat to lubricate or weaken the structure of a baked product is known as its shortening value.

In bread made without shortening, gluten particles stick to each other and give the sensation of toughness when the bread is chewed. If shortening is present, the gluten particles are lubricated. This makes them slip by each other and produces a sensation of tenderness.

There are four factors that affect shortening power. They are:

1. Melting point
2. Plasticity at temperature when used
3. Degree of unsaturation
4. Crystal size of the fat

Shortening in the middle range of melting points is considered best. If the melting point is too low (as in a very soft fat, or in oil), the shortening is simply too oily. Instead of existing as flakes, it exists as globules.

If the melting point is too high, the shortening is simply too hard to be distributed through the dough properly.

It is important to realize that melting point alone does not determine shortening value. For example, coconut oil can be prepared to have the same melting point as butter, yet it is inferior to butter in shortening properties.

Plasticity is the workability of a shortening at the temperature at which it is used.

You will hear shortening salesmen talk about the plastic range of their shortenings. That means the temperatures between which it will have suitable workability.

For example, lard has a wider plastic range than hydrogenated shortening. Coconut oil has practically no plastic range at all; at 70°F. it is like tallow, and at 75°F. it becomes liquid.

Butter has a very good plastic range. Oleomargarine, on the other hand, has a rather narrow plastic range.

IX. BUTTER AND MARGARINE

Butter

Legal definition: "A food product made exclusively from milk or cream, or both, with or without common salt, and with or without additional coloring matter, and containing not less than 80 percent by weight of milk fat. . ."

Composition of Butter

Fat	80.47%
Moisture	16.34%
Salt	2.35%
Casein	0.84%

Air will vary from 1 to 5 percent. The item listed as casein includes the protein, mineral substances, and lactose derived from the buttermilk.

Butter is used in baked foods primarily for flavor. Because of its high price, the baker can afford to use it only in higher priced products. Compared with other plastic shortenings, it is not as uniform, has a rather narrow plastic range, and does not keep well at normal temperatures. Nevertheless, it continues to be the choice of bakers for the production of superior baked products.

Margarine

Margarine was developed in France about 100 years ago as a substitute for butter. Originally, it was produced from beef fat and milk and was called oleomargarine. At present, most high grade margarine is produced only from vegetable oils, with butter flavor, vitamin A and color added. It is just about as nutritious as butter. In many bakeries, margarine is used wherever the recipe calls for butter.

In the production of puff-pastry, a special type of margarine is used. It is called puff-paste and usually contains about 35% oleostearine and 65% cottonseed oil, emulsified with about 6% milk. Its melting point is higher than 118°F., which makes it particularly suitable as a "roll in" for puff pastry. It is usually priced just a few cents higher than regular vegetable shortening.

X. FRYING FATS

As you know, the boiling point of water is 212°F. At that point, water rapidly boils away in the form of a steam vapor. But did you know that oils cannot boil? Instead, when heated to comparatively high temperatures, they start to decompose. At 600°F. fats and oils burst into flames. This is called the flash fire point.

All shortenings used for frying darken and decompose. That is why doughnuts darken and taste bitter when they are fried in burned fat. Decomposition of frying fats can be controlled by (1) careful temperature control, (2) removal of foreign material, (3) addition of fresh fat.

Emulsified shortening is not satisfactory for deep fat frying, mainly because it has a lower smoke point due to the presence of monoglycerides. Hydrogenated shortening is best for frying. Not only does it have a higher smoke point than emulsified shortening, but it also gives a drier, less greasy taste and does not gum up when cooled.

Doughnuts fried in hydrogenated fat will also be better than doughnuts fried in oil. Even after frying, oil is still oil, and it will soak up sugar more rapidly than will hydrogenated fat. That's why doughnuts fried in oil will tend to taste more greasy.

Smoke Point of Frying Fats

The smoke point of a fat or an oil is dependent on the percentage of free fatty acids present, as these are decomposed most readily by heat. The greater the percentage of free fatty acids, the lower the smoke point.

The chart below shows the initial smoke point of various fats:

Kind of fat	Smoking Temperature
Cottonseed oil	451
Crisco	448
Leaf lard	430
Corn oil	406
Butterfat	406
Bulk lard	381
Olive oil	347
Peanut oil	323
Suet	242

When frying doughnuts, you've probably noticed that the fat starts smoking at lower temperatures than those shown above. Free fatty acids, which are the cause of smoking, are increased by high temperature. Thus, even the slightest use of the fat causes the smoke point to be lowered.

In frying,different qualities are sought in fats to be used for bread or cake baking. Plasticity is not important in frying, but high smoke point and resistance to rapid hydrolysis is. In general, frying fats should meet the following requirements:

1. They should permit the normal development of the fried product while it is being fried.

2. They should impart no undesirable odors.

3. Absorbed fat must congeal and not remain oily.

4. They should continue to fry consistently even though used-up fat is being continually replaced.

It has been found that deep frying with fresh shortening does not yield the highest quality doughnuts. Not until there is an increase in the free fatty acids, as a result of prolonged heating, does the quality period begin. For that reason refiners have developed special frying shortening calculated to produce the desired fatty acid content. These shortenings eliminate the pre-quality period almost entirely.

SHORTENING GLOSSARY

NOTES

Adsorption -
A gathering of a gas, liquid, or dissolved substance on a surface in a condensed layer.

Alkali -
A substance capable of neutralizing an acid. An alkali turns red litmus paper blue and reacts with acid to form a salt. Caustic soda, potash, and limewater are common alkalies. Used in refining edible fats and oils from crude animal fats.

Antioxidant -
A substance which retards oxidation. Added to fats and other food products to prevent rancidity.

Bland -
Having the quality of tastelessness, desirable in shortening in many kinds of baked products. Recently, shortenings have been introduced containing butter flavor. These are not bland.

Bleaching -
Part of the refining process in the manufacture of edible fats and oils. Among the methods used are exposure to air and light and the use of oxidizing agent.

Butter -
Food product made exclusively from milk or cream, or both, with or without common salt, and with or without additional coloring matter, and containing not less than 80% by weight of milk fat.

Butterfat -
The fat of milk.

Butyric acid -
A fatty acid occurring principally in butter.

Calorie -
A unit used to express the heat output of an organism and the fuel or energy value of food. One gram of fat when burned in the body yields 9 calories -- more than twice as much as is produced by carbohydrates or proteins (about 4 calories for either).

Casein -
The main protein compound found in milk; it is the principal protein ingredient of cheese.

Catalyst -
A substance which, when added to a reaction mixture, will initiate or speed the rate of reaction without itself being appreciably changed in nature or amount, or appearing as an end product of the reaction.

Compound -
A hard shortening, either animal or vegetable, only part of which has been hydrogenated.

Congealing point -
The temperature at which a liquid or solution is changed to the solid state. The congealing point has been determined for shortening, lard, etc., and has specific significance in various processes of food manufacture.

Corn oil -
Oil that is pressed from corn.

Cottonseed oil -
Edible vegetable oil, obtained by pressure from cotton seeds. When hydrogenated, the fat is widely used in making bakery products.

Creaming peak -
That point in the creaming process of fats where the maximum amount of air is incorporated consistent with a satisfactory product.

Creaming power -
The ability of a shortening to combine with sugar and entrap air. Creaming power varies with many factors, including the temperature of the shortening.

Deodorize -
To remove odor, particularly offensive odors, in crude animal margarine, or vegetable oils and fats. Usually done by steaming.

Diglyceride -
Two molecules of a fatty acid combined with one molecule of glycerin. Used in mixtures with monoglycerides as bread softener or emulsifier.

Dispersion -
The state of being widely distributed throughout a mix, as, globules of emulsified shortening are more widely dispersed throughout a cake batter than they would be if the shortening had not been emulsified.

Emulsifier -
A compound which allows a relatively permanent suspension of oils and fats to be made with water. When monoglycerides are used as emulsifiers in regular hydrogenated shortening, the fat globules are broken down into smaller globules and are dispersed more uniformly through the entire mix.

Emulsified shortening -
Shortening to which a compound has been added to break down the fat globules into relatively small globules. Mixtures of monoglycerides, diglycerides, and triglycerides serve this purpose. Also, lecithin is an emulsifier.

Ester -
Chemically, a compound formed by the interaction of an alcohol and an acid. Some of the more complex esters are responsible for the typical odor of white bread.

Fat.
Natural fats are triglyceride esters of fatty acids and are closely associated in nature with phosphatides and other fat-like substances. Fats are insoluble in water but soluble in such fat solvents as ether, benzene, and chloroform. They may be utilized by living organisms.

Fatty acids -
A general term referring to any organic acid found to be present in combination with glycerol in natural fats. They may be either saturated or unsaturated.
Examples: palmitic, stearic, oleic acids.

Filtering.
Although some oils can be distributed to the consumer after a preliminary settling out of foreign matter, almost all fats are filtered, either through fuller's earth, or the blowing of air, etc.

Filtration -
The process of separating a solid from a liquid by means of a porous substance through which the liquid passes. In refining edible oils, one of the filtering materials used to remove impurities is fuller's earth.

Flash fire point -
In frying fats, about 600°F. -- the temperature at which boiling oil will burst into flame. Bakery equipment is built so that this much heat cannot be generated.

Free fatty acids -
Fatty acids which are found in fats and oils and which are formed by the hydrolysis. The commonest are oleic, palmitic, and stearic.

Hard fat -
Animal or vegetable fat to which additional stearin has been added, or which has been exposed to additional hydrogenation. In bakeries, hard fat is particularly used in the production of puff pastry.

High-ratio cake -
Cake containing unusually high percentage of sugar and moisture. To produce such cakes, specially hydrogenated-emulsified shortenings and flours are needed.

Hydrolysis -
The breaking down of a large molecule into smaller molecules in the presence of water by the action of enzymes or chemicals.

Glycerol -
Also called glycerin. A thick, oily, colorless, odorless hydroscopic liquid compound, with a sweet taste, soluble in alcohol and water. Used as a preservative in foods. It is produced by the hydrolysis of fats into fatty acids and glycerol and is also obtained as a by-product in the soap industry.

Hydrogenated shortening -
A shortening prepared by hydrogenating all the constituents of the shortening.

Hydrogenation -
The process of combining with hydrogen in the presence of a catalyst. For example, oils are hydrogenated in the presence of the catalyst nickel and changed to solid fats.

Iodine number -
The number of grams of iodine which will be taken up by 100 grams of fatty acids or other fatty substances or any unsaturated compound. It is a measure of the degree of unsaturation.

Kettle lard -
That obtained from the residue of tissues from which top grade No. 1 neutral or leaf lard has been rendered.

Lard -
The rendered fresh fat from hogs in good health at the time of slaughter. It is free from rancidity and contains not more than one percent of substances other than fatty acids and fats.

Lecithin -
A yellowish-brown waxy solid, occurring in various animal and vegetable tissues, especially brain, egg yolk, soy bean and wheat germ oil. It is insoluble in water and soluble in alcohol, ether, and choloroform. It is used as a fat extender, emulsifier, and stabilizer.

Lipase -
A fat-splitting enzyme found in the pancreatic juice. It splits the fats into their component fatty acids and glycerol. Sometimes called steapsin.

Lipid -
Any one of a group of fat-like substances, which includes the fats and esters, having analogous properties. They are organic substances insoluble in water but soluble in fat solvents.

Margarine -
Also known as oleomargarine. A substitute for butter. Composed of hydrogenated vegetable or animal fats or oils churned with soured milk, and with bacteria added to give butter flavor. Cake margarine is different from pastry margarine in that the latter is stiffer and has a higher melting point. Margarine may not contain more than 16 percent water.

Melting point -
The temperature at which different fats will melt. Since fats are a combination of tiny individual crystals enmeshing a considerable proportion of liquid oil -- and since the quantities of crystals and oil vary with different fats -- each fat has a different melting point. To some degree, the melting point of a fat or oil is a general indication of its degree of unsaturation. Fats that are firm at room temperature consist mostly of saturated fatty acids; fats that are soft or liquid at room temperature consist mostly of unsaturated fatty acids.

Molecule -
The smallest physical unit of a substance, containing one or more atoms. A molecule may be very simple - for example, a molecule of table salt consists of an atom of sodium and one of chlorine - or it may be extremely complicated - for example, the proteins, starches, and fats are all large, complex molecules containing many different atoms.

Monoglyceride -
One molecule of a fatty acid combined with one molecule of glycerin. Mixtures containing monoglycerides are used as bread softeners or emulsifiers.

Oil -
Of the same composition as a fat, but is liquid at room temperature. Both are triglycerides made up of three molecules of a fatty acid and one molecule of glycerin.

Oleic acid -
One of the four principal acids commonly found in most fats, the others being stearic, linoleic, and palmitic. It is one of the unsaturated fatty acids.

Oleo -
The oil derived from beef fat. Still widely used in the preparation of pastry margarine.

Oleomargarine -
See margarine.

Powdered or dry shortening -
A composition of shortening, protein material (milk, soybean, etc.) which has been homogenized and spray dried. The protein mass surrounds the fat particles and causes the shortening to behave like a powder.

NOTES

Palmitic acid -
One of the four principal acids commonly found in most fats, the others being stearic, oleic, and linoleic. It is one of the saturated fatty acids.

Plastic range -
One of the most important considerations in evaluating the suitability of a fat. It is the range of temperatures between which a fat will cream well, or serve the purpose for which it is intended. Each fat has its own plastic range.

Plastic shortening -
Any fatty composition used for shortening purposes, which has been properly treated to control the crystal size and to incorporate a definite amount of air or other gas. A plastic shortening is a "workable" shortening.

Puff paste -
A paste made of dough interleaved with hard butter or pastry margarine and given sufficient turns to give hundreds of alternating layers of dough and fat. Handled properly, it will rise very high in the oven and when the pastries are out, the many layers will be noticeable.

Pre-quality period -
In doughnut frying, that period of time when the fat is very fresh and does not yet produce the best quality doughnuts.

Rancidity -
A form of fat deterioration, caused either by the breaking down of fat into glycerin and free fatty acids or mono and diglycerides, or by oxidation. It is evidenced by objectionable odor. Antioxidants delay the onset of rancidity.

Refining -
The process of manufacturing edible oils and fats by melting, filtering, deodorizing, bleaching, etc.

Rendering -
The process of melting down animal fats in the production of lard or shortening. Various parts of the animal yield different grades of fat. There are various methods of rendering fat, including steam and open kettle rendering.

Saponify -
To hydrolyze a fat to form a soap and glycerol. This is what can happen to frying fat in the bake shop when eclair mix containing ammonium carbonate is used for making French crullers.

Saturated.
Fatty acids in which all carbon atoms are combined with two hydrogen atoms and which therefore contain no "doublebonds", are called saturated.

Shortening -
Any edible fat, from plant or animal sources, which may or may not be hydrogenated, used in baked products to produce tenderness and enhance flavor and texture.

Shortening power -
The ability of a shortening to impart tenderness or shortness to the cake crumb.

Smoke point -
The temperature at which a frying fat will begin to smoke. A high smoke point is particularly desirable for frying. Because emulsified shortening will smoke at a lower temperature, it is not considered good for frying purposes.

Specific volume -
The volume of a unit weight of a substance expressed, for example, as cubic feet per pound.

Specific gravity -
The weight of a particular volume of substance compared with the weight of an equal volume of water. The specific gravity of most fats is approximately 0.86.

Stearine -
The solid portion of any fixed oil or fat. It can be separated out of melted fat and added to other fats to increase their hardness.

Stearic acid -
One of four principal acids commonly found in most fats, the others being palmitic, oleic, and linoleic. One of the saturated fatty acids.

Summer shortening -
Shortening that has been processed to make allowances for usually unfavorable storage conditions. Summer shortenings may be hardened with the addition of hydrogen or by formula changes that will raise its melting point and widen its plastic range.

Tallow -
Name applied to harder types of fats such as suet, cocoa butter, etc. after clarification.

Texture -
The feel to the fingertips of the surface of a slice of a baked product. To the extent that shortening is creamed, helping to incorporate air, and is distributed throughout the mix, it helps to promote desirable texture.

Triglyceride -
A compound composed of one molecule of glycerin and three of some fatty acid or combination of different acids.

Unsaturated -
Fatty acids which contain "doublebonds" are called unsaturated. Doublebonds provide points in the molecule for the addition of oxygen, hydrogen, iodine, or other reactive substances, which accounts for the term "unsaturated." An unsaturated fatty acid may be monounsaturated (one unsaturated linkage) or polyunsaturated (more than one unsaturated linkage).

Vitamin -
Specific organic substances, much like the various carbohydrates and proteins. Vitamins have the basic characteristics of organic compounds, e.g., they contain carbon as an essential constituent, have complex molecular structures, and appear in animal and plant tissue. Some vitamins can be made by chemical synthesis. Vitamins A and D are prevalent in fats. All vitamins are essential to health and growth, although in very small amounts.

UNIT IX - MILK AND MILK PRODUCTS

CHAPTER HEADINGS

I. Introduction
II. Classification of Forms of Milk
III. Functions of Milk in Bakery Products
IV. Reliquefying Dry Milk
V. The Manufacture of Dry Milk
VI. Chemistry of Milk
VII. Storage of Liquid Milk
VIII. Approximate Composition of Milk and Milk Products

Milk Glossary
Test on Milk

REFERENCES AND RECOMMENDED READINGS

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NOTES

I. INTRODUCTION

Milk is one of the standard ingredients of baked foods. In this unit we shall learn something about the various kinds of milk and how milk is processed. We shall learn how milk functions in bakery products and why milk is used in breads and cakes. We shall also learn a little about the chemistry of milk.

We take for granted that milk comes from cows, but in other parts of the world people drink milk from goats, sheep, buffalos, llamas, reindeer, and camels.

The Department of Agriculture has set the standard for what we shall call milk. According to their definition, "Milk is the whole, fresh, clean lacteal secretion obtained by the complete milking of one or more healthy cows, properly fed and kept, excluding that obtained within 15 days before and 5 days after calving or such longer period as may be necessary to render the milk practically colostrum-free."

II. CLASSIFICATION OF FORMS OF MILK

Milk is graded according to standards established by the U. S. Public Health Service on the basis of bacteria count and fat content.

Pasteurized milk is milk that has been heated to 140°F. for 30 minutes and then quickly cooled to 50°F. or lower. This assures the destruction of certain forms of bacteria. Another method is to heat milk to 160°F. for 16 seconds.

Homogenized milk is pasteurized milk that is forced through a tiny orifice under high pressure. This brings about a reduction in the size of fat particles, so that they remain dispersed and no longer form a cream layer.

Vitamin D milk is milk in which the vitamin D content has been increased. This is done either by irradiating the milk with ultraviolet light, by feeding cows irradiated yeast, or by adding the vitamin directly to the milk. This type of milk is sold mostly in liquid form and is not used in bakery productions except under special conditions.

Skim milk is fresh milk from which nearly all the fat has been removed.

Condensed milk is produced by heating the milk to higher than pasturization temperatures and then evaporating part of the water. During the process, about 16 pounds of sugar is added to each 100 pounds of milk. The final product contains about 42% sugar, which serves as a preservative.

Evaporated milk is produced in a similar fashion, but no sugar is added.

Dry or powdered milk, made from either whole milk or skim milk, is used more than any other type of milk in the bake shop because of its many advantages. Among them are:

1. A higher proportion of necessary milk solids in dry milk than in liquid.

2. Ease of handling.

3. Improved baking qualities when used in dry form.

4. Lower cost.

Buttermilk originally was the liquid remaining after the removal of fat from the milk or cream in the process of churning butter. If the butter was made from sweet cream, the resultant buttermilk was very similar to skim milk in its composition and characteristics. If sour cream was used for butter making, the buttermilk contained lactic acid, which imparted to it its characteristic sour taste. Most of the buttermilk on the market nowadays, however, is made directly from skim milk; a culture containing micro-organisms is used to develop the desired flavor and consistency.

Whey is the product which remains after the removal of most of the casein and fat from milk in the process of cheese making.

NOTES

III. FUNCTIONS OF MILK IN BAKERY PRODUCTS

In Bread

From a nutritional standpoint, read what Dr. Collum of John Hopkins University said, as long ago as 1923: "So far as we know, the simplest, cheapest, and most effective way to improve the quality of bread is to introduce more milk solids in its composition." Mainly, the protein, calcium, and vitamin content are increased.

From a physical standpoint, milk is valuable in bread because it improves aroma, flavor, color, grain, texture, and keeping quality. This is particularly noticeable when it is added to the dough in the form of nonfat milk solids, in a percentage of about 6% of the flour.

The golden brown crust color is brought about through caramelization of the sugar in the milk during the baking process. Smooth, velvety texture--that is, the feel of the surface of a slice of bread--also results because of the presence of milk in the dough. It has also been shown that bread made with milk stays fresh longer because the combination of milk proteins and flour proteins tends to keep the bread soft.

In Cake

Laboratory workers as well as practical bakers found that, when the milk solids were increased in cakes, an improvement in cake quality was observed. Milk imparts richness, flavor, eating, and keeping qualities.

Like eggs and flour, nonfat dry milk solids is a structure-building material. In the bake shop, milk is used more in the nonfat dry form than in any other form.

Nonfat dry milk solids may be used in dry form or reliquefied, that is, combined with the original amount of water to make liquid skim milk.

Nonfat dry milk solids can be used to reconstitute all forms of milk, including fresh whole milk.
(See Unit IV to learn how the latter is done.)

IV. RELIQUEFYING DRY MILK

While dry milk does not "turn sour" as fresh liquid milk does, it must be kept in mind that, as soon as dry milk is liquefied, it is subject to bacterial action just as is fresh fluid milk. For this reason, all containers must be kept scrupulously clean.

After washing, if the containers are not to be used immediately, they should be rinsed with hot water and placed upside down.

To reliquefy dry milk, do not use water that is too hot or too cold. About 70°F. is just right.

Always place dry milk on top of the water. Stir immediately, or lumping will result. If the milk is to stand for any length of time, it should be placed in the refrigerator.

To reliquefy nonfat milk, the exaxt proportion of water to nonfat milk solids is:

7 lbs. 13 oz. water
to
13 oz. nonfat milk solids

However, in everyday shop practice, we use 1 gallon of water (8 lbs. 5 oz.) to 1 pound of nonfat milk solids.

To reliquefy one gallon of whole milk from nonfat dry milk solids, use:

7 lbs. 7 oz. water
13 oz. nonfat milk solids
6 oz. butter

To make 10 pounds of sweetened condensed milk, use:

2 lbs. 14 oz. water
2 lbs. nonfat milk solids
4 lbs. 3 oz. sugar
15 oz. butter

NOTES

V. THE MANUFACTURE OF DRY MILK

Dry milk is produced by one of two methods: spray-process drying or roller-process drying.

In the spray process, whole milk or skim milk is drawn from a holding tank to a preheating tank, where its temperature is raised to 180°F. for 30 minutes. It is then pumped into a chamber where the heated milk is aerated at high temperatures. In this process the milk loses a great deal of its water, and a highly concentrated product is obtained.

This product is then pumped into a drying chamber in the form of a fine mist. The mist is met by a blast of hot, sterilized air which dries the sprayed milk almost instantaneously. The dry milk then drops to the bottom of the drying chamber and is removed on a continuous belt. Although there are many intermediate steps, the above outline covers the most important ones.

When whole milk is used, the result is whole dry milk. When skim milk is used, the result is nonfat dry milk, also known as nonfat milk solids.

In the roller process, the milk is dried on steam heated rolls or drums. A thin layer forms and is then scraped off by stationary knives.

Spray-process dry milk is better for most bakery products because it is more soluble.

Variations of both processes are constantly being developed. On the following page is a diagram of all of the steps in spray-process drying.

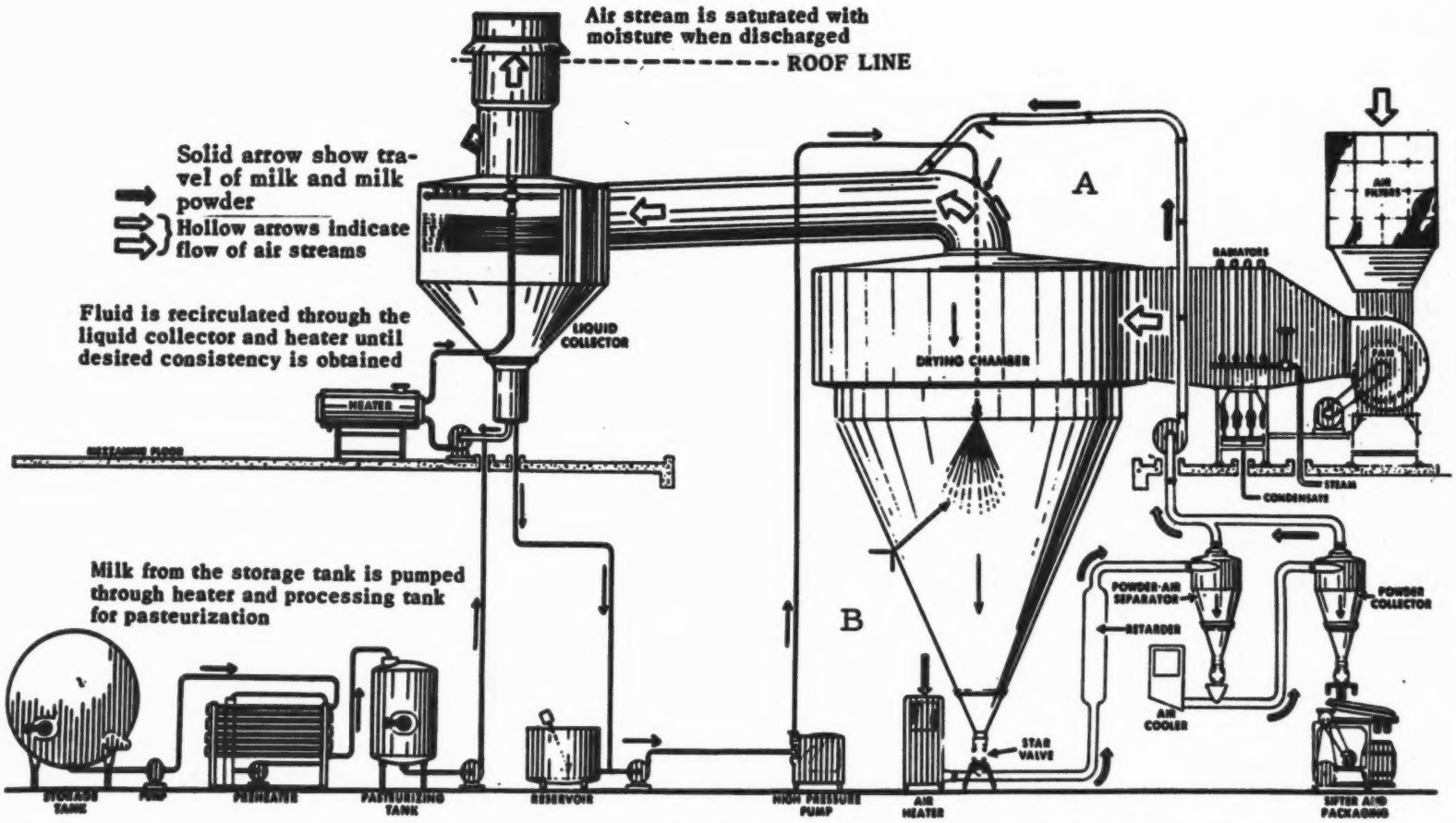


Diagram of Swenson-Grey-Jensen spray drying installation.

Exhaust air returns entrained powder to the liquid collector for recovery

A

Special atomizing nozzle breaks up fluid into a cloud of fine mist

B

VI. CHEMISTRY OF MILK

From the chemist's standpoint, milk is defined as "an emulsion of tiny globules of fat in a water solution of protein, sugar, and minerals."

The composition of milk varies somewhat depending on a number of factors. However, the average composition will be approximately that given below:

Composition of Milk

Water	87.75%
Total solids	12.25%
Total	100.00%

Composition of SOLIDS in Milk

Fat	3.50%
Protein	3.25%
Minerals (or ash)	0.75%
Lactose (milk sugar)	4.75%
	12.25%

Fat

The fat in milk is known as butterfat. It is rich in vitamins A and D and has a high caloric value.

When milk is agitated, there is a tendency for the fat globules to clump together, because their specific gravity is lower than that of the rest of the milk. This is what happens when milk is churned: The result is butter. The same thing happens in making whipped cream -- provided the cream is high enough in butterfat (between 28 and 44%). The clumped fat globules and the air bubbles in whipped cream are both surrounded by stabilizing films of protein. Too much clumping, however, will cause butter to form.

Milk Protein

There are two principal proteins in milk:

1. Casein. About 80% of the protein in milk is casein. It is easily coagulated to a thick curd by acid. It is not easily coagulated by heat.

2. Lactalbumin. About 20% of the protein of milk is lactalbumin. This protein is not readily coagulated by acid but is readily coagulated by heat (beginning at 150°F.). At 212°F., about 85% of the lactalbumin is coagulated.

Minerals

Milk contains a number of mineral elements. The most important are calcium and phosphorus, which are important for the growth of bones and teeth. Milk is low in iron.

Lactose (or milk sugar)

Lactose is the only sugar in milk. It is a disaccharide, made up of glucose and gelactose. It is only slightly sweet. It is not fermented by yeast. Lactose is acted on by bacteria to form lactic acid. This causes milk to sour.

Vitamins and Enzymes

Milk contains all known vitamins to some extent and is a good source of vitamin A, riboflavin, and the other B vitamins. Many enzymes are also present in milk. Among them are:

1. Protease (which breaks down proteins)
2. Lipase (which breaks down fats)
3. Oxidizing enzymes

VII. STORAGE OF LIQUID MILK

Fresh or pasteurized milk should be stored under refrigeration at 38-40°F. before use, to prevent changes due to bacterial growth. The table on the following page shows the value of refrigeration in preventing bacterial growth, and shows how rapidly bacteria increase at higher temperatures.

Temperature of Milk	Hours of Storage	Bacteria per ml*
32°F.	10	3,000
50°F.	10	11,000
60°F.	10½	15,000
70°F.	11	190,000
80°F.	11	2,600,000
90°F.	11	4,400,000

* approximately 1/1000 of a quart

VIII. APPROXIMATE COMPOSITION OF MILK AND MILK PRODUCTS

	% Water	% Milk Fat	% Solids Not Fat
Liquid whole milk	87.75	3.50	8.75
Dry whole milk	2.0	28.0	70.0
Liquid skim milk	91.0	.1	8.9
Nonfat dry skim milk	3.0	1.0	96.0
Evaporated milk	73.7	7.8	18.5
30% milk-fat whipping cream	64.0	30.0	6.0
Liquid buttermilk	90.5	.5	9.0
Dry buttermilk	9.0	5.0	86.0

MILK GLOSSARY

NOTES

Butterfat -
The fat of milk; sometimes called milk fat.

Buttermilk -
Originally, the liquid remaining after the removal of the fat from the milk or cream in the process of churning butter. Now made by inoculating skim milk with a culture. It contains not less than 8.5% milk solids.

Colostrum -
A thick, viscous fluid differing greatly in composition from that of normal milk. It is secreted for a short period after the birth of a calf and is thought to be unsuitable for human consumption.

Coagulate -
To change from a fluid state to a thickened jelly, curd, or clot.

Condensed milk -
A concentrated form of milk in which much of the water is evaporated and sugar is added.

Casein -
The principal protein of milk. It is present in milk in the amount of 2.7%.

Certified milk -
Milk produced under exceptionally exacting conditions of sanitation and which therefore has a very low bacteria count. It may be sold either raw or pasteurized.

Cream -
The fat part of cow's milk. That portion of milk which rises to the surface on standing or is separated from it by centrifugal force. Sweet cream contains not less than 18% milk fat and may contain as much as 45%.

Curd -
The coagulated substance formed from milk by the action of acids.

Evaporated milk -
Unsweetened canned milk from which water has been removed before canning.

Homogenized milk -
Milk which has been forced through a very small opening by high pressure so that the fat particles are so reduced in size that they no longer form a cream layer. According to the U. S. Public Health Service definition, fat globules must be broken up to the extent that there is no visible cream separation after 47 hours' storage.

Lactose -
The sugar in milk, having a relatively low sweetness - a rating of about 16 as compared to 100 for sucrose. Lactose is the principal carbohydrate in milk (about 4. 8% of the weight of the milk). It is not ordinarily fermentable by baker's yeast. Also known as milk sugar.

Milk -
According to the Federal Food, Drug and Cosmetic Act, milk is defined as "the whole, fresh, clean lacteal secretion obtained by the complete milking of one or more healthy cows, properly fed and kept, excluding that obtained within 15 days before and 5 days after calving or such longer period as may be necessary to render the milk practically colostrum-free."

Nonfat dry milk solids -
Also known as defatted milk solids. The product resulting from the removal of fat and water from milk. It contains the lactose, milk proteins, and milk minerals in the same relative proportions as in the fresh milk from which it is made.

Pasteurized milk -
Milk which has been heated to 140°F. for 30 minutes and then quickly cooled to 50°F. or lower. Pasteurization may also be carried out by heating milk to 160°F. for a very brief period of 15 to 20 seconds.

Reconstitute -
To re-form dry milk solids and water back to liquid milk, either whole or skim.

Roller process -
A process by which dry milk powders are prepared. In this process, either fluid or condensed milk is fed into a reservoir formed by two drums about 0. 02 inches apart and closely fitted end dams. The milk dries rapidly, is scraped from the surface and is ground and bolted. Roller-processed dry milk is only 80% soluble in water.

NOTES

Skim milk -
Liquid milk from which all or part of the cream has been removed.

Spray process -
By this process, condensed milk is sprayed into a moving stream of heated air within an enclosed vessel. The moisture in the milk is evaporated rapidly and the dry milk falls to the bottom as a fine powder. It is 100% soluble in water.

Vitamin D milk -
Milk in which the vitamin D content has been increased to approved levels, either by irradiation of the milk with ultraviolet light, or by feeding cows irradiated yeast, or by adding vitamin D directly to the milk.

Whey (fresh) -
The serum, or watery part, of milk, separated from the more thick or coagulated part, or curd, especially in the process of making cheese. The whey contains solids consisting mostly of the lactose, some of the protein, and a fairly large proportion of the B vitamins that were present in the milk originally.

Whey (dried) -
According to U. S. Department of Agriculture standards, "whey is the product resulting by spray-drying sweet, fresh cheese whey which has been pasteurized either before or during the process of manufacture at a temperature of 143°F. for 30 minutes, and to which no alkali or other chemical has been added."

UNIT X - STARCHES

CHAPTER HEADINGS

I. Introduction
II. The Origin of Cornstarch
III. The Manufacture of Cornstarch
IV. The Composition of Corn
V. Cooking with Starch
VI. Some Additional Information
VII. Basic Rules for Cooked Fruit Fillings
VIII. The Steps in Cooking Fruit Fillings
IX. Rules for Milk Fillings
X. Use of Instant Starch

Ingredient Chart for Starches
Starch Glossary
Test

REFERENCES AND RECOMMENDED READINGS

Amioca -- A New Domestic Starch, National Starch Products

A Treatise on Pies, American Maize-Products Company

Our Gift From the Indians, Corn Industries Research Foundation, Inc.

Pyler, E. J., Baking Science and Technology, pp. 11-27

The Story of Starches, National Starch Products, Inc.

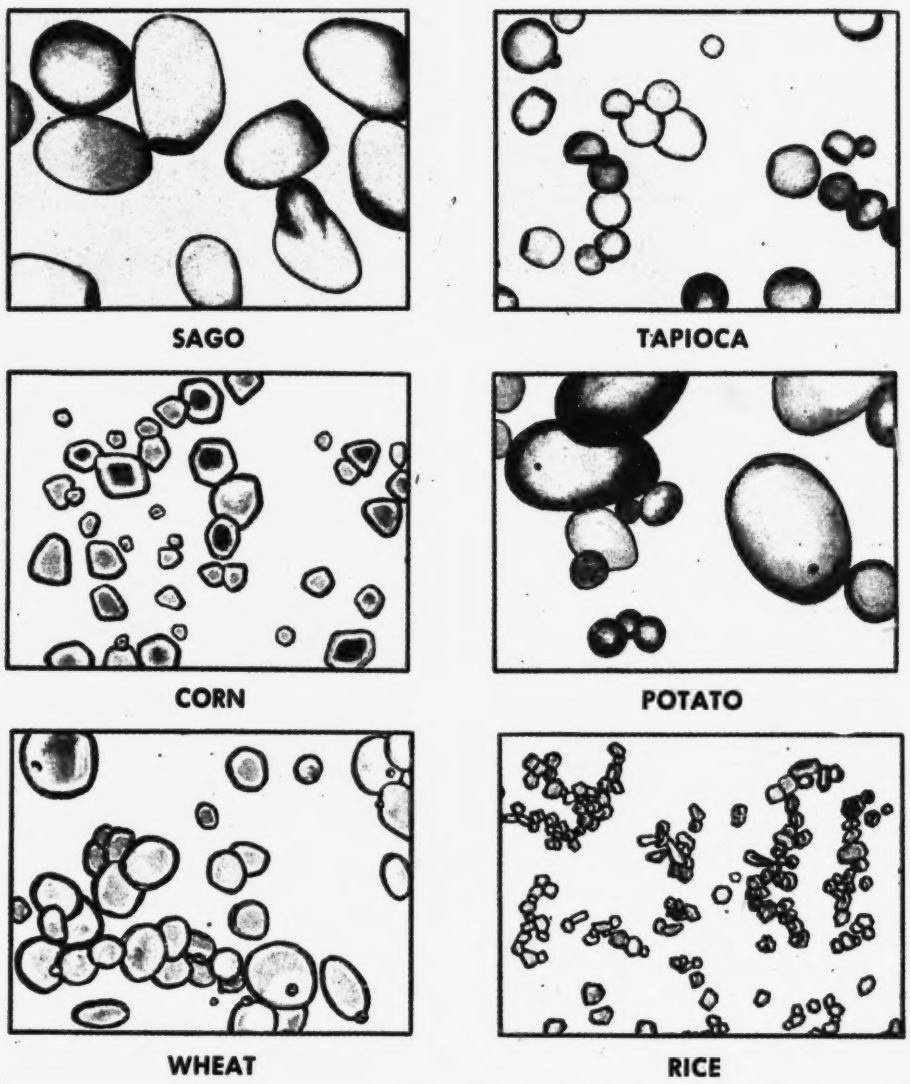
NOTES

I. INTRODUCTION

Starch is produced in abundance by all vegetable life. Each plant produces its own distinctive starch granules, whose characteristics differ from those of other plants. In some plants starch is produced mostly in the seeds, in some, in the roots, and in others, in the trunk itself.

Starch is insoluble in alcohol, cold water, and most other solvents. When cooked in water, however, it gelatinizes to form a thickened, viscous solution. The particular plant from which the starch is manufactured determines the clarity, texture, and jelly strength of the solution.

In dry form all starches look alike. They are all white and powdery. Under the microscope, however, each has a different appearance, as you can see by studying the diagram below.



Microscopic Appearance of Various
Starch Molecules
(Magnified 400 times)

In food processing, each starch behaves differently too. Some starches jel after cooking. That is, they form a firm, semi-rigid, jelly-like body. Others only set moderately; that is, they are less firm than those that jel. The three most important starches in use in bakeries are:

1. Cornstarch.
   This is the most widely used starch. When cooked it is cloudy and noncohesive. Upon cooling, it sets up a more or less jelly-like body, depending on the amount of starch used. It is the cheapest to produce, most abundant, and is often used as a base for specialty starches.

2. "Amioca."
   This starch is made from a unique type of corn known as waxy maize. In the field, waxy maize looks the same as ordinary corn. But when used in the preparation of fruit, the starch made from waxy maize-- Amioca-- is very different from cornstarch. Paste made from Amioca is clear, cohesive, and nonjellying. Another very important characteristic is that it has less cereal flavor than cornstarch.

3. Tapioca is a starch processed from the root of a tropical plant which grows about 10 feet high. In many ways it is a superior starch for bakery use. It has a bland, noncereal taste. Its cooked pastes are clear, cohesive, and stable. Because it is expensive to process and ship from South America, it is not so widely used as cornstarch or Amioca.

There are many starches including sago starch, potato starch, rice starch, and others, but we shall be concerned in this unit mainly with cornstarch.

II. THE ORIGIN OF CORNSTARCH

Cornstarch is derived from corn -- the same corn that has been used as a staple in man's diet for thousands of years.

Corn is native to the Western Hemisphere, and Columbus brought it back to Spain from his first voyage to America. It is believed to have been developed by the Indians from a native cereal grass. It is now a highly developed, cultivated plant whose growth depends on careful seeding and cultivating. It is a sturdy plant that can flourish in almost any kind of climate. It is the largest crop in America, outranking wheat 3 to 1 and cotton 26 to 1.

Depending on the climate, field corn is planted any time from March to late May. The farmer drops two or three seeds every 30 or 40 inches in straight rows, sometimes half a mile long. These grow rapidly and in a few weeks, the field is covered with tiny shoots of green leaves.

The next job is to cultivate, by removing the weeds and loosening the earth between the lines of young corn. Under average conditions it will be "knee-high by the fourth of July" and by August, it grows so fast that farmers say they can "hear it grow." After the first hard frost it is harvested.

III. THE MANUFACTURE OF CORNSTARCH

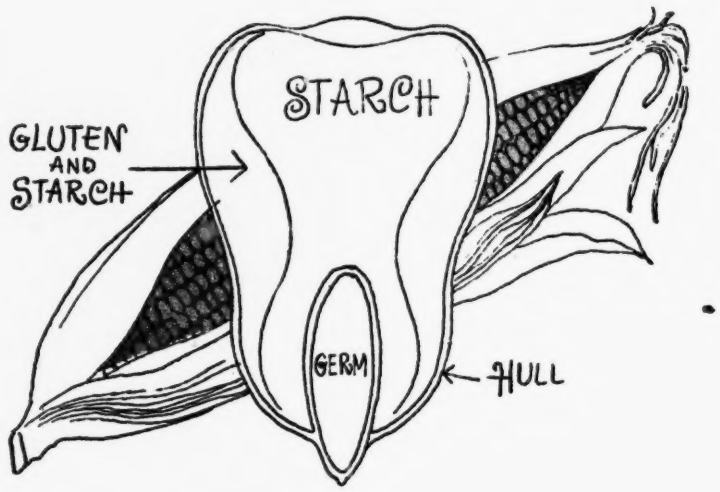
There are four principal dry substances in a corn kernel:

1. Soft starch
2. Hard starch(starch and gluten)
3. Germ
4. Hull

The gluten referred to is not at all the same as the gluten which is found in doughs made from wheat flour. When the word is used in connection with starch, it is merely a trade term. The location of the gluten in relation to the other portions of the corn kernel is shown graphically in the following diagram.

NOTES

Dry Substances in a Corn Kernel



Eighty-five percent of all corn grown in the United States is used for cattle feed. The remainder is used for food and industrial purposes. This includes the relatively small proportion of "sweet corn," consumed as grown-on the cob-or canned or frozen.

In processing starch from corn, the first step is to remove the kernels from the cob. Then the kernels go through the following steps:

1. Cleaning. Giant vacuum cleaners suck away dust, chaff, husks, and pieces of cob. A large magnet draws out nails and bits of metal.

2. Steeping. The corn is soaked in a continuous flow of warm water for 36 hours or more. This loosens the hulls and softens the kernels so that they can be separated more easily into their principal parts. The steepwater is saved, because it is rich in minerals and vitamins.

3. Degerminating. As the kernels flow along in a stream of water, they go on to a "degerminating mill" where the kernel is rubbed between flat stones and the germ is gently removed. Since the germ contains fat, it floats to the surface, where it is skimmed off and sent to the "germ separators."

4. Separating. Here, the kernels are dried, ground, and heated, and run through presses where the oil is pressed out. The ground kernels, consisting of hulls, gluten, and starch, continue on to a different type of mill called a "buhr" mill, where huge stones rub the starch and gluten from the hull.

5. Final Separating. After the hulls are removed, the mixture of starch and gluten flows into centrifugal machines, where the gluten, which is heavier than the starch, is taken off to be used for feed and other uses. Finally, the end product -- starch-- is ready to be washed, filtered, and dried and then made into various starch products. Part of the starch is to be changed by cooking and other means, into corn syrup and corn sugar.

IV. THE COMPOSITION OF CORN

The approximate composition of corn, depending on the variety, weather, fertility of the soil, and method of cultivation, is:

Moisture	11.00%
Starch	70.50
Protein	10.00
Fat	4.50
Fiber	2.50
Ash	1.50

A bushel of corn weighing 56 pounds, when wet milled will yield approximately 33 pounds of starch, 15 pounds of gluten feed, and $1\frac{1}{2}$ pounds of oil.

V. COOKING WITH STARCH

There are a number of factors that affect the finished product when fruits are cooked with starch. They are:

1. Cooking temperature
2. Cooking time
3. Intensity of agitation
4. pH of the mix
5. Effects of other ingredients

All starches do not gelatinize at the same temperature. Large granules swell at a lower temperature and in a shorter time. When the granules swell, viscosity increases. However, once peak viscosity has been reached, further cooking, even at constant temperature, thins out or breaks down the viscosity, because the granules rupture. Higher temperature also speeds breakdown.

Laboratory tests show that, even if the temperature is kept constant, gelatinization is accelerated when the starch paste is stirred in with greater agitation. Similarly, the entire mix will break down more rapidly if the starch is stirred more rapidly once peak viscosity has been reached.

The fourth factor that affects cooking and breakdown of starches is acidity. This is most noticeable when a baker attempts to use the same proportion of starch in cooking different fruits. For example, 2-3 ounces of starch is sufficient for 1 can of apples with 2 pounds of juice and water. But when the same amount of starch is used for the preparation of 1 can of cherries, a much thinner mix results. This is because of the greater acidity of cherries. The measure of relative acidity is the pH value - the lower the pH, the more acid; the higher the pH, the less acid.

The addition of other ingredients alters the pH, and thus indirectly, affects the gelatinization of the starch. It is interesting that most starches gelatinize more quickly at both high and low pH values. At intermediate pH's (about 4 to 7), gelatinization takes place more slowly. Thus, the addition of vinegar lowers the pH and speeds up gelatinization; the addition of sugar brings the pH into the intermediate range and retards gelatinization.

VI. SOME ADDITIONAL INFORMATION ON THE COOKING OF STARCH

As you may have observed in class, when starch-water is added to cooked juice or water, it immediately forms into a paste. How this paste is handled affects its properties. In general, starch solutions should be

kept only as hot as required and stirred thoroughly but no more than necessary to bring them to the desired consistency.

"Weeping" and retrogradation are two different results of improper handling of cooked fruits. Weeping is the result of undercooking the starch. As the starch granules cook, they absorb water and swell. But if the granules are not sufficiently cooked, the water is held so loosely that on cooling and aging, the water is easily released. This is called "weeping" or - watering, or to use a more technical term - syneresis.

Retrogradation is sometimes confused with syneresis. However, retrogradation refers to the change that takes place in cooked solutions of starch when they are held for any length of time at room temperature or lower, and part of the starch changes form and precipitates from the solution.

VII. BASIC RULES FOR COOKED FRUIT FILLINGS

Except when fruits are very firm - as in the case of certain varieties of firm apples, it is best to cook the juice, thicken it with starch, add the remainder of the sugar, and finally, fold in the fruit.

The amount of sweetener present before the starch is pasted is of primary importance. Starches will not paste in a concentrated sugar solution. Similarly, large amounts of egg, fat, or dry milk solids, if present during the pasting of the starch, may hinder the swelling of the granules.

Starches do not have a sharp pasting or gelatinization point, but in pure water corn starch changes noticeably at 165°F. to 168°F. The temperature would be about 10° lower for tapioca starch. If sugar is present, the pasting point would be raised.

If one pound of starch is cooked in the average amount of water in the presence of seven pounds of sugar, the resulting gel will be dull and thin and will have a definite starch taste. However, if the same amount of starch is cooked in the presence of only three times its weight of sugar, and the remaining 4 pounds of sugar are added after the pasting of the starch is completed, the result will be a clear, glossy gel with no trace of a starch taste.

The safe rule to follow is not to have more than $3\frac{1}{2}$ times as much sugar as starch present at the time the starch is being cooked. When this rule is not followed, examination under the microscope show the presence of numerous unswollen starch cells.

But the baker should not go all the way and try to cook starch without any sugar. Some sweetener should be present to prevent the mixture from becoming too stiff after the starch is pasted, thus causing lumps to form which will not smooth out easily after the addition of the balance of the sweetener.

For this reason it is a general practice to have sweetener present in an amount of at least twice the weight of the starch.

VIII. THE STEPS IN COOKING FRUIT FILLINGS

Prepare "starch milk" by dissolving very thoroughly two parts of water to one part of starch. The water -- or juice-- should be part of the total liquid to be used in preparation of the filling.

The above starch milk should be added to the juice, water, and sweetener just as it begins to boil -- 190°F. is the recommended temperature. The starch should be added gradually but should be stirred in vigorously. When all the starch is in, gently stirring should be continued until the starch thickens and clears.

After the starch is clear and the mixture thickens, the remaining sugar should be added and again stirred in vigorously. The mass should then be heated only long enough to dissolve the sweetener. The filling should then be removed from the fire.

After the completion of cooking, the fruit is added to the hot syrup. In some cases it may be desirable to heat the mixture slightly to soften too-firm fruit or to prevent possible "freezing" due to uncooked juice's remaining in the fruit. Additional cooking after the fruit is added also helps prevent possible fermentation, but it does soften the fruit somewhat.

IX. RULES FOR MILK FILLINGS

All of the above suggestions for the proper pasting of starch in fruit fillings are also applicable in the preparation of custards and soft pie fillings. In plain water or milk fillings, 2 ozs. of starch is usually used to thicken 1 quart of liquid.

The addition of eggs to this product would permit a reduction of starch. The ratio is 4 ozs. of starch less for each pound of eggs added. Note that this ratio is for plain water. Where sugar and other ingredients are added- and they usually are- an additional amount of starch or eggs is needed to offset the sugar.

Rapid Cooling Is Important

Most bakeries are not equipped with proper devices for the rapid and proper cooling necessary to safeguard against loss of flavor or color, as well as protection for the starch gel. Fast cooling is necessary, but low-temperature storage is not recommended for starch fillings except for short periods of time.

X. THE USE OF INSTANT STARCH

Many of the difficulties associated with the use of starch in cooked fillings may be avoided by the use of "instant" starch. This is a pre-gelatinized starch which eliminates cooking. During the baking process the starch thickens, and the final product is found to be the same as that made from cooked fillings. The use of instant starch is not recommended for open-face pies or similar items which are not baked.

Slightly different proportions of this starch are recommended by the various companies that process it. In general, the recommended methods for its use are the same. In practice, we have found the following method best:

1. Blend sugar with starch and other dry ingredients with wire whip or machine. (At least 4 parts of granulated sugar should be used with 1 part of instant starch to prevent lumping.)
2. Add water and whip thoroughly.
3. Gently fold in fruit.
4. Refrigerate until used.

STARCH GLOSSARY

NOTES

Acid -
The quality or state of being sour, tart, sharp to the taste. Below 7 on the pH scale.

Agitation -
The vigorous stirring of a solution.

Amioca -
Starch made from waxy maize. Looks like ordinary cornstarch even under the microscope, but has properties more nearly like tapioca. Its pastes are clear, fluid, and cohesive. It is nonjelling and has less cereal flavor than cornstarch but somewhat more than tapioca.

Breakdown -
Any form of separation of a cooked starch-paste resulting from undercooking, overcooling or any other cause.

Cereal flavor -
Starchy taste found in cooked fruit fillings thickened with starch where the starch granules are not fully gelatinized.

Cloudy -
Unclear appearance of fruit fillings. Occurs most in fillings cooked with cornstarch, or when starch is not sufficiently cooked.

Cohesive -
Gummy, rubbery texture of starch-paste.

Consistency -
Often used interchangeably with viscosity. Refers to resistance to stirring of liquids.

Cornstarch -
(See definition of starch.) Starch processed from the kernels of corn. When cooked in water, the solution is cloudy, and noncohesive. Upon cooling, it has a tendency to paste, set, or jel, depending on the concentration.

Fluidity -
The ease with which a liquid can be stirred. Opposite of viscosity.

NOTES

Gel -
Technical term referring to the process involved in forming a firm, semirigid-textured cooled starch-paste, resembling a jelly.

Gelatinization temperature -
Amount of heat required (in cooking fruit filling or custard) to cause starch cells to swell. This is not a fixed point as in the boiling of water, where the boiling point is 212°F. Different starches gelatinize at different temperatures and the larger cells swell first- at lower temperatures. Cornstarch granules begin to swell at 140°F. and become completely gelatinized at 190°F.

Gelatinize -
To cook or swell starch granules in water to obtain a viscous solution.

Gloss -
Desirable, shiny surface of cooked fruit filling.

Heavy -
of a higher viscosity.

Hydrolysis -
Process of splitting a molecule into small parts by chemical reaction with water.

Intermediate pH range -
Between 4-7 on pH scale. It is in this range that starches gelatinize more slowly.

Jel -
Firm, semi-rigid-textured cooled starch-paste, resembling a jelly.

Paste -
Short-textured, smooth starch-paste with slight or sluggish flow. Used as a noun and a verb .

pH -
A measure of the acidity of alkalinity of a solution, the neutral point being pH 7. Lower values indicate increasing acidity. Higher values indicate increasing alkalinity.

NOTES

Retrogradation -
This occurs when starch solutions are held for a prolonged period of time at room temperatures or lower. The paste breaks down and part of the starch precipitates from the solution in the form of liquid.

Set -
To form a nonfluid starch-paste without a firm jel - as a custard pie thickened without starch is said to "set" after cooling.

Stable -
Characteristic of a starch-paste that does not change much in viscosity, clarity, or texture with age.

Starch -
A white, granular material that comes from the seeds, piths, or roots of plants. It is insoluble in alcohol, cold water, and most other solvents. It may be cooked in water to form viscous solutions. Chemically it is a combination of carbon, hydrogen, and oxygen atoms.

Starch milk -
Starch dissolved in cold water, used to thicken cooked juice into a paste.

Starch slurry -
Same as starch milk.

Starch-paste -
A term used to designate a cooked and cooled starch solution.

Starch taste -
Noticeable cereal taste in cooked fruit filling, the result of incompletely swollen starch granules.

Starch-water ratio -
Ratio of starch to water for cooking custard or fruit filling. Approximate custard ratio: 2 ozs. starch to each quart water. Approximate fruit ratio: 3 ozs. starch to each quart of water -- with some variation for different fruits.

Sugar-starch ratio -
The amount of sugar in a mix in proportion to the amount of starch. For example, $3\frac{1}{2}$ pounds of sugar to 1 pound of starch is called a $3\frac{1}{2}$ to 1 ratio. At this ratio, starch will gelatinize and the solution attain the proper consistency. But if the ratio is increased to about 6 to 1, the starch will not gelatinize completely, and the resulting paste will be thin and watery.

Syneresis -
Weeping and watering of cooled starch-paste due to undercooking of starch. Also accelerated by prolonged low temperatures. Syneresis is accompanied by a drop in consistency or viscosity.

Thin -
Low in viscosity or consistency. High in fluidity or more highly converted.

Texture -
Smoothness to the touch of the cooked paste.

Tapioca -
A form of starch that comes from the root of a tropical plant called cassava. Its cooked pastes are fluid, clear, cohesive, stable, and have a noncereal taste.

Tightly bound water -
Water taken up and held by starch.

Viscosity -
Term used to indicate the resistance to stirring of liquids.

UNIT XI - CHOCOLATE AND COCOA

CHAPTER HEADINGS

I. Introduction
II. How Cocoa is Grown, Processed, and Shipped
III. The Manufacture of Chocolate
IV. The Manufacture of Cocoa
V. The Flavor of Chocolate and Cocoa
VI. Storage of Chocolate and Cocoa
VII. Using Chocolate and Cocoa Interchangeable in Baking
VIII. The Tempering of Chocolate
IX. How to Temper Chocolate
X. Chocolate Bloom
XI. Instructions for Molding Hollow or Solid Chocolate Products

Glossary
Test

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Pyler, E. J., Baking Science and Technology, pp. 595-600

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NOTES

I. INTRODUCTION

Although chocolate is generally considered one of America's most popular flavors, it is not a flavoring material in the sense that vanilla or mace are flavoring materials. Besides flavor, chocolate has food value. It also contributes definite substance and color to bakery products.

Chocolate and cocoa come from the same source -- the seed of a tropical tree. These seeds, which are about the size of almonds, are found within large pods, about the size of a long cantaloupe. They are called cacao beans before they are processed; after they are processed, the product is cocoa.

The first white man to taste cocoa was Hernando Cortez, the Spanish explorer and conqueror of Mexico. It was he who brought to Europe the secret of preparing cocoa which he had learned from the Aztec Indians.

II. HOW CACAO IS GROWN, PROCESSED AND SHIPPED

The cacao bean thrives only in equatorial countries. Those beans grown nearest to the equator are best. South and Central America, the East and West Indies, and the West Coast of Africa are sources of cacao beans.

The trees on which the cacao beans grow are about 25 feet high. At the tops of the trees are large, thick leaves. Directly attached to the trunk and main branches are small clusters of pink flowers. As many as 6,000 of these flowers may bloom on a single tree. If fertilized, each flower might produce a cacao pod; however, only about one percent ripen into pods. Thus, each tree yields about 60 pods a year. Since each pod yields about two ounces of dried cacao beans, the total annual yield of cacao beans is less than eight pounds per tree.

At harvest time, the natives cut the pods from the trees by means of knives attached to long poles. The women cut the pods open and scoop out the beans. The beans are allowed to dry in the sun or are conveyed to drying houses.

Oxidation of the beans begins almost immediately. They change from white to brown. Fermentation also begins as soon as the temperature rises and the natural sugars turn to acetic and other acids.

After a few days, any remaining dried pulp which may still adhere to the cacao bean is removed and the beans are ready to be bagged and shipped

III. THE MANUFACTURE OF CHOCOLATE

The first step in the manufacture of chocolate is to remove any foreign substances which may still be present. The beans are then roasted by currents of air heated to 400°F. in revolving cylinders. At exactly the right moment, they pass from the roaster and are quickly cooled to prevent further change by the heat they have absorbed.

The beans are then conveyed to changers where they are shattered into fragments called nibs. At the same time, the shells are lifted away from the nibs by air currents, and removed. When freed from their shells, the dry nibs are ready for milling.

In the milling process, the nibs pass between three sets of grinding stones. Here the cocoa butter is released from the cells, and a dark, rich liquor flows from the grinders, giving off a heavy aroma. This is the basic ingredient from which chocolate is made. Cocoa and cocoa butter are also made from the basic chocolate liquor.

The chocolate liquor which results after the nibs are ground is utilized in a number of ways. The first way is to allow it to harden into 10-pound blocks for commercial use. These are used by bakers and candy makers. Even though solid, the blocks are referred to as chocolate liquor or baking chocolate. Baking chocolate is also produced in small blocks for household baking.

Another way in which the chocolate liquor is utilized is in the manufacture of sweet chocolate. For sweet chocolate, granulated sugar is pulverized and mixed with chocolate liquor in rotating bowls called melangeurs. Additional cocoa butter is added, and there are additional steps in the refining process. One of these steps is called conching, in which the chocolate is ground with still more cocoa butter. The resultant semi-liquid sweet chocolate is poured into molds. Here again, the mold produces a 10-pound block of sweet chocolate, which will be used by the baker and the candy maker in the production of chocolate-coated candies and other chocolate products.

In the production of milk chocolate, the basic ingredients are the same: chocolate liquor, cocoa butter, and sugar. The other ingredient is, of course, milk. The process begins with mixing milk together with the sugar. After that, part of the liquid is evaporated. Then chocolate liquor is added. During this operation moisture continues to evaporate and the mass is changed to solid and then to a powder form.

As in the manufacture of sweet chocolate, cocoa butter is added. The grinding process begins in the conches, and the end product is a semi-liquid product that is poured into molds. Much milk chocolate is made into chocolate candy bars. A great deal of it is formed into 10-pound blocks to be made into candy coating by confectioners. Very little milk chocolate is used by the baker.

Government standards are specific in their definition of the various types of chocolate. For example, milk chocolate must contain "not less than 12% milk solids." Chocolate liquor must contain"not less than 50% cacao fat."

IV. THE MANUFACTURE OF COCOA

When most of the fat has been pressed out of the chocolate liquor in hydraulic presses, the pressed cake remaining -- still containing some of the fat -- is pulverized. The result is cocoa.

The fat which is extracted, called cocoa butter, is creamy white or yellowish in color and is neutral in flavor. By extracting the cocoa butter from the chocolate liquor, the flavor of the remaining product, cocoa, is intensifed. That's why cocoa contains about one and a half times as much flavor as chocolate.

Cocoas are either "natural" or "dutched." The process of dutching originated in Holland. The purpose of dutching cocoa is to make it more soluble and also to darken it. This is desirable because the removal of fat and fine grinding leaves the cocoa much lighter in color than chocolate.

The dutching process consists of adding a watery alkalai solution to the partially roasted cacao beans. When the water evaporates, the beans darken. From then on they are treated exactly the same as natural cacao beans; the beans are roasted and shattered into nibs, the cocoa butter is released, and chocolate liquor is produced. The liquor is pumped into powerful hydraulic presses, which expel more than half of the free-flowing cocoa butter. The remaining solid cakes are pulverized into cocoa. In this case it is called dutched cocoa.

V. THE FLAVOR OF CHOCOLATE AND COCOA

Flavor is the most sought-after characteristic in chocolate and cocoa. From this standpoint, very dark dutched cocoa is considered practically worthless by bakers of high-quality products. Laboratory tests have shown that a given quantity of breakfast cocoa containing not less than 22% butterfat will impart a more desirable flavor than a greater quantity of low butterfat cocoa.

Flavor tests of various cocoas can be made by substituting cocoa for 10% of the flour in a vanilla wafer and then comparing for flavor.

VI. STORAGE OF CHOCOLATE AND COCOA

It is not enough to specify "a cool dry place" for the storage of chocolate or cocoas. While a temperature of 55°-65°F. is ideal, there should not be a variation of over 5 degrees. This prevents sweating, even in extremely humid weather.

Low temperatures are inadvisable because this causes condensation of moisture on the surface when exposed to air. Humidity should also be low: not over 50%, with good circulation of air.

Chocolate and cocoa should always be kept away from radiators, steam pipes, etc., and they should always be stored away from other strong-smelling products, because they have a tendency to pick up foreign odors.

VII. USING CHOCOLATE AND COCOA INTERCHANGEABLY IN BAKING

Since chocolate and cocoa are basically the same, it is possible to substitute one for the other in many recipes -- provided adjustments are made to compensate for presence or absence of fat. The two charts below show what these adjustments are.

To Substitute Cocoa for Chocolate in a Recipe

To Replace Chocolate		Use Cocoa		Increase Shortening	
Lbs.	Ozs.	Lbs.	Ozs.	Lbs.	Ozs.
	4		3		1
	8		5		2
	12		8		2
1			10		3

To Substitute Chocolate for Cocoa in a Recipe

To Replace Cocoa		Use Chocolate		Reduce Shortening	
Lbs.	Ozs.	Lbs.	Ozs.	Lbs.	Ozs.
	4		6		1
	8		13		2
	12	1	3		4
1		1	10		5

VIII. THE TEMPERING OF CHOCOLATE

In former years, before the development of precision equipment, working with chocolate was more of an art than a science. The confectioner who could work well with chocolate was considered some kind of genius. But today, working with chocolate is more of a science than an art.

The tempering of chocolate is similar to the tempering of steel in that the product is brought to a high temperature, then the temperature is reduced. After that it is brought up to a slightly higher temperature, at which point the tempering process is completed and the confectioner is then ready to begin dipping.

Chocolate is a suspension of solids in cocoa butter. It must be remembered, however, that cocoa butter is itself a mixture of glycerides of fatty acids, each of which has a different melting temperature. Therefore, in order to liquefy chocolate, it is necessary to raise the temperature above that required to liquefy the glyceride with the highest melting point.

If the chocolate is allowed to cool without being stirred, the portion with the highest melting point will solidify first. The remaining portions will solidify in turn, according to the different melting points, and will more or less separate into layers. It is to prevent this from happening that chocolate must be tempered before it is used for dipping.

The confectioner expects these three results of proper tempering:

1. Certain undesirable cocoa butter crystals will be removed.
2. Finished products will have a good, permanent gloss.
3. Maximum coverage will be obtained.

IX. HOW TO TEMPER CHOCOLATE

The best way to temper chocolate is in tempering tanks. But the baker usually is limited in his facilities to the use of the old-fashioned kettle or double boiler. The proper temperature at which chocolate should be melted is 115°-120°F. for plain chocolate and 110° F. for milk chocolate. Then it is cooled slowly to 80°F. After that, it is rewarmed to about 90°F. (Since there are different types of coatings, there may be a slight variation in the final temperature. The dark coatings are worked at 90°F., but the milk chocolate or light coatings are worked at 88°F.)

Untempered coating in the kettle at 93°F. may be mixed with tempered coatings at 85°F. This process may also be reversed. When chocolate becomes too cool or too thick, it may be thinned down with untempered chocolate at 93°F.

When tempering chocolate, if a higher or lower temperature appears to be necessary, it is an indication that something is wrong. Either water (or steam) has gotten into the chocolate, or the chocolate has been stirred too rapidly.

The cooling time for tempered chocolates is relatively short. In cooling, the baker should try to approach the conditions in chocolate-coating plants, where the proper temperature at the receiving end of the enrobing tunnel is 60°F. and the delivery end has a temperature of 50°F. A humidity range of 60-70% is maintained.

It is also important that chocolate not be cooled below the dew point of the room. Otherwise, moisture will form and sugar bloom will result.

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X. CHOCOLATE BLOOM

There are two kinds of chocolate bloom or greying. The more common is fat bloom which is caused by small fat crystals forming on the surface of the chocolate. When the melted chocolate is used too warm, the cocoa butter separates from the other two ingredients in the chocolate (dry cocoa and sugar), and these sink to the bottom while the fat floats to the top. The cocoa butter itself is transparent. The high gloss that improperly coated products have before they dry, is probably the dark cocoa showing through the very thin layer of fat. But when the cocoa butter finally does harden, the result is a mottled grey effect.

The other type of chocolate bloom is sugar bloom. This is almost exclusively the result of water being absorbed on the surface of the chocolate. When this happens, the moisture dissolves some of the crystals of sugar. This forms minute droplets of syrup. Later, the moisture evaporates and the sugar re-crystallizes, resulting in a grey haze.

XI. INSTRUCTIONS FOR MOLDING HOLLOW OR SOLID CHOCOLATE GOODS

1. Take chill off molds; molds can be at 75°-80°F. temperature.

2. For molding hollow chocolate goods, fill mold completely full at once with properly tempered chocolate (about 80°-90°F.)

3. Tap mold for about 10-15 seconds to remove all air bubbles.

4. Drain chocolate from mold so that only a shell remains on the inside of mold.

5. If the chocolate was too thin, and the shell appears very thin, fill the mold again, tap and drain as above.

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6. To form the bottoms, the following procedures can be used:

   a. Have about $\frac{3''}{16}$ of chocolate in shallow pan and stand the molds in this pan to cool.

   b. If the mold has not been drained too much, stand mold on wax paper to cool. The surplus chocolate dripping down will form the bottom.

7. After chocolate has set, about 10 minutes in room of 50° temperature, remove clamps, as chocolate may crack when chilled too quickly.

8. After final cooling, 20-30 minutes, the chocolate piece should release easily from the mold.

9. Be sure to reheat the mold to molding-room temperature, as described under (1), before using it again.

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Bloom -
There are two kinds: sugar bloom and fat bloom. Both result when couverture is improperly used or when temperature conditions are not correct. The resulting products will have a dull grey finish rather than a rich gloss that chocolates are expected to have.

Fat bloom is mainly caused when melted chocolate (couverture) is used too warm. Since the chocolate is made up of three components -- dry cocoa powder, sugar and cocoa butter -- and since cocoa butter is the lightest, it will become separated from the other two ingredients and float to the top. When the chocolate hardens, it will have a dull grey appearance, known as fat (or streaky) bloom.

Sugar bloom is mainly caused by moisture being absorbed on the surface of the chocolate. In this case, the moisture dissolves some of the sugar crystals, forming tiny droplets of syrup. When the moisture in the syrup evaporates, the sugar recrystallizes and the resulting grey appearance is known as sugar bloom.

Breakfast cocoa -
High-fat cocoa. Contains not less than 22% butterfat. May or may not be dutched, but if it is dutched, the label must so indicate.

Cacao -
The bean from which cocoa and chocolate liquor are processed.

Chocolate -
The solid or plastic mass obtained by grinding cacao nibs. It contains not less than 50% cacao fat, not more than 8% ash, not more than 0.4% ash insoluble in hydrochloric acid, nor more than 7% crude fiber.

Cocoa -
A powder made from the seeds of the cacao tree. Cocoa results when the chocolate liquor, obtained from the mills, is passed through hydraulic presses where most of the fat, or cacao butter, is expelled. The remaining cocoa powder will retain a fat content of 8-25%.

Cocoa butter -
A vegetable butter, derived from cacao nibs. It is solid at ordinary temperatures. It has a narrow melting range because of a preponderance of glycerides of nearly the same melting point. Because it lacks greasiness when in a solid state and melts at a temperature below that of the human body, it makes an ideal fat for blending with chocolate coatings. It is pale yellow or creamy in color, is neutral in flavor and melts sharply at a temperature of 93°-95°F.

Couverture -
Anything used to cover; a covering. In chocolate work, the melted chocolate itself used to cover hard or soft centers.

Dutching -
A process invented by C. J. Van Houten in 1828, and claimed by the inventor to make cocoa more soluble. It consists of treating the cacao nib or mass with a small percentage of potassium carbonate, bicarbonate, or other salt of the alkalis.. The alkaline salt reacts with the astringent constituents and partly neutralizes the acidity of the cacao. This is considered to improve the cocoa, which becomes darker in color and less likely to sink to the bottom of the cup.

Hydroscopic properties -
The property of attracting and holding moisture. Cocoa exhibits this property as a result of the roasting process during which a major portion of the starch present in the raw nibs is converted into dextrines under the influence of heat. These dextrines show a great affinity for moisture when incorporated in a batter.

Liquor - Chocolate liquor.
Also called bitter chocolate or baking chocolate. The direct result of the milling process whereby cacao nibs are ground in cacao mills to a semi-liquid. Even in its hardened state, this form of chocolate is referred to as liquor.

Milk chocolate -
The product obtained by grinding chocolate with sugar and/or dextrose, with milk solids or whole milk, and with or without cacao butter and/or flavoring materials. It contains not less than 12% milk solids.

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Milling -
That part of the process of making chocolate and cocoa which has to do with using steel rolls to grind the cacao nibs into liquor.

Nib -
The cotyledon of the cacao seed. That portion inside the seed shell from which chocolate liquor is made.

Oxidation -
Combination with oxygen; conversion into an oxide or an oxide compound.

pH -
A term used to represent the hydrogen ion concentration of a given solution. Cacao products may vary in their pH value from 5.2 to as high as 8.8 for heavily dutched cocoa. The pH of natural cocoa is generally within the range of 5.2-6.0.

Pod -
A seed vessel of a long form. The cacao pod is the fruit of the cacao tree. It may attain a size of four inches in diameter and 12 inches in length. Imbedded in the pod are the cacao beans or seeds, from which cocoa and chocolate are processed.

Pulverize -
The process of making cocoa from the hardened liquor cake by grinding it to a powder.

Soluble -
Capable of being dissolved.

Sweating -
The formation of moisture on the surface of chocolate, resulting from storage or cooling at too low a temperature. One of the causes of sugar bloom.

Sweet chocolate, sweet chocolate coating -
Chocolate mixed with sugar and/or dextrose, with or without the addition of cacao butter, spices or other flavoring materials.

Temper -
According to the Oxford Dictionary, "to bring anything to a proper or suitable condition, state or quality, by mingling with something else. To modify some unsuitable or excessive state or something by admixture of something else."
According to Webster's Dictionary, "to bring to a specified consistency, for example, to bring a substance such as glass or steel to a proper degree of hardness or toughness. Steel is tempered by high heating, sudden cooling, and a gentle reheating to the degree desired."
Chocolate tempering means bringing the chocolate to a suitable condition (for working easily and economically and retaining a gloss) by proper heating and cooling to eliminate undesirable crystals.

It is necessary to overcome the natural tendency for cocoa butter to separate from the other substances present in chocolate couverture. Since the glycerides in cocoa butter have different melting points, the lighter ones have a tendency to rise to the surface, causing whitish streaks to appear. To prevent this, the chocolate should be tempered, that is, it should first be properly melted, then cooled slowly till almost at the setting point, then gently reheated to dipping consistency.

UNIT XII - GUMS AND STABILIZERS

CHAPTER HEADINGS

I. Introduction
II. What Are Stabilizers Made Of?
III. How Do Stabilizers Work?
IV. How Should Stabilizers Be Handled?
V. Use of Stabilizers in Various Products
VI. List of Common Stabilizers

Glossary
Test

REFERENCES AND RECOMMENDED READINGS

Better Cake Toppings and Fillings, Crystal Gelatine Co., Cake Service Department

Pyler, E. J., Baking Science and Technology, pp. 578-581

NOTES

I. INTRODUCTION

A knowledge of the use of stabilizers is important to the success of many bakery products. In meringues, stabilizers help to prevent "weeping." When oil and water are used for making an emulsion, the addition of a stabilizer helps to prevent the separation of the oil. When used with cooked fruit, stabilizers help to prevent retrogradation.

Because stabilizers are expensive - often in the neighborhood of ten cents an ounce - some bakers refuse to use them. Others look on the use of stabilizers as if they were some kind of magical ingredient. Many cannot understand how the stabilizers add to the quality of the product.

In truth, stabilizers are neither magical nor expensive. Stabilizers have properties which have been proven in the laboratory and, when properly used, can be depended on to bring about certain known reactions. As for price, when properly used, stabilizers can actually bring down the price of the finished product by adding longer shelf life, palatability, and other desirable qualities.

II. WHAT ARE STABILIZERS MADE OF?

Some stabilizers are made of gums. For the most part, gums are formed by plants or trees when they are cut. Gums can also be processed from seeds or leaves by pressing, boiling, drying, or other means. Gum tragacanth, which is used in making gum paste for decorative flowers on cakes, is such a gum stabilizer. It forms when the astragulus shrub, grown in Turkey, is cut.

Another stabilizer comes from animal sources. Gelatin, which is made from animal tissue (skin, tendons, ligaments) by prolonged boiling, is such a stabilizer. Its properties are similar to those of the gum stabilizers.

Still another form of stabilizer is manufactured. Carboxymethyl cellulose (CMC), which is processed from cellulose, is such a stabilizer.

Another form of stabilizer is starch. This has been dealt with in Unit X and will not be considered here. Even flour, when it is used to thicken custard or pumpkin pie mix, is considered a stabilizer.

III. HOW DO STABILIZERS WORK?

Stabilizers are of either of two types: soluble or insoluble. The soluble type dissolves and thickens the liquid; the insoluble type absorbs the liquid. It is believed that the swollen molecules of the gum act like tiny fibers which run in all directions through the water in a kind of network. This is probably more true of the stabilizers which form gels than those which form pastes.

When the baker buys a stabilizer, he should know what gums are in it, for different gums have different properties. They cannot always be used interchangeably.

Some gums dissolve in cold water. Others require hot water or boiling water for solution. Among the cold-water gums are:

Algin (sodium alginate)
Arabic
GMC (carboxymethyl cellulose)
Guar
Karaya
Locust bean
Pectin (its alkali salts only)
Tragacanth

Among the hot-water stabilizers are:

Agar
Gelatin
Irish moss

Commercial stabilizers usually consist of a gum (or a combination of gums) mixed with sugar, so that the baker can use the product without running the risk of having it lump up before it gets a chance to be distributed in the mix.

IV. HOW SHOULD STABILIZERS BE HANDLED?

When gums are mixed directly with water, they usually absorb the water so rapidly that the solution becomes lumpy. That's why it is not practical for the baker to use gums "straight." The better practice is to mix the dry gum with sugar. The sugar separates the particles of gum, permitting each one to swell separately. This is particularly true of cold-water gums.

Hot-water gums also require special handling. They should always be dissolved in cold water first; then the water and the gum should be heated together.

V. USE OF STABILIZERS IN VARIOUS PRODUCTS

Boiled Icings

Gelatin or agar can be used in boiled icings. Gelatin also adds to the gloss. If the icing is to be heated to about 170°F. but not boiled, Irish moss extract is good. In the presence of milk, it will also help form a firmer icing.

Uncooked Icings

Algin is used because it dissolves completely in cold water and has good water-holding properties. With milk it will add to the gel-forming properties.

Gum arabic may be used to improve gloss.

Gelatin may be used because it sets to a firm gel. (When gelatin is used, it must first be dissolved in cold water, then heated.)

Ornamental Icings

Tragacanth may be used because of its slow-swelling properties. The icing will be soft enough to handle. Later, as the gum continues to absorb water, the icing will become firm and hard.

Fruit Pie Fillings

In baked pies, the work of stabilizing the filling is done by starch. Ordinarily, starch is not thought of as a stabilizer, and if you were to order a stabilizer from a bakery supply house, it would not send

you starch. But starch is a stabilizer to the extent that it keeps the water from separating out of the cooked filling.

Gums alone cannot be used because none of the gums alone develops a thick enough body when hot. Some gums can be used in addition to starch, however.

Custard Pies

Custards set to a gel because of the coagulation of eggs during cooking. When a stabilizer is added, the gel will be firmer. Often, it will also help the pies to take on a gloss. The stabilizer used for custard pies may be algin or Irish moss, because they form a firm gel with milk.

Chiffon Pies

Gums are better for chiffon pies than starch because they form a lighter bodied filling than starch. Gelatin, agar, and Irish moss are frequently used.

Meringues

Agar, algin, Irish moss, or locust bean are often used in stabilizers to be used in meringues. When the stabilizer is added to the syrup which is to be added to the whipped egg whites, it results in a stable meringue with lower sugar content. Because it prevents the liquid from separating out, it prevents weeping.

Meringue Powder

This product is made from dried egg whites (albumin) and, when whipped with sugar and water, forms a firm meringue. Since whites whip faster with the addition of salt and acid, such gums as gum arabic and karaya, which are slightly acid, are usually used.

Whipped Cream

Sweet cream of high butterfat content will whip into a firm product and usually does not require the use of a stabilizer. Lighter cream, however, does require a stabilizer.

If the stabilizer is added to the cream before whipping, it may retard whipping. Because gelatin is thin bodied before it sets, it can be mixed in before whipping. However, it does have the tendency to make the whipped cream somewhat tough. When a stabilizer is to be added when the cream is nearly whipped, it should be thoroughly blended with the sugar and should be of cold-water-soluble type.

VI. LIST OF COMMON STABILIZERS

Name	Source	Properties
AGAR (also called vegetable gelatin)	Extracted from certain seaweed from Pacific Ocean	1. Dissolves in boiling water. 2. Solutions, when hot, are thin bodied. 3. Solutions, when cold, form gels. 4. At 1% concentration in water, the gel resembles gelatin. 5. Odorless, flavorless.
ALGIN (also called sodium alginate)	Extracted from giant kelp in the Pacific Ocean	1. Dissolves readily in cold water. 2. Can be cooked and cooled without losing thickening power. 3. Forms a firmer gel with milk than with water. 4. At 1% concentration in water it forms a firm gel.
ARABIC (also called gum arabic or gum acacia	From Acacia trees grown in central Africa	1. Soluble in cold water. 2. Does not form a firm, solid gel with water. 3. Almost tasteless and odorless. 4. Solutions have a slight color. 5. Is slightly acid. 6. It is an emulsifying agent and protective colloid. It coats particles of other materials and keeps them suspended or separated.
GUAR	From the seeds of a plant grown in India	1. Very similar to properties of lucust-bean gum. Dissolves completely in cold water. 2. Forms a thick paste but does not form a firm gel. 3. May be cooked with fruit, as it is very resistant to the action of fruit acids.

Name	Source	Properties
IRISH MOSS	Extracted from seaweed which grows along the coast of Ireland and New England	1. Dissolves in water when heated to 170°F. 2. Forms excellent but tender gel with milk because it reacts with the casein.
KARAYA	From trees grown in India	1. Solutions are thick bodied but do not form firm gels. 2. The less the acidity of its solutions, the thicker bodied they are. This thickening increases further up to pH 8.5 as the alkalinity goes.
LOCUST BEAN	From beans of the locust-bean or carob tree, which grows in countries bordering on the Mediterranean Sea.	1. Dissolves completely in cold water. 2. Forms a thick paste but doesn't form a firm, solid gel. 3. Very resistant to fruit acids and may be cooked with fruit.
TRAGA-CANTH	Forms when the astragulus shrub is cut. Comes from Turkey and Iran.	1. Dissolves in cold water 2. Swells slowly for 48 hours or more. However, if heated to 160°F., the maximum thickening will occur in about 2 hours.
	STABILIZERS OTHER THAN GUMS	
PECTIN	Citrus-fruit pulp or apples	1. Does not swell to a thick-bodied liquid or set to a firm jelly in water alone. 2. When boiled with sugar in the presence of a fairly strong acid such a s is found in many fruits, will form a firm jelly.

Name	Source	Properties
GELATIN	Animal product made from cartilage or bones	1. Dissolves only in boiling water. 2. Solution is thin-bodied when hot. 3. At 1% concentration it forms a firm gel when cold. 4. Sets slowly. 5. If heated in acid solution, it breaks down chemically and loses its ability to gel. 6. If not completely dissolved, forms dark spots. 7. Odorless, flavorless, and has only slight color. 8. Excessive amounts make product tough and rubbery.
CMC (carbo-xymethyl cellulose)	A manufactur-ed product, made from cellulose	1. Swells quickly in cold water to form a thick solution.

GLOSSARY ON GUMS AND STABILIZERS

NOTES

Agar -
A stabilizer derived from Pacific seaweed. Also known as vegetable gelatin, because when dissolved the gel resembles that of gelatin and because it dissolves only in boiling water.

Algin -
A stabilizer extracted from various seaweeds or kelps.

Arabic -
A true gum stabilizer extracted from the acacia tree, grown in central Africa.

CMC -
An abbreviation for carboxymethyl cellulose. A stabilizer manufactured from cellulose. Dissolved only in boiling water. Solution is thin bodied when hot, but sets to a firm gel when cold.

Gel -
A semirigid colloidal dispersion of a solid with a liquid as a jelly. Also jel.

Gelatin -
A protein stabilizer derived from animal tissue, cartilage, and bones. Dissolves only in boiling water. Thin bodied when hot but sets slowly to a firm gel.

Guar -
A gum derived from the seeds of a plant grown in India. Properties are similar to those of locust-bean gum.

Gum -
One of the kinds of stabilizers used in bakery production to prevent separation in icings and cooked fillings. Gums are that form of stabilizer which comes from trees and shrubs in the form of a sticky secretion. Other stabilizers, such as gelatin, which is derived from animal matter, are often referred to as gums because they have similar properties, but strictly speaking they are not gums at all.

Soluble gums form viscous solutions by dissolving in liquid, and insoluble gums absorb many times their own volume of liquid.

Irish moss -
A gum derived from seaweed which grows along the Irish and New England coasts. It dissolves in water when heated to 170°F. Forms a firm gel with milk because it reacts with the casein.

Jel -
See gel.

Karaya -
A gum derived from trees grown in India. Swells rapidly in cold water. Solutions are thick bodied but do not form firm gel.

Kelp -
Large brown seaweeds which grow off the coasts of Ireland, Scotland, and other places. Various stabilizers are made from kelp, such as Irish moss and algin.

Locust bean -
A gum derived from the locust-bean tree, grown in countries bordering on the Mediterranean Sea. The tree is also known as carob, and the seed pod as St. John's bread. The gum dissolves completely in cold water, forms a thick paste, is resistant to fruit acids, and may be cooked with fruit.

Meringue powder -
A powder usually composed of dried egg white, sugar, and a gum or other stabilizer. When combined with water and whipped, it forms a stable meringue.

Mixture -
A homogeneous combination of two or more substances, not chemically combined. In relation to this unit, a liquid in which certain solid ingredients have been dispersed or dissolved.

An aggregate of two or more substances which are not chemically united and which exist in no fixed proportion.

Pectin -
A stabilizer prepared from citrus-fruit pulp or from apples. Pectin forms jellies when boiled with sugar and strong acids (pH 2.8 to 3.4).

Solution -
Technically, a mixture formed when a gas, liquid, or solid is dispersed in another gas, liquid, or solid.

Stabilizer -
A substance of a colloidal character which, when added to the oil and water used for making emulsions, helps prevent the separation of the oil. Also, a substance capable of taking up and holding an excess of water by forming a gel. Also, a substance possessing the ability to prevent sugar crystallization.

Syneresis -
See Weeping.

Tragacanth -
A gum derived from a shrub grown in Turkey. It dissolves in cold water and swells very slowly. Excellent emulsion stabilizer. Also used in production of gum paste for decorative flower molding.

Viscous -
Of a sticky, adhesive character. For example, a gel becomes more viscous as additional thickener is added.

Weeping -
Also known as syneresis. The watering of cooled starch paste due to undercooking of starch. Can also result from prolonged storage at low temperature. Accompanied by lower viscosity of cooked fruit. This is usually applied to liquids separating out of lemon meringue pies.

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Name _____ Class _____ Date _____

TEST ON FLOUR

Part I: Multiple Choice. Circle the letter of the most meaningful answer:

1. Spring wheat is wheat that

   a. is planted in the winter and harvested in the spring.
   b. is planted in the spring and harvested in the late summer.
   c. is planted in the fall and harvested in early spring.
   d. will produce bread that has good "oven spring."

2. Winter wheat kernels have an outer covering that is usually

   a. softer than the outer covering of spring wheat kernels.
   b. hard - due to exposure to severe weather.
   c. easy to separate from the inner portion.
   d. no different from spring wheat kernels.

3. The word "hard" in the term "hard spring wheat" refers to

   a. the hardiness of the strain of wheat from which it is grown.
   b. the "hard" feel of the flour to the touch.
   c. the kind of rolls that can be made from this flour.
   d. the part of the wheat kernel which is to be used in milling the flour.

4. All purpose flour is

   a. a combination of clear and patent flours.
   b. flour milled from the whole wheat grain.
   c. flour that is generally used by the housewife for all types of cakes, cookies, pies, etc.
   d. flour milled from various strains of wheat.

5. A "strong" flour contains

   a. almost none of the outer covering of the wheat kernel.
   b. a greater portion of the outer kernel than a "weak" flour.
   c. none of the inner portion of the wheat kernel.
   d. a smaller percentage of protein than weak flour.

6. The percentage of protein in cake flour is

   a. more than 12%.
   b. less than 9%.
   c. more than that in bread flour.
   d. none of the above.

7. One of the reasons for aging flour is

a. to bleach it to a whiter shade.
b. to give the gluten a chance to develop.
c. to increase its vitamin content.
d. to give the baker a chance to use up his present stock of flour.

8. Chemical bleaching of flour

a. speeds up the aging process and cuts down storage space needed.
b. increases the value of the flour.
c. is harmful to human beings because it uses gasses that may be toxic.
d. is undesirable because bread made with unbleached flour is better.

9. The ability of a flour "to be made into well-piled loaves" refers to

a. its tolerance.
b. its high absorption.
c. how well baked the crust is.
d. its strength.

10. When we say that flour has an absorption of 56%, we mean that

a. 100 pounds of water will take up 56 pounds of flour.
b. 100 pounds of flour will take up 56 pounds of water.
c. 100 pounds of flour will take up all the liquids, including those in the milk, eggs, butter, etc., up to 56 pounds.
d. it contains more than half moisture when it comes from the mill.

11. Strong flour will have

a. higher absorption than weak flour.
b. lower absorption than weak flour.
c. less ability to produce a high-quality loaf than a weak flour.
d. a different kind of protein than a weak flour.

12. Short patent flour is likely to be

a. cheaper than long patent flour.
b. more expensive than straight flour.
c. the same price as all purpose flour.
d. less expensive than whole wheat flour.

13. When the miller uses most of the grain to produce straight flour, the cost of clear flour is

a. likely to be higher than usual.
b. lower than usual.
c. unchanged.
d. about the same price as cake flour.

14. The usual percentage of wheat extraction is

a. 28%.
b. 80%.
c. 72%.
d. None of the above.

15. If all flour were milled into whole wheat flour, the amount of patent flour available would be

a. increased.
b. eliminated.
c. not affected in any way.
d. dependent on the amount of clear flour required.

16. Circle the letter of the missing word. "The _____ the extraction, the lower the quality of the flour."

a. higher
b. cheaper
c. lower
d. finer

17. When wheat is milled into whole wheat flour

a. there is more separation than when it is milled into patent and clear flour.
b. there is more flour milled into patent than into clear.
c. no separation whatsoever.
d. None of the above.

18. On the average, wheat contains

a. 70% ash.
b. 70% carbohydrates.
c. 70% protein.
d. None of the above.

19. Since flour contains only about 2% fat, its presence has very little effect on bread making.

a. The above statement is true.
b. The above statement is false.
c. The above statement refers only to bread made with whole wheat wheat flour.

20. The main reason for bleaching flour is to

a. improve gluten development
b. satisfy public preference.
c. speed up the milling process
d. none of the above

21. 72% extraction wheat is

a. superior to 80% extraction wheat.
b. inferior to 70% extraction wheat.
c. called "wartime" flour.
d. none of the above.

22. In purchasing flour, a flour with 56% absorption would probably be

a. cheaper than a flour with 60% absorption.
b. worthless because of its high moisture content.
c. better for cake making than for bread making.
d. none of the above.

23. In the separation of flour

a. the more patent you get, the less clear.
b. the less patent, the less clear.
c. there is no relationship between the amount of patent and the amount of clear flour.
d. straight flour is what is left after patent and clears are taken off.

24. Fill in the missing number in the following sentence:
"In the United States, approximately _____ varieties of wheat are grown."

a. 200.
b. 5.
c. 72.
d. 80.

25. One of the following is <u>not</u> one of the main classifications of wheat.

a. Durum.
b. Hard red winter.
c. White.
d. Semolina.

Part II: Definitions. Define the following terms as they relate to flour:

1. Tolerance

2. Absorption

3. Strength

4. Extraction

5. Separation

6. Whole wheat flour

7. Gluten

8. Hydration of gluten

9. Ash

10. Gelatinization

Part III: True - False:

_____ 1. Bread is usually made from soft wheat flour.

_____ 2. Hard wheat flour contains a greater percentage of protein than cake flour.

_____ 3. White bread can be improved by the addition of at least 5% wheat germ.

_____ 4. A 100-pound dough made from a flour with 58% absorption will have 42 pounds of water.

_____ 5. The amount of minerals in a flour is reflected by the percentage of ash.

_____ 6. Gelatinization of the starch refers to the swelling action of starch granules by water.

_____ 7. Patent flour normally has a fat content of about 2%.

_____ 8. The structure of a loaf of bread depends largely on the quantity and quality of the gluten.

_____ 9. About 83% of the wheat kernel is bran.

_____ 10. The endosperm of the wheat kernel is the germ or seed portion, from which new varieties of wheat are developed.

_____ 11. Because cakes are made with chemical leavening rather than yeast, it is necessary to use a stronger flour for cake making than for bread making.

_____ 12. When clear flour is added to rye flour in the production of rye bread, the result is likely to be a small, compact loaf.

_____ 13. When wheat is milled into fancy patent flour, the remaining clear flour will also be fancy.

_____ 14. All-purpose flour and short patent flour are more nearly alike than all-purpose flour and straight flour.

_____ 15. 100 pounds of cleaned wheat will yield 100 pounds of whole wheat flour.

_____ 16. The average 100-pound bag of flour contains 1.3 pounds of moisture.

_____ 17. Most of the minerals of wheat are contained in the endosperm.

_____ 18. Self-rising flour is flour to which dehydrated yeast has been added.

_____ 19. Good cake flour is whiter than patent flour.

_____ 20. It is not necessary to use chemicals to bleach flour; flour can also be bleached by aging.

_____ 21. Clear flour will be higher in ash content than patent flour made from the same wheat.

_____ 22. Semolina flour is milled from durum wheat.

_____ 23. Family flour may be blended from both soft and hard flours.

_____ 24. Better bread can be made from high-extraction flour than from low-extraction flour

_____ 26. Flour of fine granulation will not be as soft and as white as flour of coarse granulation.

Name _____ Class _____ Date _____

TEST ON YEAST AND FERMENTATION

True - False:

_____ 1. Leavening can be achieved only through the use of yeast.

_____ 2. Before the invention of yeast, the production of leavened bread was not possible.

_____ 3. Molasses is one of the ingredients used in the manufacture of yeast.

_____ 4. Budding is the system by which two yeast cells join together to produce a single new yeast cell.

_____ 5. In the manufacture of yeast, the combined ingredients which serve as food for yeast are called wort.

_____ 6. The temperature in the fermenting tanks in which yeast is grown is maintained constant throughout the entire process.

_____ 7. When yeast is drawn off from the fermenting tank, it is ready to be packaged.

_____ 8. In the manufacture of active dry yeast, entirely different strains of yeast from those used for compressed yeast are necessary.

_____ 9. To rehydrate ADY means to return to active dry yeast the water that has been evaporated from it.

_____ 10. The chief difference between active dry yeast and compressed yeast is that when using dry yeast, only $\frac{1}{4}$ as much is required.

_____ 11. Dry yeast should not be mixed in water that is higher than 78°F.

_____ 12. Once the process of fermentation starts, the gluten structure of a dough does not change.

_____ 13. Fermentation cannot begin until a certain amount of gluten development has taken place.

_____ 14. Because yeast is a living plant, it manufactures its own food by enzyme action.

_____ 15. Proper dough maturity is that point in fermentation at which all of the yeast has been consumed in the dough.

_____ 16. All of the CO_2 manufactured by yeast remains in a gas state and has no effect on the pH of the dough.

_____ 17. Correct mixing of a balanced dough is said to be the key to proper fermentation.

_____ 18. Salt is one of the ingredients used in baking that increases the production of CO_2 in a dough.

_____ 19. The addition of diastatic malt to flour serves to decrease the amount and the rate of gas production.

_____ 20. Increased gas production is possible if temperatures are raised above 95°F.

_____ 21. Such factors as mixing, rounding, molding are more related to gas production than to gas retention.

_____ 22. Enzyme action is closely related to gas production.

_____ 23. As long as maximum fermentation is achieved, the baker is sure of a good loaf of bread.

_____ 24. When a dough is dumped into a trough that is too large for it, instead of rising the dough will spread out and will not ferment properly.

_____ 25. As a rule, straight doughs are set at temperatures somewhat higher than sponge doughs.

_____ 26. Yeast can be frozen without being seriously harmed.

_____ 27. Although the fermentation time required for a straight dough is shorter than the time required for a sponge dough, the fermentation loss is greater.

_____ 28. Fermentation can be said to be more efficient with sponge doughs than with straight doughs.

_____ 29. Fermentation tolerance is better in sponge doughs than in straight doughs.

_____ 30. Better volume of the finished loaf is possible with straight doughs than with sponge doughs.

_____ 31. A bread made from a sponge dough is likely to have a better grain and texture than bread made from a straight dough.

_____ 32. In the sponge stage, one of the ingredients seldom included is salt.

_____ 33. After a dough is punched, it rises faster because the yeast begins to work better after stale CO_2 is expelled.

_____ 34. It is better for a dough that it be punched than that it merely be folded and turned.

_____ 35. If a dough is folded back at the right time, practically no gas loss occurs.

_____ 36. Both a straight dough and a sponge dough are said to be ready when they spring back immediately without leaving any finger marks, when touched with the tips of the fingers.

_____ 37. If a dough is "punched" more than once, it takes twice as long for the second "punch" as for the first "punch."

_____ 38. Doughs that are to be refrigerated should be allowed to proof the same as doughs that are to be made up at once.

_____ 39. There is sufficient nutrition for yeast in good flour alone for the production of satisfactory bread.

_____ 40. A dough that has been mixed without salt will not rise because of the effect that salt has on yeast.

_____ 41. Since water does not furnish any food value to yeast, it is not necessary for fermentation.

_____ 42. One quart of dough with one pound of sugar will ferment more rapidly than one quart of dough with only 4 ounces of sugar.

_____ 43. A dough with milk in it will require less yeast than a dough without milk.

_____ 44. The letters OSE at the end of a word indicate that it is an enzyme.

_____ 45. Sucrose, dextrose, and levulose are sugars that are directly fermentable by yeast.

_____ 46. Fermentation loss can be avoided by increasing the quantity of all ingredients used in a dough.

_____47. Fermentation tolerance refers to the ability of a dough to make good bread even though the fermentation period is extended.

_____48. It is possible to make bread without yeast if a leaven is used.

_____49. Yeast foods are used in a dough to supplement the minerals that may be lacking in the water.

_____50. The addition of shortening to a dough will increase yeast activity.

Name _____ Class _____ Date _____

TEST ON CHEMICAL LEAVENING

Part I: True - False:

____ 1. Although using baking powder will cause a product to rise, this has nothing to do with its eating quality.

____ 2. Satisfactory baking powder can be made with two parts of baking soda and one part of baking cream.

____ 3. If baking soda alone is used as a leavening, it will probably produce a residue of washing soda.

____ 4. Biscuits made with buttermilk and bicarbonate of soda will probably rise just as well as biscuits made with baking powder, provided the baker knows the acid strength of the buttermilk and adjusts the baking time and temperature accordingly.

____ 5. According to government standards, baking powders must consist of sodium carbonate and one other product and yield a required amount of gas.

____ 6. Baking powder made with tartrate powder will be a fast-acting baking powder.

____ 7. Fast-acting baking powders are better for layer cakes than slow-acting powders.

____ 8. The main reason for adding a filler to baking powders is to help reduce their cost.

____ 9. Sodium bicarbonate is more expensive than ammonium carbonate.

____ 10. Baking powders in which the acid reactant is soluble in cold water are fast acting.

____ 11. Cheap cake mixes usually require less baking powder than expensive cake mixes.

____ 12. Cakes mixed at high altitudes will require more baking powder than cakes mixed at sea level.

____ 13. The reason pound cakes are made with little or no baking powder is that they are well creamed and usually have a high proportion of eggs.

____ 14. In many recipes, baking cream can be used to replace cream of tartar.

____ 15. A creamed batter can be said to be a mechanically leavened batter.

____ 16. Sodium bicarbonate and bicarbonate of soda are identical.

____ 17. "Soda" is identical with sodium carbonate.

____ 18. A pound of freshly mixed baking powder with an inert filler will probably have more leavening power than a pound of freshly mixed baking powder without it.

____ 19. Baking powder with an inert filler will probably retain its leavening power longer than baking powder without an inert filler.

____ 20. The Egyptians were the first ones to use chemical leavening in baking.

Part II:

1. List two reasons for the use of a filler in baking powder.

   a.
   b.

2. If the baking powder used in a layer-cake mix is of the slow-acting type, how will it react in the oven?

3. What two commonly used baking ingredients are used as fillers in baking powder?

   a.
   b.

4. List four results of using too much baking powder in a cake mix.

   a.
   b.
   c.
   d.

5. List two reasons why a cake mix might require a reduction in the quantity of baking powder.

a.

b.

6. What one ingredient <u>must</u> be present in baking powder?

7. What other ingredient is usually present but not required?

8. What function does this optional ingredient perform?

9. According to the government definition, what is the minimum amount of gas that baking powder must release?

10. What is the name of this gas?

11. Why is the <u>manner</u> in which the gas is released more important than the <u>quantity</u> of gas liberated?

12. What is the advantage or disadvantage of using fast-acting baking powder in a cake mix that may have to stand for two hours before baking?

13. When sodium carbonate is combined with shortening, what product will it yield?

14. List four ways in which leavening may take place.

a.
b.
c.
d.

15. List four ingredients that might be used to neutralize the baking soda in a bake d product.

a.
b.
c.
d.

16. List three possible results of not using enough baking powder.

a.
b.
c.

17. List three probable results of using soda without an acid reactant.

a.
b.
c.

18. Define the term "acid-reacting component," and give one example.

19. What is the difference between a double-acting baking powder and slow-acting baking powder?

20. What is the difference between a "leaven" and a "leavening agent?" Give one example of each.

Name _____ Class _____ Date _____

TEST ON SALT

Part I: One-word answers.

1. How much salt is needed in 100 pounds of cookie dough? _____
2. What is the chemical name for common table salt? _____
3. What is the chemical symbol for common table salt? _____
4. Approximately what is the pH of salt in a solution of distilled water? _____
5. Based on the amount of water, how much salt will be needed in 10 quarts of bun dough? _____

Part II: The following questions require a full explanation.

6. In what way does salt help to condition a dough?

7. Does salt have a bleaching action on dough? Explain your answer.

8. Which dough will require more salt: a lean dough or a rich dough? Why?

9. In adjusting a formula from summer to winter, what changes will have to be made in the quantity of salt used? Why?

10. What is the meaning of the phrase "to condition a dough"?

11. What is the relationship between the temperature of the dough and the amount of salt that is required?

12. Which will require more salt: a lean icing or a rich icing? Why?

13. What effect does salt have on the strengthening or weakening of the gluten in a dough?

14. What is the effect on a dough when salt is withheld until the dough is partly mixed? Explain.

15. What is the effect of salt on the texture of a dough?

Name _____ Class _____ Date _____

TEST ON WATER

Part I: True-False

____ 1. A soft, sticky dough is likely to result if a dough is made with soft water.

____ 2. Alkaline waters can usually be corrected by the addition of vinegar.

____ 3. It is impossible to make bread without some form of water.

____ 4. The temperature of a dough can be most easily controlled by controlling the temperature of the water.

____ 5. Soft water contains a considerable amount of organic matter.

____ 6. The consistency of a dough can always be traced to the hardness or softness of the water.

____ 7. One of the functions of water in bread making is to set and swell the starch.

____ 8. Minerals can be boiled from the water if they are in the form of sulphates.

____ 9. Soft water is better for modern white bread than hard water.

____ 10. Temporary hard water contains minerals in carbonate form.

____ 11. The effects of extremely hard water can be corrected by the addition of the proper amount of yeast food.

____ 12. Alkaline waters retard the acidity necessary for proper fermentation.

____ 13. The effects of very soft water can be corrected by the addition of salt.

____ 14. Bread may contain as much as 38% moisture.

____ 15. Temporary hard water is also known as non-carbonate water.

Part II: Multiple Choice

____ 1. When soft water is used in a dough

a. the dough will ferment more quickly than if hard water is used.
b. it will produce a loaf of bread that will remain fresh longer than if it were made with hard water.
c. it will not produce as tasty a loaf as that produced with alkaline water.
d. none of the above.

____ 2. Ground water contains

a. a considerable amount of organic impurities.
b. minerals that are, in general, beneficial for fermentation.
c. rain water that has just fallen.
d. substances that, in normal quantities, retard fermentation.

____ 3. For bread making purposes, pure water is

a. best.
b. practically non-existent.
c. water that has been filtered at the bakery in special filtering tanks.
d. better to use than ordinary tap water.

____ 4. The natural water cycle explains

a. why there is a periodic shortage of water in some sections of the country.
b. how the world's water supply is constantly being replenished.
c. why certain minerals are needed to make water palatable.
d. how much water there will be available for baking purposes.

____ 5. Yeast foods are used in bread making to

a. kill harmful bacteria that develop during fermentation.
b. overcome excessive hardness.
c. supplement a deficiency of minerals in the water.
d. none of the above.

____ 6. Alkaline waters are inclined to be

a. soft
b. hard
c. unsuitable for bread making.
d. beneficial in building bones in young children.

____ 7. Temporary hardness in water is caused by

a. the presence of carbonates that can be removed by boiling.
b. the absence of carbonates.
c. the addition of chlorine at the filtering plant.
d. the presence of sulphates that cannot be boiled out.

____ 8. Surface water is water that

a. is found in deep wells.
b. cannot be used in baking.
c. contains few impurities.
d. comes from streams, lakes, and ponds.

____ 9. The kind of water that is best suited for fermentation is

a. chlorinated water.
b. alkaline water.
c. hard water.
d. soft water.

____ 10. The chemical composition of water

a. has no effect on the amount of yeast that should be used in breadmaking
b. is analyzed in terms of "parts per thousand."
c. cannot be altered at the bakery.
d. has a direct relation to the amount of yeast that is required.

Part III: Definitions Define the following words or terms:

1. Carbonate hardness

2. H_2O

3. Solution

4. p. p. m.

5. Hydration of gluten

6. Pure water

7. Natural water cycle

8. Classes of water

9. Solvent action of water

10. Absorption

Name _____ Class _____ Date _____

TEST ON SUGAR AND OTHER SWEETENERS

Part I: Match the words in Column I with words in Column II that have the same meaning or are directly related.

In some cases the words in Column II can be used more than once; in some cases the words do not match at all.

COLUMN I		COLUMN II
1. invert sugar	_____	heat and energy
2. disaccharide	_____	sucrose
3. maltase	_____	starch
4. levulose	_____	malt sugar
5. carbohydrate	_____	sucrose + H_2O
6. hydrolysis	_____	enzyme
7. maize	_____	6X
8. glucose	_____	simple sugar
9. saccharometer	_____	fructose
10. hydroscopic	_____	residual sugar
11. calories	_____	CO_2 + alcohol
12. fermentable sugar	_____	attracts moisture
13. invertase	_____	corn syrup
14. $C_{12}H_{22}O_{11}$	_____	Indian corn
15. dextrose	_____	Baume
16. caramelize	_____	yeast enzyme
17. fermentation	_____	inversion
18. confectioner's sugar	_____	Nulomoline
19. fondant	_____	blackstrap molasses
20. maltose	_____	lactose
		solution
		dextro-maltose
		decolorize

Part II: True - False

____ 1. Granulated sugar is a monosaccharide.

____ 2. All sugars contribute equally toward caramelization of baked products.

____ 3. "Fermentation tolerance" refers to the range of time during which a properly fermented dough will produce a good loaf of bread.

____ 4. Sugar contributes toward initial softness better than dextrose because dextrose has a higher caramelization point than sugar.

____ 5. Rapid baking results in a drier crumb and lower moisture content in bread because heat causes moisture to evaporate.

____ 6. In a comparison of relative sweetness of various sugars, table sugar is given a value of 100. This means that by comparison, other sugars must have a value of less than 100 because 100 is a perfect score.

____ 7. The more sugar used in a dough, the less yeast it will require.

____ 8. Because yeast must feed on sugar, it is impossible to achieve proper fermentation in a dough unless sugar is added to the basic ingredients.

____ 9. Sugar refined from sugar cane is considered to be superior to sugar refined from beets.

____ 10. The more sugar used in a bread, the quicker it will bake.

____ 11. While crust color adds to the attractiveness of a loaf of bread, it does not add to its flavor.

____ 12. The word for an enzyme can be easily identified because it always ends in OSE.

____ 13. Invert sugar is not quite as sweet as confectionery sugar.

____ 14. Raw sugar can only be used by large wholesale bakers who can afford to buy sugar in tank cars.

____ 15. Blackstrap molasses is the highest quality molasses used by bakers.

____ 16. Soft sugars are not suitable for baking.

____ 17. Number 8 brown sugar is lighter in color and contains a higher proportion of molasses than Number 6.

____ 18. Hydrolysis refers to the process whereby a complex sugar is changed into a monosaccharide.

____ 19. Granulated sugar is about twice as sweet as corn syrup.

____ 20. Levulose and dextrose are equally sweet.

Part III:

1. List the rules involving the use of sugar for proper formula balance in the following types of cakes:

   Pound Cake and Layer Cake

   a.

   b.

   Angel Cake

   a.

   b.

   Sponge Cake

   a.

   b.

   c.

   d.

2. List the six major functions performed by sugar in bread baking.

   a.

   b.

   c.

   d.

   e.

   f.

3. Explain in what ways sugar and yeast help to bring about a loaf of bread of good flavor, color, and size.

4. List the eight major functions performed by sugar in cake baking.

a.

b.

c.

d.

e.

f.

g.

h.

Part IV: (Refer to Part II, True - False)

Write the REASON for EACH of your answers.

1.

2.

3.

4.

5.

6.

7.

8.

9.

10.

11.

12.

13.

14.

15.

16.

17.

18.

19.

20.

Name _____ Class _____ Date _____

TEST ON EGGS

___ 1. Eggs of highest quality are produced during

a. winter
b. fall
c. spring
d. summer

___ 2. Brown eggs, compared with white eggs are

a. lower in vitamin content.
b. about the same in food value.
c. higher in vitamin A.
d. higher in food value.

___ 3. The best method of thawing frozen eggs is to

a. run hot water over the can.
b. let them stand overnight at room temperature.
c. place them in a bath of cool, running water.
d. keep them in the refrigerator at 35°F. for about 3 days.

___ 4. The time required to defrost a 30-pound can of frozen eggs at room temperature is about

a. 36-48 hours
b. 28-34 hours
c. 18-24 hours
d. 10-14 hours

___ 5. The formula for reconstituting whole dried eggs is

a. one pound of eggs to 7 pounds of water.
b. three pounds of water to one pound of eggs.
c. three pounds of eggs to 7 pounds of water.
d. none of the above.

___ 6. Frozen eggs can be stored indefinitely at

a. 0°F.
b. 32°F.
c. 10°F.
d. none of the above.

___ 7. In sponge cakes, the cost of the eggs alone is

a. often more than half of the total cost of all ingredients.
b. not an important factor in arriving at the selling price.
c. less than 70% of the cost of all ingredients.
d. less than the cost of the sugar.

___ 8. When eggs are freshly laid, they are

a. covered with a gelatinous material, which should be removed as soon a s possible.
b. porous and subject to contamination.
c. not subject to change of pH value for 24 hours.
d. protected by a gelatinous coating which serves to seal the pores.

___ 9. A case of eggs weighing 40 lbs. will probably have about

a. 9 pounds of shells.
b. 4 pounds of shells.
c. 50% shells by weight.
d. none of the above.

___ 10. In shell eggs

a. the larger the air space, the fresher the egg.
b. the smaller the air space, the older the egg.
c. the air space is necessary to preserve the freshness of the egg.
d. none of the above.

___ 11. Shell eggs contain

a. 50% yolk and 50% whites.
b. 65% whites and 35% yolks.
c. 60% yolks and 40% whites.
d. none of the above.

___ 12. The thick portion of the whites will

a. whip quicker than the thin portion of the whites.
b. not whip if water is added to it.
c. take longer to whip and give less of a foam than the thin portion of the whites.
d. be found closer to the shell than to the yolk.

___ 13. The rope-like mass at each end of the yolk is called

a. albumen
b. chalaza
c. germ
d. membrane

___ 14. A germ or blood spot on the egg yolk.

a. makes it inedible.
b. is a natural part of a healthy egg.
c. is removed before eggs are processed for freezing.
d. lowers sale price of the egg.

___ 15. Newly laid eggs have a pH that is

a. very acid.
b. around 9.
c. neutral.
d. not likely to change unless exposed to extreme cold.

___ 16. Blood spots on egg yolk develop

a. when eggs are allowed to lie in the nest for prolonged periods.
b. when a blood vessel fragment becomes detached from the hen's ovaries.
c. only in inedible eggs.
d. when a hen is frightened during egg laying.

___ 17. Eggs contain an emulsifier

a. only in the white portion.
b. both in the yolk and the white.
c. only in the yolk.
d. that is more noticeable in the whites than in the yolks.

___ 18. The food value in eggs is

a. confined to the yolks.
b. greater in the white portion than in the yolk.
c. low in protein.
d. none of the above.

___ 19. Egg whites at room temperature will whip better than very cold egg whites because

a. surface tension is lowered.
b. air bubbles do not form well in a very cold product.
c. any possible grease in the whites will be dissolved at higher temperature.
d. none of the above.

___ 20. If it were possible to remove the protein in an egg

a. structure of the baked product would be improved.
b. structure would probably be impossible.
c. the baked product would have increased food value.
d. none of the above.

___ 21. In general the quality of frozen eggs is

a. lower than the quality of fresh eggs.
b. about the same quality of fresh eggs.
c. higher than the quality of fresh eggs.
d. none of the above.

___ 22. One pound of eggs is capable of leavening

a. about 14 pounds of other ingredients.
b. an equal amount of other ingredients.
c. about 5-6 pounds of other ingredients.
d. none of the above.

___ 23. When even a small bit of egg white is mixed into a batch of egg yolks

a. the yolks will not whip to a froth.
b. the yolks will be unsuitable for sponge cake.
c. the yolks will not be affected.
d. the whites will break down the froth.

___ 24. In reconstituting dried yolks

a. whip one pound of yolk to 7 pounds of water.
b. whip one gallon of water to one pound of yolks.
c. mix an equal weight of water and yolks.
d. whip one pound of eggs to 3 pounds of water.

___ 25. After reconstituting whole dried eggs

a. they should be used immediately.
b. they should be allowed to stand about 4 to 5 hours before using.
c. they should not be used until they thicken.
d. none of the above.

Name _____ Class _____ Date _____

TEST ON SHORTENING

Part I. True-False

___ 1. Edible vegetable shortenings are made from soya bean, cottonseed, and linseed.

___ 2. One of the reasons for hydrogenating shortening is to retard its tendency to become rancid.

___ 3. Animal shortening is more likely to become rancid than vegetable shortening.

___ 4. Compound shortening is a combination of animal and vegetable fats.

___ 5. In the manufacture of shortening, plasticity can be controlled to a large degree by the amount of hydrogenation.

___ 6. Shortening is used in bakery products to improve eating qualities, keeping qualities, and fermentation.

___ 7. A pound of shortening contains approximately 1,200 calories.

___ 8. Volume of the finished baked product increases in proportion to the increased quantity of shortening.

___ 9. During the baking process, shortening becomes soluble and mixes chemically with the other ingredients in the dough.

___ 10. Shortening is an internal lubricant and serves to make a dough smoother and softer.

___ 11. One of the differences between vegetable shortening and lard is that the former is bland in flavor, while the latter often has a pronounced flavor.

___ 12. In substituting shortening for butter, flavor is lost to an important degree.

___ 13. The chief reason for the use of salt in margarine is to improve flavor.

___ 14. Emulsified hydrogenated shortenings are better for frying than shortenings that are merely hydrogenated.

___ 15. All hydrogenated shortenings are also emulsified.

___ 16. All emulsified shortenings are also hydrogenated.

___ 17. Butter has better creaming power than hydrogenated shortening.

___ 18. Cottonseed oil is not usually considered a plastic shortening.

___ 19. The wide plastic range of cocoa butter makes it unacceptable as a bakery product for everyday use.

___ 20. Standard shortening is made entirely of vegetable oils, part of which have been hardened by hydrogenation.

___ 21. The term "high-ratio" when applied to shortening, means that the shortening is capable of carrying additional water and sugar.

___ 22. The chief difference between an oil and a fat is that an oil is liquid at room temperature while fat is solid.

___ 23. The process of manufacturing shortening is called refining because the object is to refine out all of the impurities.

___ 24. The creaming ability of a shortening is decreased when shortening is added at the end of the mixing period.

___ 25. "Summer" shortening contains a greater amount of hydrogen than "winter" shortening.

Part II: Explain in detail:

1. How the use of emulsified shortening affects (a) cake mixing, (b) cookie mixing, and (c) donut making.

2. How the introduction of emulsified shortening has affected the bakery business in general.

3. What happens to shortening that has been exposed to high temperature and is later brought back to the best creaming temperature? Explain your answer.

4. What effect does the use of emulsifiers have on the creaming power of shortening, so far as temperature is concerned?

5. What is the boiling point of oil? Explain your answer.

6. List three ways in which the decomposition of frying fats can be kept to a minimum:

a.

b.

c.

7. Which is better for frying, fats or oils? Why?

8. "The smoke point of a fat is dependent on the percentage of free fatty acids." Explain this statement.

9. Why is the smoke point, as given in a laboratory statement, misleading?

10. What is the difference between "creaming power" and "shortening power"?

11. Discuss at least two of the factors that affect shortening power.

12. Define "plasticity" in shortening.

Name _____ Class _____ Date _____

TEST ON MILK

1. What is the chief difference between dry skim milk and dry whole milk?

2. What is the only difference between liquid whole milk and dry whole milk?

3. List five kinds of milk:

   a.
   b.
   c.
   d.
   e.

4. On the comparison chart in Chapter VIII, which form of milk was found to contain:

   a. the most water? _____

   b. the most milk solids? _____

   c. most fat? _____

   d. most milk sugar? _____

5. What is the only form of milk that contains cane sugar?

   _____ About how much? _____

6. Whole milk is made up of five major components. Name them.

   a.
   b.
   c.
   d.
   e.

7. Which of these is missing in skim milk? _____

8. How should liquid skim milk be reconstituted for bakery purposes?

9. What is the government definition of milk?

10. Milk contains many vitamins and minerals, the most important being _____, _____, and _____.

11. Which form of milk is most economical for bakery purposes? _____.
What is the approximate cost per quart? _____.

12. Name five characteristics which milk in any form gives to baked products.

a.
b.
c.
d.
e.

13. Is spray-process or roller-process dry milk better for general bakery use? _____.
Why?

14. Describe the process of pasteurization. Tell as much as you know about this process as well as the reason for pasteurization.

15. Compare bread made with milk with bread made without milk.

16. Fill in approximate percentages in the chart below?

	Water	Butter Fat	Solids
Whole Liquid			
Whole Dry			
Liquid Skim			
Dry Skim			

Name _____ Class _____ Date _____

TEST ON STARCH

Part 1: Circle the letter of the answer that is most nearly correct.

1. The proper ratio of starch to water in a custard is:

   a. 4 ozs. starch to 1 quart water.
   b. 2 ozs. starch to 1 pound water.
   c. 2 ozs. starch to 1 quart water.
   d. 1 quart water to 2 pounds of starch.

2. The best ratio of starch to sugar for proper gelatinization of starch in a fruit filling is:

   a. three times as much starch as sugar.
   b. three times as much sugar as starch.
   c. seven pounds of sugar for every pound of starch.
   d. one pound of sugar for every ounce of starch.

3. Potato starch will gelatinize at a lower temperature than Amioca starch because:

   a. the potato granules are smaller.
   b. potatoes have a higher starch content.
   c. Amioca does not have the same jelling strength as potato starch.
   d. none of the above.

4. In making custard pies, it is possible to do without starch altogether:

   a. if the quantity of eggs is increased in the proportion of 1 pound of eggs for every 4 ozs. of starch omitted.
   b. if tapioca is used.
   c. if part of the sugar is held out until the mix is thickened.
   d. if the custard is cooked in a double boiler instead of in a open kettle.

5. An ingredient having a pH value of 8 is:

   a. extremely acid.
   b. somewhat base.
   c. extremely base.
   d. neutral.

6. The one factor below that has least to do with the quality of a cooked fruit is:

   a. pH of the fruit.
   b. temperature of the starch slurry.
   c. pH of the water.
   d. amount of sugar used.

7. Once peak viscosity of a fruit filling has been reached:

   a. further cooking will result in retrogradation.
   b. thinning down of the mix can be prevented by steady stirring at low temperature.
   c. an increase in cooking temperature is necessary to prevent syneresis.
   d. the baker must be careful not to rupture the granules, because this can cause a thinning out of the gel.

8. Cornstarch is the most widely used starch because it:

   a. has a pronounced cereal flavor.
   b. is abundant and inexpensive.
   c. has qualities that cannot be duplicated by other starches.
   d. makes a paste that is cohesive and noncloudy.

9. In cooking most fruits, the best procedure is to:

   a. first soften the fruit by cooking, then thicken with starch, then add the sugar.
   b. cook the juice or water with part of the sugar, then thicken with the slurry, then add the fruit, then the remainder of the sugar.
   c. cook the water only and thicken with WARM starch slurry, then add the remainder of the sugar, then turn off the heat and stir in the fruit gently.
   d. cook the water or juice with part of the sugar, then thicken with the starch milk, then add the remainder of the sugar, then add the fruit and bring the mix back almost to a boil.

10. Instant starch is:

   a. basically the same as regular cornstarch, except that it has been pre-gelatinized.
   b. less expensive than regular starch because it does not give a finished product that has the same high gloss as cooked starch.
   c. soluble in cold water and is therefore better for custards than regular starch.
   d. none of the above.

Part II.

1. When we say that a starch jel is "stable" we mean:

2. Three desirable characteristics of a starch that is to be used for cooking fruits are:

   a. _____
   b. _____
   c. _____

3. Three different types of starch are:

   a. _____
   b. _____
   c. _____

4. List three reasons for breakdown of starch jel in fruit pies:

   a. _____
   b. _____
   c. _____

5. What is meant by the "pasting point" of a starch?

6. List the approximate percentages of each of the following constituents in corn:

   a. Moisture _____
   b. Starch _____

7. List the four principal substances in a kernel of corn.

a. _____
b. _____
c. _____
d. _____

8. As a general practice, what is the desirable sugar-starch ratio in the first stage of preparing a gel?

9. Which starch will gel at a lower temperature -- tapioca or Amioca?

10. What is the sugar-starch ratio when using instant starch?

Part III.

1. Explain the effect that the pH value of a batch has on its jelling with cornstarch.

2. Describe the steps in the manufacture of starch from corn kernels.

3. Describe the planting and growth of corn.

Name _____ Class _____ Date _____

TEST ON CHOCOLATE

I. Define the following terms:

a. couverture

b. chocolate liquor

c. dutching

d. cocoa butter

e. sugar bloom

II. Multiple choice:

1. Breakfast cocoa contains

   a. not more than 10% butter fat.
   b. a higher proportion of glycerides than natural cocoa.
   c. not less than 22% butterfat.
   d. added acids to darken its color.

2. Because of the hydroscopic properties of cocoa, all but one of the following is true. Which one is not true?

   a. Devil's food cake contains more liquid than yellow cake.
   b. a reduction ~~in flour~~ must be made to offset the addition of cocoa.
   c. where the recipe calls for cocoa, it is not possible to substitute chocolate.
   d. Devil's food cakes are characteristically more moist than yellow cakes.

3. The pH of cocoa

   a. never varies.
   b. is higher for dutched cocoa than for natural cocoa.
   c. ranges between 7 and 8.8.
   d. has no effect on the color of the cake it will produce.

4. The melting point of cocoa butter is

   a. higher than body temperature.
   b. 72°F.
   c. dependent on the conditions under which it is melted.
   d. none of the above.

5. Cacao nibs have a fat content of

   a. 80%
   b. 12%
   c. 50%
   d. 3%

6. The pressed cake remaining after the extraction of cocoa butter has

   a. a fat content of about 50%.
   b. no fat whatever.
   c. 8-25% fat.
   d. none of the above.

7. Cocoa that has been dutched has

   a. a lighter color than natural cocoa.
   b. a lower pH than natural cocoa.
   c. most of the fat removed.
   d. a darker color than natural cocoa.

8. The number of pods a cacao tree yields annually is about

   a. 6,000
   b. 25
   c. 60
   d. 250

9. In the manufacture of sweet milk chocolate, which one of the following ingredients is not used?

   a. milk powder
   b. sugar
   c. glucose
   d. cocoa butter

10. Comparing the flavoring power of a pound of cocoa with a pound of chocolate liquor

   a. the cocoa has more flavor than the liquor.
   b. the liquor has more flavor than the cocoa.
   c. they are equal in flavoring power.
   d. they cannot be compared because each has a different flavor.

III. Problems in substitution:

1. Where a recipe calls for one pound of cocoa and the baker finds that he has none in stock, what substitutions or changes must be made in the recipe? Be specific.

2. Where a recipe calls for two pounds of chocolate liquor and the baker finds that he has none in stock, what substitutions or changes must he make in the recipe? Be specific.

IV. True-False

___ 1. The wholesale price of chocolate liquor is lower than the price of sweet milk chocolate.

___ 2. The dipping room should be about 22° lower than the temperature at which chocolates are to be dipped.

___ 3. Cacao plants can be grown only in equatorial Africa.

___ 4. When chocolate is cooled below the dew point of a room, sugar bloom is almost certain to result.

___ 5. The actual portion of the plant from which chocolate liquor is made is called the "nib."

___ 6. The addition of water or steam to melted dipping chocolate will cause it to thin out.

___ 7. Cocoa butter is processed from chocolate liquor by a process called "skimming."

___ 8. Dark chocolate coatings are worked at lower temperatures than milk coatings.

___ 9. Another name for chocolate liquor is "baking chocolate."

___ 10. One of the reasons for stirring chocolate while it is being melted is to prevent it from solidifying in layers as it cools.

___ 11. In the manufacture of milk chocolate, two of the ingredients added to the chocolate liquor are cocoa butter and sugar.

___ 12. The exact temperature to which chocolate must be heated will depend on the glyceride with the highest melting point.

___ 13. Milk chocolate must contain at least 20% milk solids.

___ 14. In tempering chocolate, the batch should never be heated over 98°F.

___ 15. In the manufacture of cocoa, the nibs are ground to a very fine powder and then sifted through very fine bolting cloth.

___ 16. Pound for pound, chocolate and cocoa have the same effect in a cake batter.

___ 17. In the manufacture of cocoa, all of the fat is drawn off so that a powdered product can be obtained.

___ 18. When we substitute cocoa for chocolate, we add a certain amount of fat.

___ 19. Chocolate should be stored in a cool, dry place with temperatures not over 45°F.

___ 20. Chocolate that has been stored under unfavorable conditions and allowed to sweat is likely to result in finished products with fat bloom.

V. Describe the process of manufacturing chocolate. Touch on the following:

1. Growth and description of plant.
2. Steps before roasting.
3. Steps in manufacture of chocolate liquor.
4. Steps in manufacture of cocoa.
5. Steps in manufacture of milk chocolate and sweet chocolate.

Name _____ Class _____ Date _____

TEST ON GUMS AND STABILIZERS

Part I. Multiple Choice

Directions: In the blank at the left of the item, place the letter of the answer that best completes the item.

___ 1. Gum stabilizers are made from

a. the boiled tissue of animals.
b. cellulose.
c. secretion of vegetable matter.
d. cornstarch, wheat flour, and other types of plants.

___ 2. Stabilizers work best when mixed with

a. hot water.
b. cold water.
c. twice as much sugar.
d. about one-third as much sugar.

___ 3. Gum tragacanth is

a. a cold-water stabilizer that is derived from animal matter.
b. a hot-water stabilizer that is used for cooking fruit.
c. often used in making gum paste for decorative purposes.
d. one of the most expensive stabilizers known.

___ 4. A stabilizer that is derived from fruit pulp and apple peelings is called

a. karaya
b. pectin
c. agar
d. peelin

___ 5. Soluble gums are gums which

a. expand to many times their own weight.
b. need not be mixed with sugar to work properly.
c. cannot be used in thickening custard or pumpkin pies.
d. none of the above.

___ 6. One of the best stabilizers to be used in custard pie is Irish moss because

a. it is inexpensive.
b. it breaks down the egg structure and produces a tender gel.
c. it reacts with the casein of milk and produces a tender gel.
d. it gives good color and flavor to the pie.

___ 7. In the preparation of fruit for pies, it is best to combine a gum stabilizer with starch because

a. starch alone cannot thicken all fruits.
b. none of the gums alone develops a thick enough body.
c. starch alone produces too cheap a filling.
d. fruit acids destroy most gum stabilizers.

___ 8. The difference between a mixture and a solution is

a. mixtures are made of solids and solutions are made of liquids.
b. in a mixture the substances are not chemically united; in a solution they are.
c. in a solution all substances are combined in fixed proportions to each other; in mixtures they are not.
d. none of the above.

___ 9. Gum arabic is

a. a stabilizer but not a true gum because it is manufactured in Arabia.
b. extracted from the Acacia tree, which grows in Africa.
c. soluble only in hot water.
d. capable of forming a very firm gel.

___ 10. All gums are

a. soluble in water.
b. usable as stabilizers in food products.
c. expensive.
d. none of the above.

Part II.

Directions: At the left of each item in Column I, place the letter of the best answer from Column II. Some answers in Column II may be appropriate more than once; some may not be appropriate at all.

	Column I	Column II
___	1. One of the best stabilizers to use in the preparation of custard pies	A. Gelatin
___	2. Hot-water stabilizer	B. Algin
___	3. A stabilizer extracted from kelp	C. Tragacanth
___	4. A stabilizer that swells very slowly	D. Guar
___	5. A stabilizer that is highly resistant to fruit acids	E. Locust bean
		F. CMC

Part III.

Directions: In the blank in each sentence, write the word or words that best complete the sentence.

1. The difference between soluble and insoluble stabilizers is that soluble stabilizers _____ in the liquid while insoluble stabilizers _____ the liquid.

2. Because all stabilizers cannot be used interchangeably, the baker should have some knowledge of the _____ of different stabilizers.

3. Commercial stabilizers are usually mixed with _____ to prevent lumping.

4. Hot-water stabilizers should first be dissolved in _____ in order to work properly.

5. Two of the gums often used in meringue powders are _____ and _____.

6. Because gelatin is thin bodied before it sets, it is sometimes used to stabilize _____.

7. Because such gums as gelatin, agar, and Irish moss form a lighter body than _____, they are often used in the production of chiffon pies.

8. The term applied to "weeping" in chiffon pies is called _____.

Part IV.

On a separate sheet of paper, write a paragraph of not less than fifty words on each of the following:

1. All gums are stabilizers but not all stabilizers are gums.

2. How Stabilizers Can Improve the Keeping Qualities of Pies.

3. How Stabilizers Can Improve the Keeping Qualities of Icings.

ED013339

FURNITURE UPHOLSTERY AND REPAIR

A study guide and progression record for Furniture Upholstery and Repair students in a cooperative training program.

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

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With Competent Consultants

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RE: (Author, Title, Publisher, Date) Furniture Upholstery (1966)

Committee of Alabama Trade & Industrial Education Coordinators

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MW — Machine Woodworking, Hunt and Armak, Harlow Publishing Co., P. O. Box 898, Norman, Oklahoma 73070

PU — Practical Upholstering, John W. Stephenson, Hall Publishing Co., 230 Fifth Ave., New York, N. Y. 10001

Re-U — Upholstering and Re-Upholstering, Clyde A. Criswell, Frederick J. Drake and Co., 7312 N. Ridgeway Ave., Skokie, Illinois 60076

TTMS — Teachers Textbook of Machine Sewing, The Singer Company, 30 Rockefeller Plaza, New York, N.Y. 10020

HOW TO USE THIS STUDY GUIDE AND RECORD OF PROGRESS

The student's record of progress is kept on the Trade Analysis and Progress Record page. Progress "on-the-job" is kept in the column headed "Job Progress", and related study progress is kept in the adjoining column headed "Related Study".

The four step method of training is used in developing the skills of a trade or occupation. A record of all these steps for each job is kept in the squares in the column below "Learning Status" (Steps), opposite a specific job.

A dot in the center of the square indicates a student is in the first step; that of observing the job being done. No other mark is made in this square as long as the student remains in this step.

A diagonal line across the same square indicates the student is in the second step; that of helping perform the job under instruction.

Two diagonal lines across the same square indicates that the student is in the third step; that of doing the job under supervision.

The square filled in solid indicates that the student has reached the fourth step; that of a satisfactory level of accomplishment. The date when this accomplishment has been reached is placed in the column "Date Objective Reached", opposite the specific job.

On the day the student has read all the references and has written the answers to all of the questions, for a specific job, the student places this date in the column headed "Date Completed", opposite this job. The grade made on the test on this job is entered in the adjoining square headed "Test Grade".

The word "Information" will be found in the "Job Progress" column for all information lessons. When all references have been read and all answers to the questions have been written, for a specific information lesson, the student places the date of completion in the "Date Completed" column, opposite this lesson number. The grade made on the test on this lesson is entered in the square headed "Test Grade".

TRADE ANALYSIS AND PROGRESSION RECORD

Furniture Upholstery and Repair

NO.	JOBS AND INFORMATION LESSONS	JOB PROGRESS		RELATED STUDY	
		Learning Status (Steps)	Date Objective Reached	Date Com-pleted	Test Grade
	UNIT I - HISTORY OF FURNITURE				
1	Egyptian-Spanish Renaissance Period	Information			
2	Tudor-Sheraton Period	Information			
3	Louis XIV-Modern Period	Information			
	UNIT II - TOOLS AND EQUIPMENT				
4	Using Upholstery Materials				
5	Using Upholstery Tools				
6	Using Upholstery Equipment				
7	Conditioning a Sewing Machine				
8	Common Causes of Machine Trouble	Information			
9	Caring for Sewing Machine				
	UNIT III - SPRINGING UP				
10	Webbing Furniture				
11	Determining Number and Size of				
	Springs				
12	Placing and Fastening Springs				
13	Tying Springs				
14	Attaching Wire to Spring Edge				
15	Attaching Burlap				

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Furniture Upholstery and Repair

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		Learning Status (Steps)	Date Objective Reached	Date Com-pleted	Test Grade
	UNIT IV - BODY WORK				
16	Making Roll Edge				
17	Making Stitched Edge				
18	Making a Pillow Edge				
	UNIT V - STUFFING				
19	Filling or Stuffing				
20	Filling for Simple Pad Parts				
21	Making Double Stuffed Pad Backs				
22	Filling Overstuffed Pad Parts				
23	Filling Cushions by Hand				
24	Making and Filling Down and Feather				
	Filled Cushion Casing				
	UNIT VI - COVERS				
25	Planning and Cutting Covers				
26	Machine Sewing of Covering				
27	Sewing				
28	Putting on Covers				
29	Planning and Measuring Covering				
30	Making Slip Covers				
31	Making Fabric Skirts				

TRADE ANALYSIS AND PROGRESSION RECORD

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NO.	JOBS AND INFORMATION LESSONS	JOB PROGRESS		RELATED STUDY	
		Learning Status (Steps)	Date Objective Reached	Date Com-pleted	Test Grade
	UNIT VII - TUFTING AND BUTTONING				
32	Tufting Furniture				
33	Making Pleated Buttoning				
34	Buttoning Circular Backs				
35	Tufting Spring Backs				
36	Tufting Spring Seats				
37	Tufting Iron Back Pieces				
38	Piping Furniture				
39	Upholstering Round Arm and Round				
	Back Furniture				
	UNIT VIII - PANELING AND TRIMMING				
40	Attaching Loose Wood Panels				
41	Blind Tacking Outside Coverings				
42	Banding				
43	Cording and Lining				
44	Gimping				
	UNIT IX - TYPICAL JOBS				
45	Upholstering a Stool				
46	Upholstering Chairs				
47	Upholstering Headboards				

TRADE ANALYSIS AND PROGRESSION RECORD

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NO.	JOBS AND INFORMATION LESSONS	JOB PROGRESS		RELATED STUDY	
		Learning Status (Steps)	Date Objective Reached	Date Com-pleted	Test Grade
48	Upholstering a Chaise Lounge				
49	Handling Leather				
50	Repairing and Polishing				
	UNIT X - OLD FINISH				
51	Learning Brief History of Finishing	Information			
52	Equipping Finishing Room				
53	Removing Varnish				
	UNIT XI - NEW FINISH				
54	Selecting Finishing Materials				
55	Stains	Information			
56	Fillers	Information			
57	Refinishing				
58	Choosing First Coats				
59	Surfacing First Coats				
60	Understanding Second Coats	Information			
61	Surfacing Second Coats				
62	Finishing Coats				
63	Finishing Troubles	Information			
	UNIT XII - SPECIAL JOBS				
64	Repairing Deep Scratches				

TRADE ANALYSIS AND PROGRESSION RECORD

Furniture Upholstery and Repair

NO.	JOBS AND INFORMATION LESSONS	JOB PROGRESS		RELATED STUDY	
		Learning Status (Steps)	Date Objective Reached	Date Com-pleted	Test Grade
65	Patching Scratches				
66	Spraying Scratches				
67	Removing Packing Marks				
68	Spraying for Packing Marks				
69	Frenching Out Packing Marks				
70	Refinishing Rubbed Places				
71	Filling Indentations in Finish				
72	Removing Water Marks				
73	Removing Stains				
74	Glazing and Shading Paint				
75	Dusting for Antique Effect				
76	Stipple Glazing				
77	Crackling Finish				
78	Frosting				
	UNIT XIII - WOODWORKING				
79	Using a Circular Saw				
80	Observing Safety Rules with Saws				
81	Ripping and Sawing to Length with				
	Circular Saw				
82	Cutting Rabbets on Circular Saw				
83	Sawing Bevels and Angles				

TRADE ANALYSIS AND PROGRESSION RECORD

Furniture Upholstery and Repair

NO.	JOBS AND INFORMATION LESSONS	JOB PROGRESS		RELATED STUDY	
		Learning Status (Steps)	Date Objective Reached	Date Com-pleted	Test Grade
84	Using Dado Head, Grooving Saws				
	and Moulding Head				
85	Using Band and Jig Saws				
86	Applying Glue				
87	Operating Sanders				

TRADE ANALYSIS AND PROGRESSION RECORD

Furniture Upholstery and Repair

NO.	JOBS AND INFORMATION LESSONS	JOB PROGRESS		RELATED STUDY	
		Learning Status (Steps)	Date Objective Reached	Date Com-pleted	Test Grade
	UNIT I - HISTORY OF FURNITURE				
1	Egyptian-Spanish Renaissance Period	Information			
2	Tudor-Sheraton Period	Information			
3	Louis XIV-Modern Period	Information			
	UNIT II - TOOLS AND EQUIPMENT				
4	Using Upholstery Materials				
5	Using Upholstery Tools				
6	Using Upholstery Equipment				
7	Conditioning a Sewing Machine				
8	Common Causes of Machine Trouble	Information			
9	Caring for Sewing Machine				
	UNIT III - SPRINGING UP				
10	Webbing Furniture				
11	Determining Number and Size of				
	Springs				
12	Placing and Fastening Springs				
13	Tying Springs				
14	Attaching Wire to Spring Edge				
15	Attaching Burlap				

TRADE ANALYSIS AND PROGRESS RECORD

Furniture Upholstery and Repair

NO.	JOBS AND INFORMATION LESSONS	JOB PROGRESS		RELATED STUDY	
		Learning Status (Steps)	Date Objective Reached	Date Com-pleted	Test Grade
	UNIT IV - BODY WORK				
16	Making Roll Edge				
17	Making Stitched Edge				
18	Making a Pillow Edge				
	UNIT V - STUFFING				
19	Filling or Stuffing				
20	Filling for Simple Pad Parts				
21	Making Double Stuffed Pad Backs				
22	Filling Overstuffed Pad Parts				
23	Filling Cushions by Hand				
24	Making and Filling Down and Feather				
	Filled Cushion Casing				
	UNIT VI - COVERS				
25	Planning and Cutting Covers				
26	Machine Sewing of Covering				
27	Sewing				
28	Putting on Covers				
29	Planning and Measuring Covering				
30	Making Slip Covers				
31	Making Fabric Skirts				

TRADE ANALYSIS AND PROGRESSION RECORD

Furniture Upholstery and Repair

NO.	JOBS AND INFORMATION LESSONS	JOB PROGRESS		RELATED STUDY	
		Learning Status (Steps)	Date Objective Reached	Date Com-pleted	Test Grade
	UNIT VII - TUFTING AND BUTTONING				
32	Tufting Furniture				
33	Making Pleated Buttoning				
34	Buttoning Circular Backs				
35	Tufting Spring Backs				
36	Tufting Spring Seats				
37	Tufting Iron Back Pieces				
38	Piping Furniture				
39	Upholstering Round Arm and Round				
	Back Furniture				
	UNIT VIII - PANELING AND TRIMMING				
40	Attaching Loose Wood Panels				
41	Blind Tacking Outside Coverings				
42	Banding				
43	Cording and Lining				
44	Gimping				
	UNIT IX - TYPICAL JOBS				
45	Upholstering a Stool				
46	Upholstering Chairs				
47	Upholstering Headboards				

TRADE ANALYSIS AND PROGRESSION RECORD

Furniture Upholstery and Repair

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TRADE ANALYSIS AND PROGRESSION RECORD

Furniture Upholstery and Repair

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Furniture Upholstery and Repair

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	and Moulding Head				
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NAME_____ OCCUPATION_____ AGENCY_____

STUDENT'S DAILY RECORD

Date	List the Job Numbers Performed the Previous afternoon	List the References Read in the Related Class by Symbols and Pages	List the Number of the Job Studied Today

Job 1

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Egyptian-Spanish Renaissance Period		FFFDP pp 21-46	

1. Why should an upholsterer study furniture eras and history?
2. What peoples were the first makers of furniture?
3. List briefly the different periods that influenced furniture designing.
4. Name some cabinet makers who have influenced furniture styling.
5. What was the belief of the wood carvers and painters during the Egyptian period?
6. How were colors mixed during the Egyptian period?
7. From what were brushes made?
8. What materials were used by the Greeks in furniture manufacture?
9. What woods were used by the Romans in furniture manufacturing?
10. What period influenced design in church and Lodge furniture design?
11. Why is Gothic furniture symbolic of Christianity?
12. List some of the distinguishing characteristics of Renaissance design.
13. What two types of chairs were used in early Spanish era?
14. How were seats upholstered during this era?

Job 2

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Tudor-Sheraton Period		FFFDP pp 47-86	

1. During what period did oak become most acceptable for furniture manufacturing?

2. What was the style of chairs in the Jacobean era?

3. Why was the Jacobean period of particular importance to us of modern times?

4. What radical change in furniture was observed in the William and Mary period?

5. How did Queen Anne chairs differ from those of earlier periods?

6. What period was recognized as the Golden Age of English furniture?

7. Give the name and date of the first furniture catalogue published.

8. For what is Chippendale best recognized?

9. What wood did Chippendale use for most carvings?

10. List some characteristics recognized in Hepplewhite chairs.

11. (a) To which of the Adam brothers is the Adam style attributed?
    (b) What in our present-day language originated with him?

12. Why was Sheraton known as the "Chaste designer"?

Job 3

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Louis XIV-Modern Period		FFFDP pp 87-118b	

1. How was Louis XIV's disposition displayed in furniture designing of that period?
2. What materials were used in upholstering during Louis XIV period?
3. What was the design of Louis XV chairs?
4. How did Louis XV and XVI styling differ?
5. Briefly describe furniture characteristics of "Directoire" period.
6. What were the three stages in the development of American Colonial style?
7. What predecessors did Duncan Phyffe copy after?
8. What were some of our modern-day features used in American Empire styling?
9. What brought about a reaction in furniture designing during middle of 19th century?
10. What furniture tragedy occurred with the advent of machine made furniture?
11. Briefly sum up the characteristics of modern furniture.

Job 4

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Using Upholstery Materials		EMU 144-153	

1. Where was burlap originally made?
2. Name three modern materials used in upholstery.
3. What material is used for upholstery webbing?
4. What are the standard widths of webbing?
5. How are the grades of burlap determined?
6. How many yards of burlap are in a bolt?
7. Where is light denim used in upholstery work?
8. Give the widths of unbleached muslin.
9. Cambric is made from what material?
10. Burlap and webbing are made from what fiber?
11. Where is cotton felt used in upholstered furniture?
12. Name two states where moss is picked commercially.
13. How is the grade of moss determined?
14. What is the source of hair used for upholstery filler?
15. Explain how hair is cleaned.

Job 5

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Using Upholstery Tools		EMU 1-3	

1. Upholstery shears should be of what quality and length?
2. Describe the webbing stretcher.
3. Of what use is the upholsterer's pin or skewer?
4. The upholsterer's pin helps the upholsterer in what way?
5. For what is the ripping tool used?
6. Of what use are the large, heavy curved needles?
7. Straight upholsterer's needles are of what length?
8. For what is the straight upholsterer's needle used?
9. Why is the straight needle double-pointed?
10. What is used to even out irregularities in stuffing?

Job 6

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Using Upholstery Equipment		EMU 3-8	

1. What may be used instead of benches or trestles?

2. Describe a good trestle.

3. Name the different types of button molds.

4. The button machine can be used for attaching several items. Name some of them.

5. Is the operation of a button machine simple or complicated?

6. Why is the padding or rolled edge necessary on trestles?

7. Give the length, width, and height in which trestles are usually made.

8. Of what construction should the sewing machine be when used for sewing upholstery covering?

9. Why should sewing over welt seams be done slowly?

10. For what type sewing is a zipper foot necessary?

Job 7

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Conditioning a Sewing Machine		MS pp 9-17	

1. (a) What is meant by stop-motion?
   (b) What is its purpose?

2. (a) How should the bobbin be wound?
   (b) How can thread be made to wind straight on bobbin?

3. How is pressure increased on the bobbin winder?

4. What size needle and thread is necessary for (a) heavy upholstery fabrics, (b) denim, (c) muslin?

5. How is the needle placed in the needle clamp?

6. How is proper tension determined?

7. How is the tension adjusted?

8. (a) Why is it sometimes difficult to tighten the under-tension?
   (b) How can it be corrected?

Job 8

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Common Causes of Machine Troubles		MS pp 27-29	

1. List some causes of upper thread breaking.
2. What causes skipping stitches?
3. What causes loop stitches?
4. How may loop stitches be corrected?
5. What are some causes of machine not feeding properly?
6. What often causes machine to work heavily?
7. When lower thread breaks what causes may be looked for?
8. How can machine operator avoid breaking needles? (Name several.)
9. Why should material not be pulled to one side when removing from machine?
10. Why is it most important never to use a needle that is too long?
11. What can cause puckered seams?
12. (a) What causes a noisy treadle?
    (b) How can this be corrected?

Job 9

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Caring for Sewing Machine		MS pp 22-26	

1. What care should be given to a sewing machine that is used continuously?
2. What should always be done before oiling?
3. What equipment is necessary for the proper cleaning of the machine?
4. What points should be oiled?
5. Why is it poor economy to use oil of doubtful quality?
6. Briefly outline the steps necessary in oiling the machine head.
7. How is the belt released?
8. How is surplus oil removed after oiling?
9. Why is it important to oil the bobbin winder?
10. What precaution should be observed after oiling bobbin winder?
11. What must be done if rubber ring is softened by oil?
12. How is gummed oil removed?
13. How is a belt replaced?
14. How is a belt shortened?
15. Why should a new belt be applied tighter than an old one?

Job 10

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Webbing Furniture		Re-U 67-69 PU 31-32 EMU 9-13	

1. How is the amount of webbing to be used determined?

2. On davenports and chairs with a spring-edge seat, it is advisable to do what?

3. For upholstered pieces which have the ordinary hard or stitched edge, how far are the springs placed from the frame?

4. Upon what two points does the durability of the entire seat depend?

5. What is the most familiar type of webbing?

6. What type of webbing comes in rolls from 25 to 1000 feet in length?

7. Why is Jute webbing always woven?

8. When using steel strapping, what tool can replace the special type webbing stretcher?

9. Give two reasons why webbing is tacked to the front and stretched to the rear when possible to do so.

10. What determines the size tacks to be used?

Job 11

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Determining Number and Size of Springs		PU 33-39 EMU 165-168	

1. Why are spring tips bent down?

2. Upholstery springs for seats are made of what gauge wire?

3. Placing of the webbing is governed by what?

4. Pillow springs are made of what gauge wire?

5. Pillow springs are always used in what part of the furniture?

6. What is the principal object of placing springs?

7. Inner-cushion spring units are popular on what kind of furniture?

8. Why are construction springs primarily used by manufacturers of upholstered furniture?

9. Heavy springs are always used in what part of the furniture?

10. If you are unable to get precisely the correct spring size, what would be your next step?

11. For most seat applications the top of the center springs should not be higher than_____?

12. What is the single, most important factor in the final form of the seating section?

13. Name two major methods or systems of tying.

14. Sometimes, when coil units are installed over a solid base, the spring makes noise. How can this be eliminated?

15. Non-sagging springs are made of what gauge wire?

Job 12

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Placing and Fastening Springs		PU 39-41 EMU 15-19	

1. On open springs, one end or tip is bent toward the center. When the spring is in place, where should this end be?

2. Why is the tip bent down on the open springs?

3. What care should be taken before tying the springs?

4. Why must care be taken when fastening springs to webbing?

5. When the springs are placed in their proper positions, what is the next step?

6. Name one method of fastening springs to webbing.

7. Why must the spring be sewed down tight?

8. Name the tools and equipment needed for fastening springs to webbing.

9. What materials are used in fastening springs to webbing?

10. How will the position of the springs be determined?

11. How many stitches are used for each spring?

Job 13

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Tying Springs		EMU 18-25	

1. What is the next step after springs have been fastened in position?

2. Upon what does the life of furniture depend?

3. Name the tools used in tying down springs.

4. Name the materials used in tying down springs.

5. How many inches of twine should be allowed over in the first row of springs for round and stuffed seats?

6. For flat seats where loose cushions are used, how much twine is required?

7. In cutting spring twine, how many pieces should be cut?

8. What is the purpose of placing two slip tacks, 1/2 inch apart in line with each row of springs?

9. On what type seats is return twine not used?

10. Why is return twine knotted?

11. Why is a spring edge with a wire attached to the front popular?

12. What is the purpose of bending the top coils of the front springs outward, so that they will extend even with the outside of the frame?

13. Why is the twine fastened to the rear of the frame?

14. When the springs have been tied to the desired height, what is the next stop?

Job 14

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Attaching Wire to Spring Edge		EMU 27-28 PU 43-447	

1. In making a spring edge, why should the wire be bent to the proper shape before attaching it to the springs?

2. What is the reason for placing the wire edge to the exact shape of the frame?

3. Name the tools used in bending and fastening wire to spring edges.

4. Give the correct procedure for bending wire to a sharp corner.

5. What procedure is necessary for bending wire to a curve?

6. What is used for fastening wire to the springs?

7. For production work, what is used to fasten edge wire to the spring?

8. Give the reason for diagonal tying eight knots per spring.

9. After all springs have been completely tied down, what is the next step?

10. Name two ways of attaching edge wire.

Job 15

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Attaching Burlap		EMU 31-32 Re-U 31-32	

1. What may happen if the burlap is pulled too tight over the springs?

2. Name the tools used to attach burlap.

3. Name the materials used in attaching burlap.

4. What measuring must be done for burlap?

5. How large should the piece of burlap be cut?

6. What is meant by centering the frame and burlap.

7. What is the first step in tacking burlap?

8. In what form can muslin be obtained?

Job 16

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Making a Roll Edge		EMU 32-34 Re-U 33-34	

1. Why is a roll edge necessary?

2. What would result without a roll edge?

3. In making a roll edge on straight wood, what determines the width of burlap?

4. Why is the burlap turned straight with the threads?

5. When filling the burlap with stuffing, upon what does the amount used depend?

6. Gimp is a binding material used on the exterior. What purpose does it serve?

7. Name one of the most widely used under materials?

8. What is the weakest link in an upholstery job?

9. Lacing twine is made from what kind of material?

10. From what is tying and spring twine made?

11. Lacing twine can be purchased in what strength?

12. For production work, a roll edge can be purchased in what length?

13. When a manufactured roll edge is tacked to the frame, what precaution is taken?

14. When making a roll edge on curved wood, how should the burlap be tacked?

Job 17

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Making Stitched Edge		EMU 35-39 PU 57-69	

1. Why is forming the stitched edge important?
2. When the stitched edge has been formed, what is the next step?
3. What tools and equipment are used in making a stitched edge?
4. What materials are necessary for a stitched edge?
5. Why is burlap sewed straight with the threads?
6. What kind of needle is used on a first row stitch?
7. Explain why more than one row of stitches is used.
8. When is a stitched edge ready for attaching purchased?
9. Which is better, a stitched edge or a hand made edge?
10. To what is the inner edge of the stitched edge sewed?
11. Explain why precaution should be taken on the overhang.
12. When attaching a ready made stitched edge, where is the front part sewed?

Job 18

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Making a Pillow Edge		PU pp 71-75	

1. From what is the name "pillow edge" derived?

2. What precaution must be taken whenever tied twines drop to lower coils on edge springs?

3. How does the principle of stuffing to form a roll for a pillow edge differ from a stitched edge?

4. What are the best springs to use in back of chair in pillow upholstery?

5. How is utmost comfort obtained in pillow upholstering?

6. Differentiate between the pillow edge roll furniture and hard edge or ordinary spring edge furniture as to hardness.

7. How can best results be obtained in contributing to softness and pliability?

Job 19

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Filling or Stuffing		EMU 39-40	

1. What three items must be given careful attention when stuffing furniture?

2. Name three materials used in top covers.

3. Why is the stuffing drawn down to the desired shape and firmness while attaching the muslin cover?

4. Name the tools and equipment used in stuffing with muslin cover.

5. Name the materials listed in stuffing with muslin cover.

6. When 3/4 of the total amount of stuffing is spread evenly, for what purpose is the remainder used?

7. Why is the stuffing sewed down to the burlap?

8. Why is the tacking of the muslin started at the middle of each edge?

9. In many cases there is no edge roll, instead, the padding in several layers is counted upon for what purpose?

10. What is one of the most difficult jobs in any upholstery project?

Job 20

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Filling for Simple Pad Parts		PU pp 77-78	

1. Why should the hair in filling be kneaded into a compact mass?
2. How should cotton cloth be tacked to the frame?
3. Why are tacks which confine cotton kept to as near inside edge of frame as possible?
4. Why should care be exercised in tacking canvas and cotton?
5. How can concavity in shaped chairs be preserved?
6. Explain briefly how to pad an oval-backed chair.
7. Why should no strong pull be placed on cotton under covering?
8. Is it wise to blind-stitch the edges? Why?
9. How may this operation be carried out?

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Making a Double-Stuffed Pad Back		PU pp 103-105	

1. What is the (a) advantage, (b) disadvantage, of double-stuffing?

2. Explain the process of sewing and kneading the filling material to the first burlap.

3. To what is the burlap covering over the filling tacked?

4. Explain the stitching necessary to fasten both filling and second layer of burlap.

5. What filling material is generally used for the second filling?

6. What precautions must be taken in tacking on the muslin with regard to the frame and "wrinkles"?

7. How is muslin fastened at the bottom of the seat?

Job 22

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Filling Overstuffed Pad Parts		PU pp 107-109	

1. Why is it not advisable to web both back and seat at same time?
2. What part of the chair is completed first?
3. List the steps in upholstering seat of overstuffed chair.
4. Why should the spring edge be employed in connection with the formation of the cushion platform?
5. In double stuffing why is a high stitched edge not desirable?
6. List steps in upholstering seat of overstuffed chair.

Job 23

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Filling Cushions by Hand		EMU 85-88	

1. In repairing or recovering furniture cushions, what is the best way to make a cushion casing?

2. In repairing furniture why must the arms and back be stuffed as they were before?

3. What are the necessary tools and equipment for making cushions for over-stuffed furniture?

4. Name two ways of measuring the size for the cover.

5. Why should covering for cushion top and bottom be cut from same material?

6. Why is cushion top chalked?

7. Where welt is used around the cushion and between seams, how many strips are used and how wide are they?

8. Where is cotton felt placed in a cushion?

9. On striped material, the stripes on the front border must always do what?

10. In sewing the cushion together, what kind of needle is used?

11. In preparing a cushion for sewing, how are the seams held together?

Job 24

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Making and Filling Down and Feather Filled Cushion Casing.		EMU 70-72	

1. When feather and down filled cushions are desired for overstuffed chairs or davenports, for what purpose is an inner casing used?

2. Why should the inner casing be made with inner walls?

3. What material is used for making inner casing?

4. Why should the casing be made 1 inch larger than the outer cushion covering?

5. Name the tools and equipment used in making down and feather filled cushion casings.

6. When measuring size of casing, what is the widest part of a chair?

7. Name the first step in cutting casing to shape.

8. Explain why 1 inch is allowed in cutting a casing.

9. How many pieces of covering are used for the inner walls?

10. Why is it advisable to fill the front sections of the casing a little firmer than the middle and rear sections?

Job 25

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Planning and Cutting Covers		EMU 44-45	

1. Why should skillful planning be used when cutting material for furniture covering?

2. Why should one measure the width first?

3. What tools and equipment are used when planning and cutting covers?

4. Name the materials used for cutting covers.

5. Where should the pattern in the material be placed?

6. When the pattern is a medallion or any form of motif having a definite top and bottom, how must the pattern run?

7. Explain how pile fabrics, such as velour, mohair, velvet, etc., must be put on.

8. In cutting covering, why should large pieces be cut first?

9. What kind of material should be used for piecing under arms and backs?

Job 26

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Machine-Sewing of Coverings		EMU 45-46	

1. In sewing covering, why should 1/2 inch be left for seams?
2. Why is the wheel of a sewing machine sometimes turned by hand?
3. Explain how the gathering of material can be prevented?
4. Where stitching shows on plain material, what color thread is used?
5. Why should seams be properly sewed and thoroughly pressed?
6. When sewing pattern material, why should the pattern match?
7. What grade of covering requires a large stitch?
8. Name the tools and equipment used in machine-sewing upholstery coverings.
9. Name the materials used in machine-sewing upholstery coverings.

Job 27

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Sewing		MS pp 17-21	

1. What should be done just prior to placing material in machine?

2. What is the purpose of placing both ends of thread back under presser foot?

3. Why should edge of garment be placed just under the presser foot?

4. Why is it important that this precaution be observed?

5. Why should the presser bar be lowered before starting to sew?

6. What precautions are necessary when finishing a seam?

7. (a) What is the proper way to remove material from machine?
   (b) Why?

8. Why should material always be kept at left of presser foot?

9. Explain how to sew a bias edge to a straight edge.

10. How can a machine be tested for straight sewing?

11. What is a cloth guide?

12. How is the guide used?

13. What determines the length of the stitch?

14. What type stitch, needle and thread are used for the following:
    (a) fine material?
    (b) heavy material?

15. How many stitches per inch are desirable for ordinary sewing?

16. How can stitches be counted where stitch length is not shown?

Continued....

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Sewing			

17. How are some machines equipped for lengthening or shortening stitches?

18. (a) When should reverse feed be used?
    (b) Why?

19. Why should the pressure on the presser bar be regulated according to the fabric to be stitched?

20. What is the result of too heavy a pressure?

21. What rule should be learned regarding pressure?

Job 28

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Putting on Covers		EMU 47-49	

1. Name three items that must receive attention when covering furniture.

2. What tools and equipment are needed for putting on covers?

3. Name the materials used for putting on covers.

4. Explain the procedure of centering the cover with the frame.

5. How are wrinkles avoided in covering?

6. What type of needle is used for sewing the pleat shut with twine?

7. How should the pleats lay in a square corner?

8. How should the pleats lay in rounded corners?

Job 29

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Planning and Measuring Covering		EMU 41-45	

1. Name the materials used in soft coverings.
2. What type covering and colors are used when a chair will receive a lot of use?
3. What patterns are most favored for upholstering modern pieces of furniture?
4. How should the welt be cut for narrow striped material?
5. In selecting pattern material, from what is welt frequently made?
6. Explain how covers are measured for size.
7. Why is the cutting of furniture covering important?
8. What pieces of the covers are usually cut first?
9. Where is the pattern in the material placed?
10. Explain how pile fabrics are put on.
11. Where certain portions of seats, backs, and arms meet how should covers be cut?

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Making Slip Covers		PU pp 7-11	

1. What is the purpose of slip covering?
2. What is one of the first requisites in making slip covers?
3. Explain how to measure a chair for slip covering.
4. What amount of material should be allowed at each point for seams?
5. How is the material for sides calculated?
6. How is the final amount of material for a chair determined through procedure outline in Nos. 4 and 5 above?
7. What is the best way to cut covers for slip-covering?
8. What is the advantage of cutting "right on the job"?
9. How much material is allowed for tucking in at junction between seat and back?
10. What consideration to pattern is necessary to slip covers?
11. How are the seam allowances at the corners treated?
12. How are the edges at tuck-away treated?
13. What methods other than sewing may be used for fastening slip covers?
14. Where should opening be for (a) chairs having back wider at top than bottom, (b) all others?
15. How is surplus material disposed of on round edges?
16. How should pleats over two inches in length be handled?
17. How much material should be allowed as a tuck-away for stuff-over furniture?
18. How may elaborate effects be gained in covering seams?

Continued.....

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Making Slip Covers			

19. What precaution is necessary in the use of zipper fasteners?

20. What is conducive in making a neater job in the uses of slip covers?

21. How are tacking strips conducive to a neater job?

22. What other method may be used instead of tacking strips to obtain a tailored fit?

23. What is the purpose of a loosely filled roll?

24. What are the primary requirements in making slip covers?

Job 31

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Making Fabric Skirts		EMU 89-98	

1. Name the types of furniture on which a fabric skirt is very popular.

2. How many types and styles of popular fabric skirts are made?

3. Name the four types of fabric skirts.

4. Why is the shirred skirt very popular?

5. Name the tools and equipment used in making fabric skirts.

6. What is the first step in attaching the shirred skirt?

7. Why are the covering pieces for box pleats cut in the same direction?

8. How are box pleats measured?

9. How is the welted skirts attached to the furniture?

10. In cutting the cover for the box pleats, how many pieces are cut?

11. Why are the pleats sewed down close to the top edge?

12. On what type furniture is the kick pleat skirt very popular?

13. Since the distance from corner to corner will vary, how is the kick pleat skirt joined together?

14. Before sewing pinned up pleats, what check should be made?

15. In attaching the skirt, how is the distance measured?

Job 32

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Tufting Furniture		EMU 79-83	

1. What care should be observed in tufting?
2. Name the filling used for tufting.
3. Which filling is the most difficult for the beginner to use?
4. Give the most popular shape in tufting.
5. Explain how the diamond shape is formed.
6. How is the size of the tuft determined?
7. Explain what is meant by cover allowance.
8. How is the size of the cover to be marked off for each tuft determined?
9. Explain how the width of the required piece of covering is determined.
10. When the coverings are not wide enough, what step should be taken?

Job 33

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Making Pleated Buttoning		PU pp 139-146	

1. How may the back of a pad-back chair be upholstered with deep buttoning?

2. Explain the laying-out process of canvas for a diamond-tufted chair back.

3. What is the button arrangement on the back of the chair?

4. How can time be conserved in covering chairs of identical form of buttoning?

5. How is the width of covering for back of pad-back chair determined?

6. How is covering marked off for back of pad-back chair?

7. How can the upholsterer economize on expensive material when covering front of chair back to lower rail?

8. What is an exception to Question 7?

9. How is the fabric arranged so that distinct pipes from bottom to the seat are formed?

10. If fabric is slightly slack after buttons are pulled down, what corrective measure may be taken?

11. How are arms canvased and marked off?

12. After covering for arms has been cut and marked and buttoned into place, give procedure for installing cover.

13. How is the fabric handled where the arms and back meet?

14. How is the front of the arm treated?

15. How may buttoning variations be obtained on high-back chairs?

16. What factor in material controls amount of fullness that should be allowed in chair backs?

17. How are chair backs that are wider at top than bottom measured for covering?

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Buttoning Circular Backs		PU pp 149-150	

1. What is the difference between circular-back and flat-back chair?
2. What is used as a bottom rail on circular-back chairs?
3. What is the advantage in the use of wire as a bottom?
4. How is the heavily over-stuffed top appearance provided?
5. When using very soft upholstering material, what remedy can be used to draw fullness into a crevice?
6. How does this twine assist?
7. How can wrinkling be avoided where a more heavily over-stuffed pillow is used if made in leather?
8. Though economy should be practiced, how should the fabric be cut and sewn in joining individual pieces?

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Tufting Spring Backs		PU pp 153-157	

1. Give briefly the steps required for tufting spring-back chairs when using a combination of buttoning with a resilient spring foundation.

2. What are the two (2) methods that may be used for tying where burlap is supported by springs?

3. Describe briefly how to use the (a) curved, and (b) double-pointed straight needle in tying.

4. What is the advantage of turning under all the edges when the chair is upholstered in cotton to be covered afterwards?

5. What is the purpose in using a pad stuffed with tow or other inexpensive filling on spring-back chairs?

6. What are the final steps in upholstering spring-back chairs?

7. (a) If springs on top and arms of chair are not used, how may a built-up effect be gained?
   (b) What is the disadvantage of dispensing with springs?

Job 36

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Tufting Spring Seats		PU p 159	

1. What is the advantage of tufting in extremely soft seats?
2. Name three types of tufting.
3. How can more substantial seats be provided?
4. What allowance is usually made for tufting seats?
5. When is it necessary to blind-stitch pleats into place on the edges of seats?
6. What makes tufting seats a job for skill and dexterity?

Job 37

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Tufting Iron Back Pieces		PU pp 161-168	

1. What are the distinguishing factors in Turkish iron back pieces?
2. In what manner are springs attached to chair?
3. What are the requisites to the installation of burlap to the frame?
4. What is the purpose of the pad?
5. How is the seat pad installed?
6. How are pillow springs tied?
7. What are steps for covering springs with burlap?
8. When is double-stuffing used?
9. Give a synopsis of forming a wire-back frame.
10. (a) What type of wire can be used?
    (b) Which is most satisfactory? Why?
11. How are steel wires tied?

Job 38

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Piping Furniture		EMU 73-78	

1. Piping or "fluting" is extensively used on what type chairs?
2. Why does piping give upholstery a comfortable hollow shape for the back?
3. What tools and equipment are used in piping?
4. What materials are used in piping?
5. When piping, how many pieces of covering are cut?
6. What method can be used to make all pipes of equal firmness?
7. Explain the finishing of the top of the end pipe.
8. What is the first step in stuffing the pipes?
9. On what type pipes will it be necessary to taper the cotton felt on the bottom?

Job 39

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Upholstering Round-Arm and Round Back Furniture		EMU 52, 55-56 Re-U 55-56	

1. How are larger round arms and backs usually finished?
2. Name the tools and equipment used in round arm upholstery.
3. Why should a few tacks be driven through the covering between each pleat?
4. How are the smaller round arms and backs frequently finished?
5. Name the four main types of backs.
6. Explain the right procedure taken in re-covering a spring curved back.
7. Name the four types of top edges for backs.
8. Why is a wooden edge sometimes left?
9. Why have many types of padded arms been outmoded?
10. For outdoor furniture, what kind of stuffing is used in a padded arm rest?
11. Name one of the most frequent points of upholstery wear in an automobile.
12. What is the diameter of the largest round fiber or hair roll?

Job 40

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Attaching Loose Wood Panels		EMU 52-54	

1. Name the material used in making panels.
2. Why is it a mystery to most people how the panels are covered and attached?
3. Name the tools and equipment used in wood paneling.
4. How much larger should the covering be than the wood panel?
5. When cutting covering for welt, how wide should it be?
6. What is the first step in making welt for panels?
7. How are wood-covered panels attached to the arms?
8. What is used to trim a wood panel?

Job 41

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Blind Tacking Outside Coverings		EMU 63-69	

1. Explain what is meant by blind tacking.
2. Why is the outside piece of covering centered with the frame?
3. How far apart should the tacks be when tacking the cover to the top edge?
4. Why should a piece of cardboard be tacked over the tacks?
5. Name the supplies used in blind-tacking coverings.
6. For what purpose are metaline nails used?
7. Why should care be taken when driving metaline nails?
8. How is the distance determined in spacing metaline nails?

Job 42

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Banding		PU pp 257-258	

1. What is meant by bands?

2. What is the purpose of their use?

3. Name the main classes of bands.

4. Describe how each of the following is accomplished:
   (a) Shirred, (b) pleated, (c) buttoned.

5. When making a pleated band, how much space should be left between pleats? Why?

6. What is the purpose of the marks on the edge of seat and frame when accomplishing the buttoned band?

7. (a) With what are pleated bands stuffed?
   (b) How much stuffing is required?

8. How is a loose and soft appearance gained in stuffed-pleated bands?

9. How does the buttoned band differ in stuffing from that of the pleated band?

10. What type of stitching should be used on stuffed bands? Why?

11. How does the herring-bone band differ from the buttoned band?

Job 43

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Cording and Lining		PU pp 259-262	

1. What is the purpose of applying cord?
2. How is the cord applied where any considerable amount of wear is necessary?
3. When cutting cord with scissors why should the ends be wrapped?
4. How may the stitched twine be fastened?
5. How is cording attached to the upholstery?
6. What care must be practiced in attaching cord?
7. What two things are necessary when a cord has to follow a curved line?
8. Why is it unnecessary to sew cords in deep recesses or scallops?
9. Why should care be taken to make sure that all ends are securely fastened?
10. What are the steps required in the lining of a chair?
11. How is the lining attached to furniture having a curving, circular, irregular shape?
12. Why is it well to insert a filling between inside upholsterin and the lining of better class furniture?
13. What steps are usually performed where a filling material is used?

Job 44

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Gimping		EMU 67-69 169-170	

1. For what purpose is gimp used on furniture?
2. Name the three methods of attaching gimp to furniture.
3. Why should one be careful when tacking gimp with gimp tacks?
4. On straight lines, how far apart should gimp tacks be placed?
5. What is meant by staggered tacks?
6. Why should gimp be tacked on the outer and inner edge?
7. How should gimp tacks be placed on corners?
8. Why should care be taken in gluing on gimp?
9. Name the materials used for gimping.
10. Why is gimp made in many colors and materials?
11. From what kind of material is gimp made?
12. Why should cotton gimp never be used on silk, nylon or rayon coverings?
13. Gimp may be purchased in various weaves. Name the most popular.
14. Why is the scroll gimp most popular where glue is to be used?

Job 45

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Upholstering a Stool		EMU 109-112	

1. Describe the filling used in a stool.
2. How do you sew upholstered corners when there is no sewing machine available?
3. Why is it advisable to cut each piece of lumber a little larger for the stool?
4. What is the first step in assembling the frame?
5. Why is a 1/4 inch hole bored through the flat side of each corner block?
6. Where are the four corner blocks attached?
7. When cutting the top filler how many inches should be cut?
8. Why is a 1/2 inch left for overhand around the board top?
9. When cutting the cover how many inches should be cut?
10. How much space is left for seams, while sewing the four corners?
11. Where is the cover tacked to the stool?
12. Where are the four iron plates permanently attached?

Job 46

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Upholstering Chairs		FFFDP 511-513 PU 111-119	

1. Name the types of wood used for suite chairs.
2. What is the cheapest way to finish a chair made of birch, beech, or elm?
3. Explain the purpose of thinning asphaltum varnish.
4. Name the types of wood used for utility enamel chairs.
5. What type wood is best for a mahogany finish?
6. Why should a special varnish or lacquer be used on church and lodge furniture?
7. What is the most common characteristic of barrel-chairs?
8. What condition simplifies the task of applying burlap?
9. What is the second step in upholstering a barrel-back chair?
10. What is a normal allowance for pipe fullness on a flat chair back?
11. Why must each pipe be calculated separately?
12. For what purpose is a packing stick used?
13. Explain why each seam is drawn into the crevice between the stuffed pipes.
14. How should the height of each pipe division be measured?

Job 47

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Headboard Upholstering		EMU 129-135	

1. On what type bed frames are headborads extensively used?
2. Give the width of the twin size bed.
3. What width is the full size bed?
4. What is the most appropriate type of cover for headboards?
5. Name some suitable woods for headboards.
6. Give the dimensions of the twin-size headboard end post.
7. What is used to hold the corners when they are joined together?
8. Why is it advisable to cut each piece of lumber a little larger than the exact size given in the bill of materials?
9. How much welt strip is used when covering twin-size headborads?
10. Why should the filler be cut larger than the frame?

Job 48

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Upholstering a Chaise Lounge		PU pp 235-242	

1. What must be considered when upholstering a chaise lounge?
2. How is the lower band increased in width?
3. How is nosing applied?
4. What is the down-proof bag?
5. What is the purpose of the two bands back-tacked behind the nosing on frame?
6. How is the back prepared for springs?
7. When is it best to place roll around the bottom of the back?
8. How should the stitching twine used for buttoning be sewn?
9. (a) What are French knots?
   (b) Why should they be used instead of buttons?

Job 49

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Handling Leather		PU 175-178	

1. What practices of upholstering should a qualified craftsman be able to handle?

2. What is the most outstanding characteristic of leather covered furniture?

3. Name one of the most important considerations in building upholstered furniture.

4. What danger is there in notching leather down to the corner blocks?

5. Where leather is employed, how should seat surfaces be built?

6. Explain why care must be taken in upholstering a scoop-seated arm chair.

7. What is the most important fact in the preliminary stages of upholstering leather?

8. Explain why the appearance of the finished stitched edge is important.

9. What is the purpose of long stitches?

10. How much material is left for seams in fitting the cover?

Job 50

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Repairing and Polishing		PU pp 269-272	

1. How may material and time be saved in upholstering certain pieces of furniture?

2. Briefly give steps for replacing webbing without removing seat cover.

3. Why should springs be tied down while webbing is being installed?

4. When is it more economical to strip the entire chair and build the seat again?

5. When contour of seat needs restoring, what is the best procedure for this operation?

6. How may glue joints be repaired without the aid of clamps?

7. What care should be taken in using glue around finished wood?

8. Is it better to use little or much glue with wood joints? Explain.

9. Why should upholstery repair not be done until all woodwork has been thoroughly repaired?

10. In cases where one leg of a chair is slightly shorter than the other three and casters are to be used, what is the best method of leveling?

11. Describe a simple method of determining amount to be cut from bottom of leg.

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Brief History of Finishing		FFFDP pp 121-125	

1. Give earliest mention of paint material.
2. Evidence of art of painting was found in King Tutankhamen's tomb. How long ago was that?
3. How long before Christ was paint used?
4. When was painting fully developed?
5. How old is the Dutch process of making white lead?
6. When was the Dutch lead process patented? Where?
7. Who discovered the use of zinc white? When?
8. How long ago was lampblack used? By whom was it used?
9. Who discovered aniline? When?
10. Who discovered Prussian blue? When?
11. How long has chrome yellow been in use?
12. In early days, what were waxes used for?
13. Formerly, how were finishing materials applied?
14. What were objections to using nitro-cellulose lacquer by early manufacturers?
15. How were clear lacquers first made?

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Equipping Finishing Room		FFFDP pp 144-150	

1. What is the first requisite in construction of a finishing room?
2. How should artificial lighting be arranged?
3. How should heating be arranged?
4. Why do lacquer or shellac require no special drying room?
5. Why should finishing rooms be of air-tight construction?
6. Upon what factor does the size of the finishing room depend?
7. Why should cabinets be constructed for use in finishing room?
8. Of what is "brush-keep" composed?
9. What safety precaution should be taken in the construction of finishing room and cabinets?
10. Why is the air scrubber a most important item with the spray gun?
11. What damage may result if oil or water gets in lacquer and shellac?
12. How may a simple scrubber be made?
13. What care should be given to construction of spray booth?
14. Why is the rubbing machine so useful in the shop?

Job 53

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Removing Varnish		FFFDP pp 223-226	

1. What is the most desirable material to use in removing varnish, lacquer, shellac or enamel?
2. What precaution should be taken to prevent injury to hands while using varnish remover?
3. Give a common formula for a varnish remover.
4. Why is it not advisable to use lye as a varnish remover?
5. List two ways of removing varnish from furniture.
6. How long should solvent be allowed to remain on furniture?
7. What care should be given to brushing on paint remover?
8. When should solvent be removed from wood?
9. How long should solvent stand on varnish or paint before being wiped off?
10. After using paint solvent, what type scraper should be used?
11. What other tools may be used to scrape off solvent besides steel scraper?
12. What caution must be used in scraping open-grained wood?
13. What is used to remove any wax that may be left on surface?
14. Why is it important to remove all traces of wax?
15. What operation should follow removal of solvent and scraping of surplus wax?
16. What grade of sand paper should be used in following scraping?
17. Why should great care be exercised in sanding? Why?

Job 54

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Selecting Finishing Materials		FFFDP pp 150-158b	

1. What is the first consideration with regard to stains?
2. Why are aniline stains in such wide use?
3. List the three types of aniline stains.
4. Which of the three types is the most desirable? Why?
5. What is desirable about non-grain raising stains?
6. Which of the non-grain raising stains are most important?
7. How may a green stain be produced from other colors?
8. Why is there objection to the general use of oil stains?
9. How are spirit stains usually sold?
10. How are shading stains made?
11. Why is shellac desirable as a first coater?
12. What precaution should be taken in purchasing lacquer thinner?
13. What are the primary colors?
14. List desirable features of synthetic varnishes.
15. How are synthetic varnishes prepared?
16. What advantages have synthetic-nitro-cellulose-lacquers?
17. What special care should be given to synthetic-nitro-cellulose-lacquers?

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Stains		FFFDP pp 159-173a	

1. What wood is commonly stained to match (a) walnut, (b) mahogany?
2. What care must be exercised if a cabinet has more than one kind of wood in the exposed surface?
3. Into what three classes are dyes divided that are made from coal tar distillation?
4. What are objections to using chemical stains?
5. How are pigment stains made?
6. What kind of stain should be used on furniture that is exposed to sunlight?
7. List two ways to apply oil stains.
8. What care should be taken when applying oil stains?
9. What results when insoluble aniline gets on surface?
10. What are advantages in using spirit stains?

Job 56

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Fillers		FFFDP pp 174-181	

1. Why is wood filler used?
2. What seems to be the most desirable quality of a filler?
3. What is required of a filler that can be dissolved by toluol or xylol?
4. Why should fillers be tested before use?
5. In what shades may fillers be obtained?
6. How may any desired shade of filler be made?
7. How may a crack filler be made?
8. For color darker than walnut, oak or mahogany, what may be used?
9. How may Silver, French or Kaiser gray oak finish be made?
10. How should filler be brushed on with regard to graining? Why?
11. What are disadvantages to filling carvings?
12. What materials are used in quick and slow drying?
13. What materials are used for wiping off excess filler?
14. How should strokes run in wiping off excess filler?
15. How long should filler be allowed to dry?
16. Why is it often necessary to fill oak and mahogany twice?

Job 57

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Refinishing		FFFDP pp 226-232	

1. List qualities of non-grain-raising stains.
2. What is the first consideration in refinishing old pieces?
3. What, to a large extent, governs choice of stains?
4. Does a new or old wood take stain darker?
5. If an old piece of wood has a new one attached, which should be stained first? Why?
6. How may checks be removed from varnish?
7. How may old surfaces be covered without removing varnish?
8. What is meant by the "turpentine test" for varnish?
9. How may wax be removed from a varnished surface?
10. Describe test for determining if a surface is lacquer.
11. What precautions should be taken in applying lacquer?
12. What is the best method of treating spirit aniline stain?
13. List three (3) wood bleaching preparations.
14. How should wood be treated after bleaching?

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Choosing First Coats		FFFDP pp 182-194	

1. What two general classes of first coaters are there?
2. List some materials coming under each of the two general classes.
3. Why don't the best flat whites contain lead?
4. How are colored lacquers produced?
5. What should be used as a first coater if furniture is to be finished in shellac finish and waxed?
6. What material should be used on natural finishes of any light wood?
7. What is used on dark finish?
8. Why shouldn't orange shellac be used over spirit stain?
9. What principal ingredients are found in first coat oil varnishes?
10. Why can't oil varnish coater or sealer be used successfully over oil stain without filler?
11. What is the rule for varnish finish?
12. What may result if too heavy a coat of shellac is used for a first coater?
13. What is the rule for transparent lacquer finish of satin lustre?
14. Where possible, why should first coaters be sprayed?
15. Why shouldn't shellac and lacquer be brushed?
16. What is the procedure for spraying shellac?
17. What is the usual alcohol formula?
18. Upon what two factors does distance of air gum from material depend?

Continued.....

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Choosing First Coats			

19. Why should care be exercised when coating flutes, grilles, mouldings, or ornaments?

20. What is meant by "four-pound cut" in shellac?

21. Why does shellac turn white?

22. What size brush should be used for applying shellac or any spirit varnish?

23. What is the rule for drying of shellac, spirit varnish, clear lacquers and lacquer enamels?

Job 59

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Surfacing First Coats		FFFDP pp 194-198	

1. What kinds of machines are used for sanding?
2. What is the approximate ratio of work done by men and a sanding machine?
3. What care must be exercised in using the machine?
4. What is meant by belt sanding?
5. How is the wheel sander used?
6. What disadvantage is there in wheel sanding?
7. How is the first coat hand-sanded?
8. How is finishing paper held?

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Understanding Second Coats		FFFDP pp 199-209	

1. Why is shellac inferior to lacquer as a coating material?
2. Why can lacquer be applied over shellac with a perfect knitting coat?
3. Why does shellac seem to give a good coating under a second coat?
4. How should shellac be applied if it is to be followed by spirit varnishes, lacquers, oil varnishes or enamels?
5. To be successfully applied, what must follow a first coat of oil varnish?
6. Should shellac be used over oil varnish?
7. If lacquer is brushed over a first coat of same, what may occur?
8. Why does spraying of lacquer give best results?
9. What care must be exercised in spraying?
10. What material gives an excellent coating for close-grain woods?
11. Give examples of close-grain woods.
12. What is the common name for finishes having a nitro-cellulose ingredient?
13. What should lacquer enamel be used over?
14. What is the purpose of a lacquer sealer?
15. List points in favor of lacquer sealer.
16. How should spraying of sealer coat be done?
17. When spraying, if a white appearance is seen, what should be looked for?

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Surfacing Second Coaters		FFFDP pp 209-211	

1. What kind of paper should be used in sanding a shellac or spirit varnish coat if another coat is to be applied?
2. What kind of finish is usually desired when shellac or spirit varnish is used as a two-coat finish?
3. If another coat of lacquer is desired after a second coat, how is it finished?
4. What care should be given in sanding on edges?
5. How can it usually be determined if enough sanding has been done?
6. Why is waterproof paper preferred over steel wool?
7. When may pumice stone FF and water be used for a second coat of lacquer material?
8. How are oil and pumice stone used?
9. What precaution must be observed in sprinkling pumice over wood surface?

Job 62

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Finishing Coats		FFFDP pp 212-222	

1. In surfacing enamel or varnish coats, on what coat is oil rubbing used? What is used for rubbing?

2. After preliminary sanding, what is used to rub shellac finish?

3. How should carvings and straight surfaces be rubbed?

4. What solvent is used to clean off pumice and oil?

5. On the last coat in dull finishing, why is oil used instead of water?

6. (a) How is a dull finish obtained on varnish?
   (b) Why must plenty of water be used?

7. How is a satin finish obtained?

8. What treatment should be given edges?

9. How should round surfaces be rubbed?

10. In rubbing, what two things must be mastered to insure good results?

11. What abrasives are used to secure extra fine, full or satin finish?

12. What coating takes the finest finish of any material? Why?

13. How is it determined if enough rubbing has been done?

14. (a) When is French polishing used?
    (b) What are the objections to French polishing?
    (c) How is French polishing done?

15. Briefly, how is rotten stone polishing done?

16. Where are flat coat materials used extensively?

17. Why are flat coat materials used?

Job 63

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Finishing Troubles		FFFDP pp 232a-232f	

1. When source of trouble in finishing is definitely located what two items should be checked?
2. If a coating goes bad in service, what may be done rather than remove coating?
3. What are the characteristics of bleeding in finishing?
4. Give an example of bleeding.
5. What is a non-bleeding color?
6. What causes blistering?
7. How does blushing show up on a finished surface?
8. What causes blushing?
9. How may blushing be prevented?
10. What causes chipping?
11. What conditions cause crawling of finish coat?
12. How does drying differ in spirit varnishes or lacquers and varnishes and oil enamels?
13. What usually causes pinholing?
14. When do runs or sags appear?
15. What remedy is offered for runs or sags?

Job 64

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Repairing Deep Scratches		FFFDP pp 403-408	

1. What is the worst type of scratch to refinish?
2. What is the best known material for filling deep scratches?
3. How is this material prepared?
4. What is "burning in"?
5. How is the cement knife used?
6. Why should the stiff-bladed knife be used where possible?
7. Why should great care be given to selection of proper colored cement?
8. What cement should be used when scratch has not approached stain and the finish is shallow?
9. Why is it always the policy to burn-in with transparent cement when possible?
10. What cement should be used when scratch is deep into stain and wood or several coats of finish?
11. How may cement colors be selected?
12. Briefly describe burning-in process for scratches.
13. How should cement be handled after placing in scratch?
14. List several "don'ts" for burning in.
15. Describe a method for smoothing a burned-in scratch.
16. Where necessary, how is rubbing of cement spots done?
17. How is cement surfaced for frenching?

Job 65

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Patching Scratches		FFFDP pp 398-401	

1. What are usual characteristics and causes of furniture scratches?
2. How is a light scratch sanded?
3. Why should oil be used in connection with finishing paper?
4. When spraying is to be done, what previous operations should be carried out?
5. What is best method to use on varnish or shellac surfaces after sanding?
6. Why is it difficult to use above method on lacquer surfaces?
7. What is necessary to match surrounding surface after scratch removal by French polishing?
8. Describe a method of dulling a patch to match surrounding surface.

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Spraying Scratches		FFFDP pp 401-403	

1. When should spraying be done in scratch-removal finish?
2. Why should same material be sprayed on finish as was formerly used?
3. What usually occurs if lacquer is sprayed on varnish?
4. Where doubt exists as to kind of finish, what should be done?
5. For a satin finish, what is a safe method for matching a spot to the rest of the surface?
6. If, after finishing, surface seems too dull, what may remedy this?
7. Why shouldn't steel wool be used on spots in conspicuous places?
8. What advantage is there in using 6/0 or 7/0 waterproof garnet paper on lacquer or varnish finish?
9. What care should be given to the use of the above paper?
10. How much time should be allowed for drying of: (a) lacquer and shellac (b) rubbing varnish?

Job 67

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Removing Packing Marks		FFFDP pp 388-389	

1. What usually causes packing marks on furniture?
2. Why is marking not so common now as in the past?
3. What special method of eliminating marks is employed by some manufacturers?
4. Describe method of removing shallow and deep marks.
5. If marks are through last coat of finish, what should be done?
6. Where only light rubbing seems necessary, what procedure should be followed?
7. If spot seems dull after rubbing, what should be done?
8. How may marks be removed if they are to be French polished?

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Spraying for Packing Marks		FFFDP pp 393-397	

1. On what type of furniture may spraying be used to remove packing marks?

2. What condition of the lacquer must exist before marking usually occurs?

3. Why should the cheaper type of finish not be rubbed with pumice and oil?

4. How should surface be prepared before spraying this type of furniture?

5. What equipment should be had in connection with spray gun to facilitate quick change of materials?

6. Why does a continuous stream hand-spray find good use in shop?

7. How should material be selected for spraying a patch?

8. If quick results are necessary, what process should be followed?

9. What precaution should be taken in selecting lacquer?

10. How may it be ascertained that nitro-cellulose is in a finishing material?

11. What preliminaries are necessary to good spot spraying?

12. What rule should be followed in manipulating spray gun?

13. Why may flat or semi-flat finishes appear?

14. In matching old finish, how may a desired sheen be obtained?

15. Why should great care be taken in spot-spraying over an unfilled surface?

16. What is the best method of spot-spraying?

Continued.....

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Spraying for Packing Marks			

17. Why is surfacing for spray patching so difficult?

18. What is the best material to use in rubbing spray patches?

19. After rubbing spot with pumice and it appears too dull, what should be done?

20. Why is it difficult to use steel wool for spot finishing?

21. Why should care be exercised in rubbing a lacquer patch sooner than 24 hours after patching?

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Frenching Out Packing Marks		FFFDP pp 382-383; 389-392	

1. Describe process for making a rubber (pad) for frenching.
2. How is frenching out of packing marks done?
3. How is rubber or pad best used for frenching?
4. Why should movements of rubber not be concentrated in the same spots?
5. Why should rubber not be stopped on surface or moved too slowly?
6. List some positive rules to follow in French polishing.
7. List some negative rules to follow in French polishing.

Job 79

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Refinishing Rubbed Places		FFFDP pp 416-417	

1. When only is it satisfactory to refinish a rubbed-through place?
2. What should be done when many rubbed places are seen or a great area of finish is rubbed off?
3. On rubbed spots, what preparations are made before frenching?
4. How should spots on a lacquered coat be treated if spraying is intended?
5. How is a spot stained before spraying lacquer?
6. On what surfaces should a spray be used for patching?
7. How are varnish and shellac surfaces most easily finished?
8. How should spray gun be handled in spraying rubbed-through spot?
9. What methods may be used to dull sprayed patches?
10. Why should care be taken in dulling spot with steel wool or pumice and oil?

Job 71

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Filling Indentations In Finish		FFFDP pp 413-415	

1. What is usually the nature and cause of indentations?
2. Where a dent is made in the finish only, what is the best method of removal?
3. If indentations are deeper than finish, should transparent cement be used? Why?
4. When should solid color cement be used?
5. How is colored cement selected for shade?
6. Describe method of filling an indentation.
7. How should cemented spot be treated prior to finishing?
8. What is perhaps the most desirable method of finishing cemented spot?

Job 72

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Removing Water Marks		FFFDP pp 421-424	

1. What finishing materials are supposed to be water-proof?
2. What materials are used to counteract or remove water stains?
3. Describe brushing method for removal of water spots.
4. How is spraying done in removing water spots?
5. When is French polishing of water spots advisable?
6. Describe French polishing in removing water spots.
7. List several causes of cloudy or grayish finishes.
8. What causes an unbalanced lacquer formula?
9. List some simple methods of removing a cloudy finish.
10. Describe process of removing cloudy spots with amalgamater.
11. How is finishing done after application of amalgamater?

Job 73

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Removing Stains		FFFDP pp 424-426	

1. What governs the ease of removal of ink stains from finish?
2. How may fresh ink stains be simply removed from varnish or lacquer finish?
3. How may the more stubborn ink spots be removed?
4. If above methods of removal of ink spots fail, what should be done?
5. How does alcohol affect finished surfaces?
6. When a piece of cloth has been pressed into a surface softened by alcohol or perfume and pulled away when dry, what should be done?
7. How may heat blisters on finish be treated?
8. Where serious burning is involved, what should be done?

Job 74

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Glazing and Shading Paint		FFFDP pp 245-251	

1. What names are given to antique shading on painted furniture?
2. What purpose is involved in antique shading?
3. Why should antique "glazing" be applied very thin?
4. How may pigment glaze to be shaded and high-lighted by hand be prepared?
5. What color combinations may be used in pigment glaze?
6. How should glaze mixtures be treated after application?
7. Why should undercoat be hard dry before glazing?
8. How may stain and lacquer antique shading materials for spraying be made in shop?
9. How should glaze be put on by hand?
10. How should wiping of glaze be done?
11. What governs the amount of antique effect in working with glazed surface?
12. After wiping surface in glazing, how is "feather-edging" restored?
13. Where the antiquing idea is often subordinated to a desire for color harmony, what is usually done?

Job 75

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Dusting for Antique Effect		FFFDP pp 252-255	

1. Why does dusting create an antique effect?
2. How are open-grained woods executed in an antique finish?
3. How is filler protected in the antiquing process?
4. Where carvings, flutings and mouldings are concerned, how may a more pronounced aged effect be gained?
5. What characteristics should liquid wax used in above work have?
6. How are close-grained woods handled in antiquing?
7. Describe process of giving pine furniture an extra antique appearance.
8. How is pigmented wax treatment given to lamps, picture frames, and polychromed portions of stained furniture?

Job 76

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Stipple Glazing		FFFDP pp 256-261	

1. By what name is stipple glazing known?
2. What is purpose of stipple glazing?
3. Is stipple glazing easier to produce than shading? Explain.
4. What working tools are necessary for stipple glazing?
5. How is material applied in this process?
6. How may different patterns be created in stipple glazing?
7. What method is used to insure a fine or coarse pattern?
8. What are the characteristics of spray stippling?
9. How is glaze made up for spray stippling?
10. How should gun be handled in spray stippling?

Job 77

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Crackling Finish		FFFDP pp 306-308	

1. What causes crackling on certain wood finishes?
2. What coats are necessary to produce a crackled finish?
3. Why is an undercoat necessary in crackling?
4. How many undercoats may be applied?
5. Name one desirable undercoat. Why is it used?
6. List some crackle color combinations that are desirable?
7. How may more subdued appearances be obtained?
8. What method of application is best in putting on crackle lacquer?
9. When should crackle lacquer be applied?
10. What noticeable change occurs soon after applying crackle lacquer over enamel?
11. How is crackled lacquer coat protected after drying?
12. What general rule governs size and depth of crackles in crackle finish?

Job 78

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Frosting		FFFDP pp 309-312	

1. Define frosting.
2. Upon what does frosting depend for decorative interest?
3. What ground coats may be used?
4. How are ground coats sealed in?
5. What is the best all-around frosting color?
6. How may they be obtained?
7. In what ways may frosting color be applied?
8. Describe process of putting on frosting material.
9. How may a novelty effect be gained in frosting?
10. What care should be taken in frosting with regard to materials used?
11. When not frosted or only lightly so, what novel effect may be given to wicker furniture?

Job 79

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Using a Circular Saw		MW 9-13	

1. Why is the circular saw a very useful woodworking machine?
2. List the main parts of the circular saw.
3. In what way does the variety saw differ from the universal saw?
4. What is the purpose for the tilting arbor?
5. What saw speed is widely used?
6. For what purpose is the ripsaw blade used?
7. For what kind of sawing is the combination blade designed?
8. Why does the arbor nut have left hand threads?
9. What is the best method of holding the arbor and blade to loosen the arbor nut?
10. How does the number of teeth a saw has affect it?

Job 80

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Observing Safety Rules with Saws		MW 5-8, 14, 18, 25, 33	

1. What will prevent most accidents?

2. To operate a machine safely what five things must an operator do?

3. When should a machine never be oiled?

4. Where should the operator's hands be kept in relation to the saw blade?

5. Why should the operator stand to the left of the saw blade?

6. How should waste material around the saw be removed?

7. Why should the guard be kept over the saw?

8. What safety precaution should be observed when ripping short stock?

9. What is the purpose of the splitter?

10. How high should the saw blade project above the material being sawed?

Job 81

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Ripping and Sawing to Length with Circular Saw		MW 19-33	

1. What are the three common ripping operations?

2. How will a dull saw affect ripping?

3. Why should the saw be stopped at once when it begins to smoke?

4. What two conditions will cause the saw to make an unusual sound when it is started?

5. What may be caused by the wood being advanced too slowly into the saw?

6. Why must the tail man hold both pieces firmly?

7. When should a push stick be used?

8. What kind of blade is used for sawing to length?

9. Why should the stock not be pushed across the saw too fast when squaring the ends?

10. What is the purpose of the stop block when sawing short pieces to length?

Job 82

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Cutting Rabbets on Circular Saw		MW 57-60, 102-104	

1. What two methods can be used for rabbeting on the circular saw?
2. What should be used if an exceptionally smooth cut is desired?
3. How does the dado head save time in rabbeting?
4. What is a rabbet?
5. What limits the width of a cut made by a jointer?
6. Why is the jointer preferred over the circular saw for making rabbets?
7. How must the fence be set for cutting a rabbet joint?
8. Explain how a deep cut should be made when rabbeting.
9. What is the purpose of the rabbeting ledge?

Job 83

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Sawing Bevels and Angles		MW 34-44	

1. How many sides does a triangle have? A square? A hexagon? An octagon?

2. Give the formula for finding the number of degrees in an interior angle of any polygon.

3. What kind of blade is used for sawing a bevel?

4. For what are compound miters used?

5. How are bevels or miters on ends cut?

6. Give a method for ripping edges to a desired bevel.

7. Give four saftey rules to be observed when sawing bevels and angles.

Job 84

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Using Dado Head, Grooving Saws and Moulding Head		MW 45-52	

1. What is a "dado"?
2. Of what does a dado heat consist?
3. In what widths may grooving saws be obtained?
4. What is the most common use of the dado saw?
5. How should the dado head be set up on the circular saw?
6. What is a "quick set"?
7. What saw is best for making cone or concave cuts?
8. For what kind of cuts is the dado saw most dangerous?
9. What should be done if dado blades start to smoke?
10. What may cause the arbor nut to become loose?

Job 85

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Using Band and Jig Saws		MW 139-149	

1. How does the band saw get its name?
2. What is the main purpose of the band saw?
3. At what speeds do band saws run?
4. What will cause the wood to burn when using a band saw?
5. Why should sawing always be done on the waste side of the line, leaving the line?
6. Why must the correct tension be kept on the blade?
7. How should the band saw blade guides be set?
8. Why are ripping guides not satisfactory for use with band saws?
9. How should the ball-bearing blade supports be set?
10. Give five safety rules for using the band saw.
11. How do the uses of the jig saw differ from those of the band saw?
12. How is the size of the jig saw designated?
13. What prevents the jig saw blade from lifting the material from the table as it saws?
14. What kinds of blades can be used in a jig saw?

Job 86

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Applying Glue		MW 122-131	

1. From what is animal glue made?
2. How is the strength of glue determined?
3. In what two forms is animal glue obtainable?
4. For what materials should animal glue never be used?
5. Why should wood on which animal glue is to be used be warmed in cold weather?
6. What type of applicator should be used for applying glue?
7. How may excessive glue be removed?
8. From what is casein glue made?
9. What is the first step in the process of gluing?
10. Why must glue be of the proper consistency?
11. Why should the end grain be given two coats of glue?
12. Describe the procedure for gluing boards.
13. What three tests must be applied if end sections are to be glued together?

Job 87

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Operating Sanders		MW 172-183	

1. Name five purposes for which sanders should not be used.

2. What two methods may be used for sanding broad surfaces with a belt sander?

3. Why must only light pressure be applied on the hand block when using a belt sander?

4. Why must dust collectors be used on sanders?

5. For what purpose are cylinder sanders used?

6. What are spindle sanders?

7. For what purpose is the disc sander used?

8. How may a disc to be used as a disc sander be made?

9. What are the two types of portable sanders?

10. How much pressure should be applied when using a portable sander?

11. Why can smoother work be done with a wide belt on portable sanders?

12. Why should the sander be laid on its side when not in use?